A Comprehensive Assessment of Fish Passage Barriers in the Scappoose Bay Watershed

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EXECUTIVE SUMMARY

Thousands of culverts, small dams, and tide-gates block potential habitat for salmon in the streams and rivers of Oregon. In most watersheds, citizens do not know the location of all of the barriers or have sufficient information to plan for their correction. The goal of this project was to obtain the information most useful for expediting the correction of numerous barriers in the 85,000-acre Scappoose Bay Watershed, located along the Lower Columbia River. The Scappoose Bay Watershed Assessment recommended that a comprehensive assessment be conducted to identify and prioritize artificial fish passage barriers that occur in the watershed and to develop preliminary designs and cost estimates for correction of each barrier. This precedent-setting project, which was funded by most of the stakeholders in the watershed, was intended to provide the information needed to most effectively plan for barrier corrections and obtain the funding to conduct restoration projects in the near future.

The fish passage barrier assessment project began in June 2000. The Scappoose Bay Watershed Council (Council) contracted the project to David Evans and Associates, Inc. (DEA). The project consisted of two stages: Stage I, field surveys, and Stage II, analysis and prioritization. For Stage I, most of the field surveys were conducted by a biologist and surveyor between June and October, 2000. Using GIS-derived maps to identify road crossings of fish-bearing streams, the field crew surveyed 293 road crossings, dams, and other human-caused obstructions of known fish-bearing streams. Of these crossings, 131 potential barriers were identified that did not meet ODFW fish passage design criteria for passage of juvenile and adult salmonids. Most of the culverts and dams were found to be barriers. None of the bridges surveyed were identified as barriers. Of these potential barriers, the top 107 were surveyed in more detail, including surveys of fish and upstream and downstream channel conditions.

For Stage II of the project, the detailed data for 107 potential barriers was used in hydrologic and hydraulic analyses to determine the severity of the barriers for various sizes and species of fish, existing flood capacity, and design options. If hydraulic analysis using the design flows indicated that the barrier did not meet fish passage criteria for the full range of salmonid species and life stages tested due to either high velocity or leap height, it was considered a complete barrier. Seventy-seven percent (77%) of the barriers were found to be complete barriers and the remainder were identified as partial barriers. Conceptual designs were developed and preliminary cost estimates were prepared for each of the 107 barriers. Barriers were then prioritized by sub-watershed and for the watershed as a whole. Prioritization was based on whether the barrier was partial or complete, and based upon a Habitat Index score. The Habitat Index summarized upstream habitat quantity and quality as measured by habitat length and access to refugia identified previously in the Scappoose Bay Watershed Assessment. The highest priority projects in this ranking system were those that were located in key sub-watersheds, were complete barriers, provided access to refugia, and opened up the greatest length of upstream fish habitat. This prioritization is a provisional guideline. Additional factors, such as ownership and condition of the barrier, were also provided for use by various organizations in selecting correction projects.

The assessment results are available in several formats, including this report. The bulk of the data is in electronic Excel spreadsheet format and geo-referenced in a Geographic Information System (GIS) previously developed by DEA for the Council. The Excel spreadsheet data and photos of each site are also included on a compact disk. Hard copy maps at the large scale (1:24,000) and summary scale are also provided. A technical advisory team of agency experts and stakeholders helped develop and review all aspects of the project. In summary, this comprehensive assessment of fish passage barriers represents the "due diligence" that is intended to provide the Council and other stakeholders with the information they need to obtain funding to restore fish passage to many streams in the Scappoose Bay Watershed.

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INTRODUCTION

PROJECT OVERVIEW

In the Pacific Northwest, large numbers of relatively small obstructions, such as road culverts, municipal water supply dams, and tide-gates, block thousands of miles of habitat suitable for threatened and endangered salmon. In most areas in Oregon, only cursory surveys of these barriers have been conducted. In many cases, watershed councils, counties, cities, and private landowners do not have sufficient information to prioritize or obtain funding for correction projects. This comprehensive barrier assessment project for the 85,000-acre Scappoose Bay Watershed is intended to provide the level of information needed to bridge the gap between problems and solutions. This comprehensive survey identified barriers in the watershed and used field data to conduct hydraulic and hydrologic analyses, and to develop conceptual designs and cost estimates for correction of each barrier. The barrier correction projects were then prioritized based on upstream habitat value (including access to refugia), cost, and other factors. GIS was used as a principal database and analysis tool. It is hoped that this assessment and the methodology developed to produce it may provide a helpful model for use in other watersheds in Oregon.

This project addressed a major data gap and high priority recommendation of the Scappoose Bay Watershed Assessment (DEA 2000). According to information available at the time the Assessment was conducted, road culverts, small dams, and tide gates appeared to have greatly reduced the available habitat for salmonids in the watershed. The Scappoose Bay Watershed Assessment identified 45 fish passage barriers in the watershed, some of which were blocking miles of anadromous fish habitat (DEA 2000). Information sources for the Assessment included surveys by the Oregon Department of Fish and Wildlife (ODFW) and Oregon Department of Forestry (ODF). However, only some of the barriers on state and county roads were identified at the time the Assessment was published. Many more significant barriers were thought to occur on private lands. In addition, the ODFW surveys included almost no information on 25 of the 35 county and state road barriers that they identified, and there was little information on six dams, a tidegate, and additional culverts identified as barriers based on local knowledge. For almost all barriers, information was lacking on the type of barrier, and on the amount and quality of potential upstream habitat blocked. The existing information was clearly inadequate to identify, prioritize, and fund fish passage projects in the watershed.

PROJECT GOALS AND OBJECTIVES

Considering the potentially high cost of fixing a single barrier, the Scappoose Bay Watershed Council (Council) believes that it is imperative to ensure that funding go to the highest priority projects, as identified through a detailed and watershed-wide assessment. Barrier removal is also a critical part of the Council's larger watershed restoration strategy to ensure that fish have access to high priority refugia identified in the Scappoose Bay Watershed Assessment (DEA 2000). The goal of this project was to comprehensively assess human-caused barriers to fish passage in the Scappoose Bay Watershed. The comprehensive nature of the project is intended in two respects: 1) a watershed-wide survey, including as many cooperating land owners as possible, and 2) a final report that moves from identifying problems to planning solutions.

To achieve this goal, the Council and its contractor needed to obtain broad-based community support – both to collect the required data and to build a foundation of cooperation from which to pursue funding for correction of the watershed's most urgent fish passage problems. The specific objectives of the project were two-fold: Stage I of the project was to identify all artificial potential barriers in the watershed, and Stage II was to analyze the top 100 barriers in more detail, including hydraulic analysis of barrier conditions, development of preliminary designs and cost estimates for correcting each barrier, and prioritization of barriers based on potential upstream habitat value.

To ensure that the study would be widely accepted by the community, principal stakeholders in the process were represented on a technical advisory sub-committee of the Council and reviewed the project at various stages of completion. The technical team included a representatives from the Council and DEA, landowner representatives (including the Bureau of Land Management), and fish passage and road experts with the City of Scappoose, Columbia County, and ODFW. Public outreach efforts included: 1) a slide show prepared by DEA and presented to community groups by the DEA project manager and by Council members, 2) press releases and photographs to local newspapers, 3) a poster describing the barrier assessment goals and process, and 4) a guided field trip where interested community members examined and discussed several of the barriers identified by the survey.

PHYSICAL/BIOLOGICAL DESCRIPTION OF THE WATERSHED

The 85,000-acre Scappoose Bay watershed is located in northwest Oregon and is characterized by coastal hills, stream valleys, and lowland estuarine wetlands draining to Scappoose Bay of the Lower Columbia River. The watershed includes the towns of Scappoose and St. Helens, and Scappoose Creek, Milton Creek, and other once-productive salmon streams of the Lower Columbia River.

Historically, the watershed contained a broad diversity of habitats, ranging from small, steep mountain streams to extended low-gradient stream valley floodplains, to the rich lowland floodplain of Scappoose Bay and Lower Columbia River estuary. Over the past 150 years, the watershed has been impacted by a broad range of uses: agriculture, forestry, surface mining, and residential and industrial development. The Scappoose Bay Watershed supported four of the six salmon species found in the Pacific Northwest (chinook, coho, steelhead, and chum salmon) as well as sea-run and resident cutthroat trout. Four of the salmonid species are currently listed or proposed for listing under the federal Endangered Species Act, and the fifth (Lower Columbia coho salmon) may also be listed in the near future (DEA 2000). The dramatic decline in all species of salmonids in the watershed is not due to one or even several independent habitat-impacting activities, but rather to a complex interplay of activities that have degraded specific habitats used at particular times in the life histories of the fish. Included in this complex scenario is the effect of introduced hatchery fish and fishery management policies, as well as the shift to poor ocean conditions along the Oregon and Washington Coasts throughout the 1980s (DEA 2000).

METHODS

STAGE I: FIELD SURVEYS

Stage I of the project included Phase I and Phase II field surveys conducted by a two-person team between July and October, 2000. Several additional follow-up Phase II surveys were conducted between October 2000 and March 2001.

Phase I Survey

The Phase I survey was a field survey of all crossings of known fish-bearing streams in the Scappoose Bay Watershed. DEA used available GIS data layers developed for the Scappoose Bay Watershed Assessment (DEA 2000) to identify total fish distribution (anadromous and resident) and existing road crossings of streams (Bureau of Land Management road data). A total of 293 road crossings and other potential obstructions on private and public lands were surveyed. The survey did not include Longview Fiber Co. and several other landowners who chose not to participate in the assessment. Most land managers and road and dam owners in the watershed, including Bureau of Land Management, Olympic Resources Management, Willamette Industries, City of St. Helens, City of Scappoose, and Columbia County, granted blanket approval to conduct surveys prior to the start of the field season. In other cases, the crew made a concerted effort to locate owners of barriers to request permission prior to conducting the surveys. No stream crossings were surveyed without landowner permission. In some cases, barriers occurring on the property of non-cooperating private landowners could be surveyed to a limited extent from public roads.

The Phase I survey involved extensive collection of data on the crossing itself and conditions immediately upstream and downstream (Appendix A – Phase I Field Data Form). The team used a hand-held GPS unit, accurate to within 30 meters (m) for barrier location. The team used a construction level and survey rod to obtain accurate information on culvert slope, outfall drop, and other factors. If the obstruction did not meet the ODFW design criteria (Robison et al. 1999) for passage of juvenile fish for outfall drop, slope, or inlet constriction, it was considered a potential barrier. Crossing locations and survey data were geo-referenced in a GIS system. A digital camera was used to take at least four photographs at each site: upstream, downstream, inlet, and outlet of the barrier. One hundred thirty one potential barriers were identified in Phase I and considered for Phase II survey.

Phase II Survey

Of 131 road crossings and dams identified as potential barriers to fish passage in the Phase I survey, 107 barriers were selected for Phase II survey. Selection was based on the amount of upstream habitat. Potential barriers eliminated from consideration were those that would probably rank lowest in a prioritization based on amount of upstream habitat. Potential barriers with less than ½ mile of fish habitat and less than one mile of total stream distance upstream of the barrier were not included in Phase II surveys. Although not prioritized, these obstructions are still listed as potential barriers in the assessment pending further analysis.

The Phase II surveys included a more detailed survey of the obstruction (Appendix B – Phase II Field Data Form). Each potential barrier was surveyed using a construction level and survey rod for accuracy. Use of survey equipment allowed a relatively fast and accurate survey of culvert attributes such as slope, perch, outfall elevation, and road fill height. Other information such as location of barrier, type of barrier, condition, and size of culvert were collected, consistent with ODFW methods for assessing fish passage barriers (Robison et al. 1999).

The Phase II survey also included measurement of selected habitat parameters for up to 200 feet upstream and downstream of each barrier. The survey team measured channel slope and width at regular intervals and took cross-section measurements at the tailwater and upstream of the barrier. The surveys were consistent with ODFW methods for physical habitat surveys (Moore et al. 1999).

Some information on current fish use immediately upstream and downstream of each barrier was obtained in the Phase II survey by minnow trapping and field observation. The survey team set out three minnow traps, baited with bread, above and below each barrier. The traps were collected the next day and fish identified and released unharmed. The crew also noted observations of fish, amphibians, and other species in the course of conducting the upstream and downstream habitat surveys and trapping.

STAGE II: HYDROLOGIC ANALYSIS

The hydrologic and hydraulic analysis performed by Phillip Williams and Associates (PWA) follows Oregon Department of Transportation (ODOT) and ODFW standards for fish passage. Readers are directed to the FishXing manual (Love 2000), the ODOT hydraulics manual (ODOT 1999), the ODFW and Washington Department of Fish and Wildlife (WDFW) Road/Stream Crossing Restoration Guides (Robison et al. 1999, WDFW 1998), and the electronic spreadsheets submitted along with this report for further detail regarding the theories and methodologies used throughout the analysis.

A regional regression analysis based on United States Geological Survey (USGS) procedures (Harris et al. 1979) was used to estimate the 2-, 50- and 100-year recurrence interval stream flow at each barrier. Low and high fish passage design flows were developed using ODFW guidelines. The hydraulic analysis was performed using the software FishXing for the design flows (Love 2000) and ODOT inlet control guidelines (ODOT 1999) for the more extreme 50- and 100-year stream flow events.

Fish Passage Design Flow and Flood Flow Estimation

A regional regression analysis was performed for each barrier following USGS Open-File Report #79-553 (Harris et al 1979). The Scappoose Bay watershed lies within the Willamette Region, and recurrence interval flows were estimated using the following regression equations:

$$Q_2 = 8.70\ A^{0.87}\ I^{1.71}$$

$$Q_{50} = 38.00\ A^{0.88}\ I^{1.31}$$

$$Q_{100} = 46.9\ A^{0.88}\ I^{1.25}$$

where

Q = Stream discharge (cubic feet per second (cfs) for the 2-year (Q_2), 50-year (Q_{50}), or 100 year (Q_{100}) recurrence interval flows

A = Drainage area (square miles)

I = 2-year, 24-hour rainfall intensity (2.5 inches/day)

The drainage area (A) upstream of each structure was provided in both spreadsheet and GIS format from DEA. A local rainfall intensity of 2.5 inches/day was selected for the entire watershed based on a visual observation of the Western Oregon Isopluvial maps provided in the USGS Open-File Report #79-553 (Harris et al. 1979).

The design high passage flow for fish passage as put forth by ODFW is defined as the flow that is not exceeded more than 10% of the time during the months of adult migration. This flow is estimated by:

$$Q10\% = 0.18 \times (Q2) + 36 \quad \text{(Robison et al. 1999)}$$

For a Q_2 flow of less than 44 cfs, the high flow discharge can be estimated as being equal to Q_2.

The ODFW criteria for design low flow is based on the 2-year, 7-consecutive-day low flow. In order to calculate the design low flow, gauged flow data is required. There are no stream gauges available within the project watershed, so gauging stations from neighboring watersheds with similar meteorological, geologic, and hydrologic characteristics were chosen. The selection criteria for these gauges were based on the following criteria:

- The gauged watershed must be in southwestern Washington or northwestern Oregon in the vicinity of the Scappoose Bay watershed.
- The watersheds must have no greater than 3.0 inches of precipitation, based on the isopluvial map for the 2-year, 24-hour storm event.
- Each gauging station must be on the eastern slope of the coastal range, with the aim of experiencing a similar rain shadow.
- No portion of the watershed may be on the western slope of the Cascades, so as to eliminate orographic rainfall effects.

Six gauging stations met all of the criteria listed above (four in Washington and two in Oregon) and are listed in Table 1.

The mean daily flow data for each gauge station was used to develop a relationship between drainage area and the 2-year, 7-consecutive-day flow.

Figure 1 illustrates this relationship, which yielded an average discharge per square mile of 0.203 cfs. The 2-year, 7-consecutive-day low flow for each stream crossing was estimated by multiplying the drainage basin area by the average discharge per square mile (0.203).

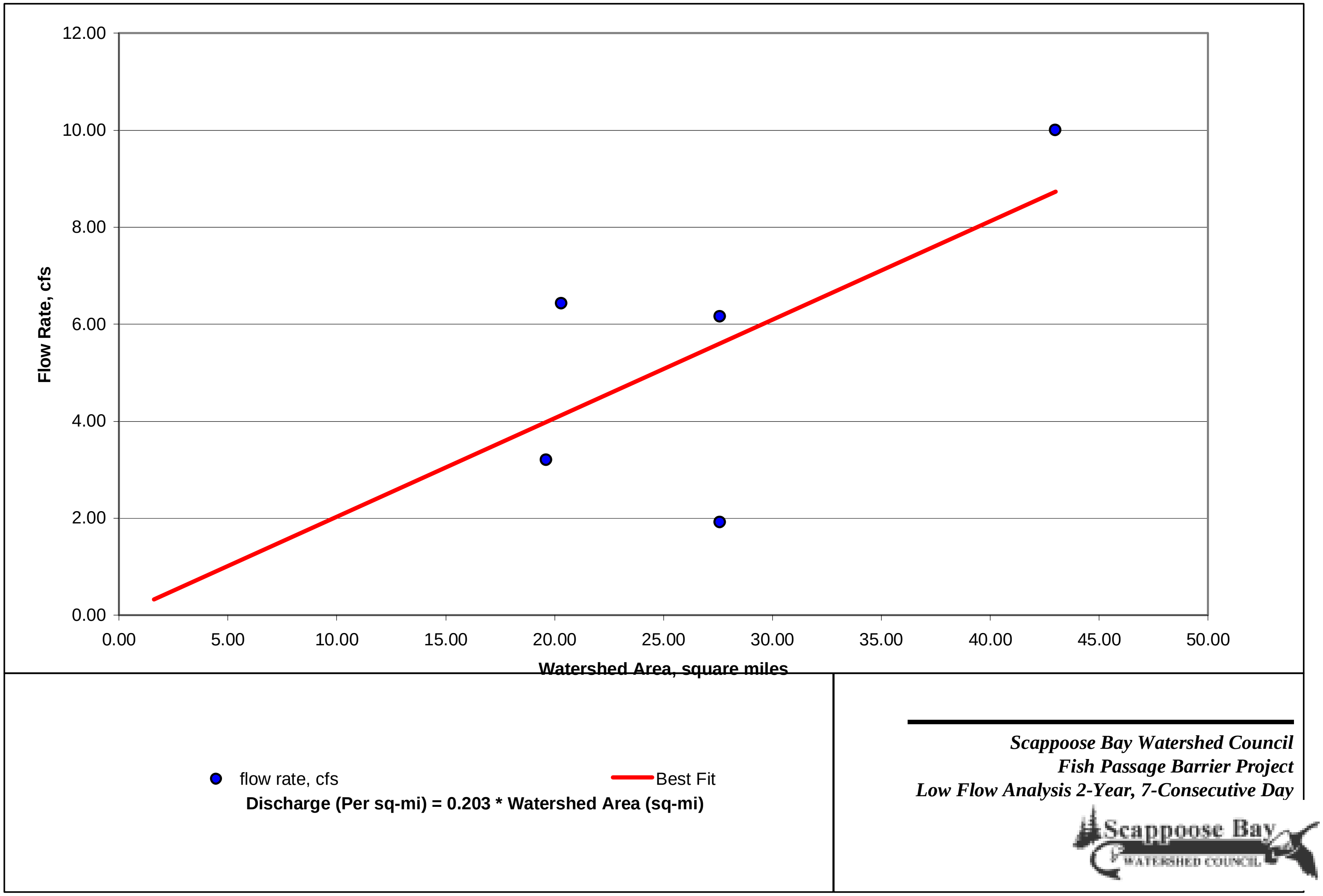

Figure 1: Relationship Between Drainage Area and 2-Year, 7-Consecutive-Day Stream Flow

Table 1: Gauging Stations Used in the 2-Year 7-Consecutive Day Low Flow Analysis

USGS Gage Number	*Location*	*Drainage Area (sq-mi)*	*2-year, 7-consectutive day low flow*
14246000	Abernathey Creek near Longiew, Washington	20.3	6.43 cfs
14243500	Delameter Creek near Castle Rock, Washington	19.6	3.20 cfs
14247500	Elochoman River near Cathlamet, Washington	65.8	28 cfs
14246500	Mill Creek near Cathlamet, Washington	27.6	6.16 cfs
14206000	McKay Creek near North Plains, Oregon	27.6	1.92 cfs
14205500	East Fork Dairy Creek at Mountaindale, Oregon	43	10 cfs

Design Flow Verification

Flow verification is an important step in providing an added level of confidence in the results generated in a hydrologic analysis. For this work, two separate methods, both based on physical stream and culvert characteristics identified in the field by DEA, were selected to verify the estimated passage design flows.

Passage Flow

According to the FishXing Field Guide (Love 2000), the rustline observed in culverts can be approximately correlated to the 20% annual exceedence flow. In this case, the 20% exceedence flow for the Scappoose Bay watershed was estimated to be 7.6 cubic feet per second per square mile (cfs/sq mi), using historical stream gauge data from Delameter Creek, which maintained the longest period of record. Linear regression of discharges estimated from observed rustline heights in the culverts yielded an average discharge per square mile of roughly 12 cfs (Figure 2). This is slightly higher then the 20% exceedence flow estimated from the gauge data, but given the variability present in the predicted data set, offers a reasonable verification of the hydrologic analysis and justification for the use of this stream gauge for estimating low passage design flows in the Scappoose Bay watershed.

Flood Flow

A second method for validating the hydrologic analysis was to estimate the bankfull or 1.5 year discharge from several stream characteristics observed in the field by DEA, including active channel width, average stream slope, and bed roughness. By employing Manning's Equation, a common formula for open channel design and analysis, a discharge prediction was made for each stream reach. According to Leopold (1994), the flows corresponding to the active channel width generally reflect the 1.5-year recurrence event. (The active channel width was established by surveying the vegetation line from stream bank to bank.) A linear regression was applied to each prediction and ultimately compared to the 2-year regional regression flow. As evident in the rustline verification, bankfull flow measurements also provide a reasonable level of validation, given the substantial variability in the data set (Figure 3).

STAGE II: HYDRAULIC ANALYSIS

Estimates of the water depth, velocity, and downstream leap height requirements were developed for each culvert using the FishXing software package (Love 2000). For those structures where analysis with FishXing was not feasible (primarily dams), a number of spreadsheet routines were adopted. The following sections describe these analysis procedures.

Culverts

The analysis of each culverted stream-crossing was accomplished using FishXing by inputting general survey data regarding culvert geometry. Additional information describing the downstream pool and outlet geometry as well as the design flows (Q_{High} & Q_{Low}) were also input into FishXing. Performing the calculation generated a complete water surface profile through the culvert. FishXing also provided velocity and depth estimates throughout the culvert. Leap height was calculated based on the difference in surveyed elevation between the outlet lip of the culvert and the downstream grade control per ODFW methodology (Robison et al. 1999). This leap height is greater than the distance between the outlet and pool water surface, which changes depending on flow rate.

For those culverts which could not be analyzed completely in FishXing (because of software limitations when headwater or tailwater levels exceed the culvert crown), an inlet control condition was assumed and a spreadsheet solution was applied to determine the culvert hydraulics.

Dams

The analysis of the hydraulic performance of a dam was more complicated. To facilitate the analysis of these structures, a simplified, compound weir rating curve analysis was adopted. A rating curve (a relationship between flow and depth) was developed for each section of the dam experiencing spillage. In some cases, a dam had multiple overflow locations. These relationships were then combined to generate a complete rating curve for the entire dam. Estimates of depth, discharge, leap height, and velocities were then estimated for each design flow from these rating curves. Design alternatives ranging from complete dam removal to fish ladder construction or simple weir notching retrofits were used in this assessment.

Figure 2: Rustline Hydrologic Validation

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Figure 3: Active Channel Width Validation

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Flood Event Hydraulic Analysis

PWA completed an analysis of the headwater depths at each barrier when subjected to the estimated 50- and 100-year flood flows. For simplicity, all culverts were assumed to be governed by the inlet control conditions. Inlet control takes the form of either the weir equation (unsubmerged) or the orifice equation (submerged). The ODOT hydraulics manual provides both inlet equations, as well as a criterion for selecting the appropriate equation at each barrier. These equations were input into a spreadsheet application to solve for headwater depths.

During these high flow events, it is not uncommon to experience roadway overtopping due to insufficient culvert capacity. PWA examined this phenomenon for both the 50- and 100-year discharges by balancing the respective head on the inlet control culvert equation and the broad-crested weir equation. The weir elevation was assumed to correspond directly to the single road elevation survey point, and a horizontal weir length was assumed to be 100 feet (for all barriers) based on photographic evidence.

STAGE II: BARRIER ANALYSIS

Barrier Criteria

ODFW and WDFW fish passage guidelines define passage barriers and provide recommendations for barrier corrections (Robison et al. 1999, WDFW 1998). Passage barriers can be categorized into the following conditions, generally listed in order of importance:

1. Inadequate flow depth through the stream crossing
2. Excessive drop at stream crossing outlet
3. High velocities or abrupt changes in velocity through the stream crossing
4. Lack of resting pools at the stream crossing inlet
5. Turbulence through the stream crossing
6. Debris accumulation at the stream crossing inlet

For the purposes of this investigation, the top three barrier conditions have been evaluated in more detail and used to guide the selection of the type of barrier corrections.

Insufficient water depth for swimming, excessive water velocity, or excessive downstream leap height requirements can all be considered barriers to fish passage. By virtue of their small size, juveniles are less capable swimmers than adults and are more susceptible to velocities and jump height limitations. Adults, on the other hand, are physically much larger, and therefore require deeper water throughout the culvert. Similar rules can also be applied to different species.

An assessment of the type of potential barriers at each stream crossing for all fish species and age classes was completed using criteria provided by DEA (Table 2). This set of criteria is based on ODFW criteria for design of new crossings and identification of existing barriers (Robison et al. 1999).

Flood Design Flow Assessment

According to the ODFW manual, the purpose of the flood design flow assessment is to assess the structural stability of the roadway and stream crossing. Two stability criteria were analyzed:

- The 50-year flow must remain below the crown of the culvert.
- The 100-year flow must not overtop the roadway.

Table 2: Fish Passage and Road Stability Criteria Adopted for Stream Crossing Assessment

Fish Species / Age Class	Adult Steelhead, Chinook, and Coho	2+ Rainbow / Cutthroat Trout	1+ Rainbow / Cutthroat Trout	Young of the Year (YoY)
Fish Length	500 mm	200 mm	130 mm	80 mm
Prolonged Mode				
Swim Speed	6.0 ft/s	2.8 ft/s	2.4 ft/s	2.0 ft/s
Time to Exhaustion	30 min	30 min	30 min	30 min
Burst Mode				
Swim Speed	10.0 ft/s	6.4 ft/s	4.5 ft/s	3.0 ft/s
Time to Exhaustion	5 s	5 s	5 s	5 s
Velocity Reduction Factors	Inlet = 1.0 Barrel = 1.0 Outlet = 1.0	Inlet = 0.8 Barrel = 0.6 Outlet = 0.6	Inlet = 0.8 Barrel = 0.6 Outlet = 0.6	Inlet = 0.8 Barrel = 0.6 Outlet = 0.6
Jump Height	4 ft with > 2 ft pool 1 ft with no pool	1 ft	0.5 ft	0.5 ft
Minimum required water depth	0.8 ft	0.5 ft	0.3 ft	0.2 ft
Stability:50-Year Flow	Below culvert crown	Below culvert crown	Below culvert crown	Below culvert crown
Stability:100-Year Flow	Below road level	Below road level	Below road level	Below road level

STAGE II: CONCEPTUAL DESIGNS

ODFW (Robison et al. 1999) provides a prioritization of correction types based on an order of preference. These recommendations are, from least preferred to most preferred:

1. For culvert retrofits: Culvert baffles
2. For culvert replacement: Non-embedded culvert placed at less than 0.5% slope
3. For culvert replacement: Embedded round culverts to simulate stream bed conditions
4. For culvert replacement: Embedded bottomless arch culverts to simulate stream bed conditions
5. For culvert replacement: Bridges

These corrections primarily relate to mitigating passage barriers related to high flow velocities and inadequate flow depth through the stream crossing itself. Some design criteria for these barrier corrections are described below.

Culvert baffles: Culvert baffles are generally not advocated by agencies because of the potential for trapping flood debris and resulting increased maintenance requirements.

Accordingly, they have only been considered in this project for those culverts under US Highway 30 and Old Portland Road with adequate capacity and where cost and public disturbance of full replacement projects would be exceptionally high.

Non-embedded culvert: Where the stream reach slope is 0.5% or less through the stream crossing, non-embedded pipes may be used (Robison et al. 1999). These corrections are typically relegated only to the lower reaches of stream systems where stream gradients are flat and tidal influences occur.

Embedded round culverts: The installation of embedded round culverts typically results in a significant disturbance to the existing stream channel for a proposed stream crossing; bottomless arch culverts that span the natural channel may be a lower impact option. Bottomless arch culverts may be the preferred option in bedrock substrates where the excavation needed for embedded culverts is not possible. However, in stream substrates of unconsolidated gravel, the footings of bottomless arch culverts may be more prone to failure than embedded culverts (Robison et al. 1999).

Embedded bottomless arch culverts: For both types of embedded culverts, the depth of embeddedness must be at least one foot or 20% of the culvert rise, whichever is greater, and streambed slopes through the crossing should be at a natural grade (Robison et al. 1999).

Bridges: Bridges are acceptable and preferred for all stream crossings. However, they tend to be a more expensive correction type than culverts. Bridges tend to become economically justifiable when the required hydraulic opening requirement exceeds 15 feet in span (active channel width) or 10 feet in diameter (Robison et al. 1999).

Design Selection Strategy

Recommendations for barrier corrections were developed by reviewing guidance provided in ODFW and WDFW fish passage documents (Robison et al. 1999, WDFW 1998). Based on these methods and previous experience of PWA staff, a simplified barrier correction methodology was developed to meet agency criteria while utilizing key field data collected as a part of this project. For this methodology, barrier correction recommendations were first assessed by considering the larger scale physical parameters, such as stream channel slope, which governs water and sediment movement through the particular stream crossing at the reach scale (Figure 4). Progressive and iterative assessments were made to refine the initial recommendation at increasingly closer spatial scales, related to the length of the barrier correction and for the remaining two dimensions of width, or span, and height, or rise, of the barrier correction. A summary of the progressive assessments in the simplified methodology are described in Figure 5.

Stream Channel Slope Assessment

This initial assessment involved a determination of a preferred barrier correction type based on the existing stream reach slope, or the longitudinal profile, through the stream crossing of interest. The stream reach slope was estimated from field data by comparing the elevation difference and distance between the most upstream and downstream surveyed channel invert elevations (channel bottom elevation). Guidance for this initial selection of a barrier correction type was based on options presented in Robison et al (1999) and shown in Figure 4. The correction method employed for stream reach slopes greater then 8% is a bridge. For slightly more gradual stream channels (2% to 8%), the stream simulation option was adopted. No conceptual design decisions were made at this point for any of the remaining stream crossings whose slope was less then 2%.

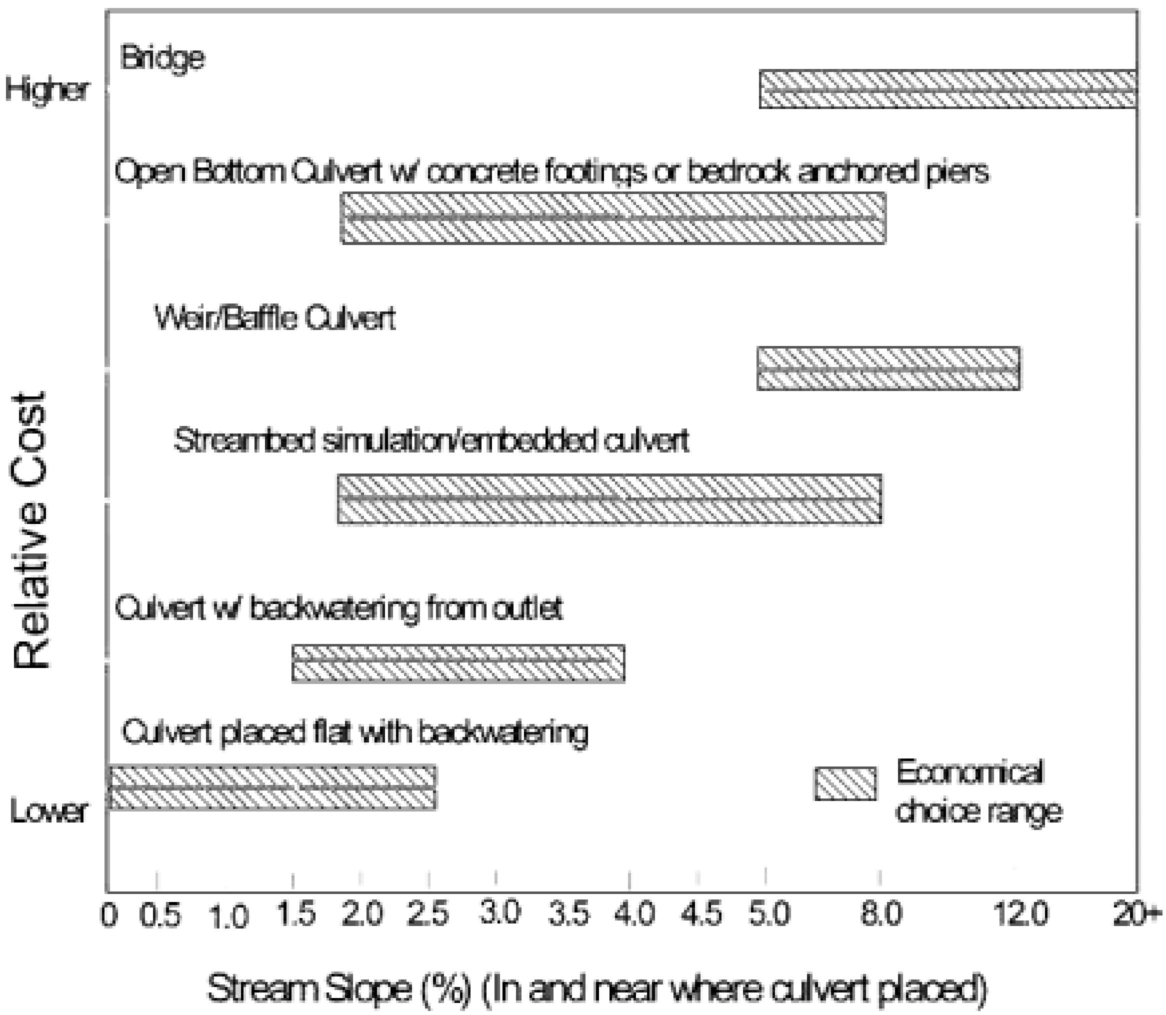

Figure 4: Guidance for Initial Selection of Barrier Corrections

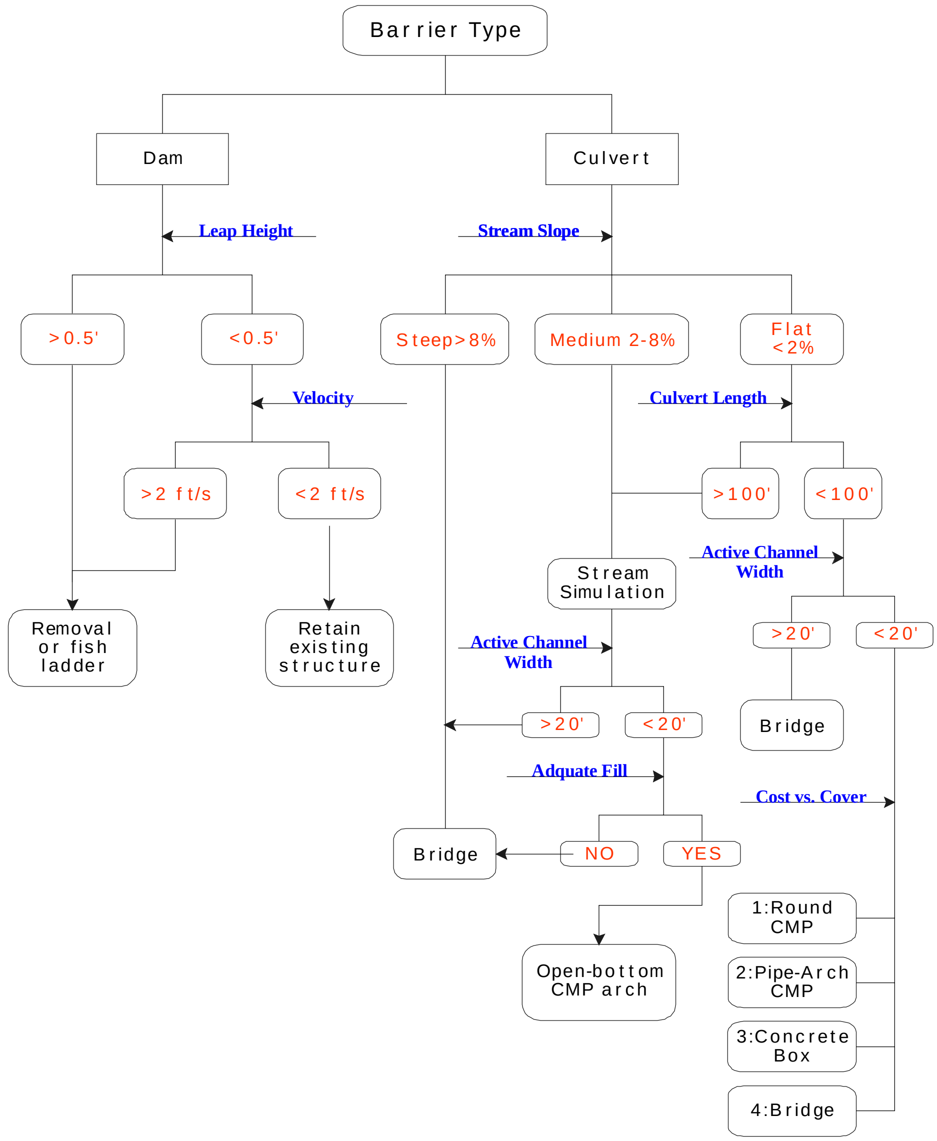

Figure 5: Barrier Correction Methodology Flow Chart

Barrier Length Assessment

The length of the barrier correction is dependent on the roadway width and distance between the toes of the fill embankment slopes (upstream and downstream of the road). Roads with higher traffic volumes and more lanes will lead to stream crossings with longer lengths. The stream crossing length was estimated from the DEA field data, using the measured length of the existing culvert. Increasing lengths of concentrated flows through a stream crossing can subject fish to extended periods of higher velocity flows and prevent their passage. ODFW provides maximum flow velocities for fish species related to culvert length (Table 3). The existing culvert length was assumed not to change with a barrier correction involving new culvert replacement. Therefore, maximum allowable design flow velocities were identified for the new culvert based on the existing culvert length. These threshold velocities were used in FishXing to guide the sizing of replacement culvert span and rise dimensions. For culverts over 100 feet in length, only streambed simulation designs were selected for the barrier correction type per ODFW criteria to provide passage for juvenile salmonids.

Table 3: Average Water Velocity Suitable for Fish Passage (fps) at High Flow Design Discharge

Culvert Length (ft)	*Salmon & Steelhead*	*Adult Trout (>6")*	*Juvenile Salmonids*
Under 60'	6.0	4.0	2.0
60' to 100'	5.0	4.0	2.0
100' to 200'	4.0	3.0	Streambed Simulation
200' to 300'	3.0	2.0	Streambed Simulation
over 300'	2.0	1.0	Streambed Simulation

Barrier Span Assessment

The span of the barrier correction is dependent on the active channel width (ACW) of the stream reach at the crossing. The active channel width was estimated from the DEA field data by using the average channel width measured along the stream reach in the vicinity of the crossing. The culvert span was set to a width equal to or greater than the active channel width based on the relationship:

$$W_{culvert} = [1.2 \text{ x ACW}] + 2 \text{ feet} \quad \text{(WDFW 1999)}$$

ODFW does not require a specific relationship for sizing open bottom culverts, but specifies the structure to be at least as wide as the active stream channel. The resulting width estimate from the WDFW relationship was rounded up to correspond to nominal culvert diameters or arch spans provided by culvert manufacturers.

Barrier Rise Assessment

The rise of the barrier correction is primarily dependent on the flood conveyance capacity of the crossing structure and the height of soil cover over the crossing structure. A flood conveyance criterion developed for the Oregon Department of Forestry and accepted by ODFW (Robison et al. 1999) applies to steeper forested headwater drainage basins and was adopted for this project. This criterion specifies that the headwater elevation at the inlet of a culvert for the 50-year flood be at or below the crown of the culvert. For stream simulation correction types, the culvert span was set based on the active channel width criteria, and the culvert rise was estimated by solving the unsubmerged inlet control equation and adjusting the culvert rise until the headwater for the 50-year flood was equal to the culvert rise.

For those stream crossings that did not require a bridge or stream simulation, but rather direct culvert replacement, the stream crossing shape was selected sequentially based on a cost vs. fill depth analysis. Generally, a corrugated metal round culvert is less expensive then a corrugated metal pipe arch, which is in turn less expensive then a reinforced concrete box culvert. Conversely, a box and circular culvert of the same hydraulic capacity may require significantly different fill depths, depending of the particular stream crossing. A box may be wide and low, while the equivalent circular culvert will be significantly higher. If the existing top or road elevation does not provide sufficient height of cover between the roadway and the culvert crown, then the culvert installation may not meet the manufacturer's requirements (Figure 6).

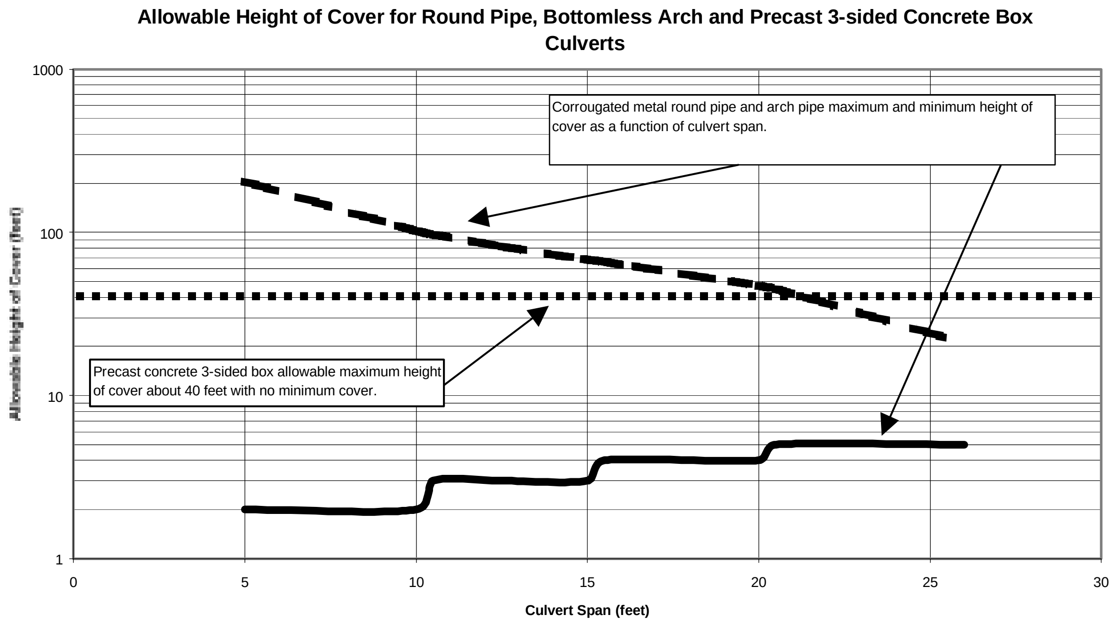

Figure 6: Height of Cover Limitation and Required Culvert Rise Criteria

An iterative process was adopted following this rule, whereby a circular culvert was tested for both flow capacity and fill depth. If the culvert passed the required 50-year design flow and maintained adequate height of cover, it was selected. If not, a pipe arch was then analyzed, and finally a box culvert crossing, to determine the optimal crossing shape and dimensions. The final culvert shape and size was made by selecting a nominal culvert size available from the manufacturer. In cases where no culvert crossings were sufficient due to an inadequate height of cover, a bridge was chosen.

Bed Controls

A downstream bed control should be used to provide adequate backwater depth and flow velocity reduction through a culvert stream crossing to allow fish passage. Bridges and stream simulations do not require grade control structures because depth and velocity limitations are assumed to be met since the stream channel is a natural bed throughout the crossing. For the conceptual designs, which required downstream bed control structures, a maximum jump height limitation of 6 inches was used per ODFW guidelines. Bed control structures may also be used if the stream channel at the stream crossing is actively degrading or anticipated to degrade in the future. Streambed degradation is typically a result of upstream urbanization and subsequent increase in peak flows. During final designs, the existing land use characteristics of the drainage area upstream from the stream crossing should be evaluated for the extent and intensity of urbanization and imperviousness. Final design may require changing the bed control assumptions used at this conceptual design level.

STAGE II: PRELIMINARY COST ESTIMATES

A preliminary cost estimate was developed for each crossing alternative. This evaluation was made by costing construction materials, labor, excavation/earth removal, foundations, and general design and contingency costs. Because of the conceptual nature of the designs in this assessment, actual costs associated with each alternative may vary to some extent from the estimates presented in this report.

The preliminary construction costs were developed from a number of sources. Culvert manufacturers provided crossing material, foundation, and delivery cost estimates, while earthwork cost estimates were based on general 2000 unit costs data ($4/cubic yard [cu yd] for excavation, $6/cu yd for backfill and $7/cu yd for earth disposal – from PWA project files). Cost estimates for the downstream grade control structures were based on WDFW (1999) cost recommendations, adjusted to 2001 using a 6% increase ($3,450/6 in of drop). For those barriers corrections that involve bridge construction, a unit cost per square foot (sq ft) of deck was adopted ($100/sq ft). Labor costs were estimated as a percentage of total construction and material costs (100%). Lastly, engineering, administration, and construction contingency costs were developed as a percentage of the total construction labor and material cost estimate subtotal (10% - engineering, 15% - administration, and 10% - construction contingency). For those conceptual barrier corrections associated with the 12 dams analyzed, no direct cost estimates were developed; rather a lump sum demolition cost ($5,000) was provided for those barriers being removed, while costs associated with fish ladder construction were provided by DEA based on their recent preliminary design and cost estimate for a fish ladder at the Gourley Creek dam.

These cost estimates have been prepared for guidance in the evaluation and implementation of proposed construction. The final costs of the project will depend on actual labor, material costs, competitive market conditions, final project scope, implementation schedule, and other variables. As a result, the final costs may vary considerably from the estimates associated with this project. For this reason, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and funding.

STAGE II: BARRIER PRIORITIZATION

To develop a prioritization method for correction of fish passage barrier in the Scappoose Bay Watershed, the Technical Advisory Committee first reviewed the current prioritization methods used in Oregon, Washington, and California. These methods are summarized as shown below.

Washington Department of Fish and Wildlife Method

This method is summarized from WDFW's *Fish Passage Barrier Assessment and Prioritization Manual* (WDFW 1998).

Priority Index = sum for all species of quadratic root of [(BPH)xMDC]

B= proportion of passage improvement (passability after project minus passability before)

H= habitat gain in m^2

M= Mobility modifier (2 = anadromous, 1 = resident, 0 = exotic)

D= Species condition modifier (3 = critical, 2 = depressed, 1 = other)

C= Cost modifier (3 = <-100,000, 2 = 100,000-500,000, 1 = >500,000)

Oregon Department of Fish and Wildlife Method

This method is summarized from the *Oregon Road/Stream Crossing Restoration Guide* (Robison et al 1999).

Type 1 – total blockages to coho habitat or high risk of crossing failure impacting downstream coho habitat (within 2 miles)

Type 2 – partial blockage to coho habitat or moderate crossing failure risk impacting downstream coho (within 2 miles)

Type 3 – total or partial blockage to steelhead or sea run cutthroat or moderate/high risk of crossing failure impacting these species downstream (within 2 miles)

Type 4 – total or partial blockage to any game fish (resident cutthroat) or high risk of crossing failure to these species downstream (within 2 miles)

Type 5 – moderate or high risk of crossing failure on non-fish bearing streams

Further prioritize based on actual habitat quantity and quality blocked. Shift types based on best professional judgement.

Draft California Department of Fish and Game Method

This information is summarized from a draft report California Salmonid Stream Habitat Restoration Manual: Part X - Fish Passage Evaluation at Road Crossings. (Taylor and Love 2000 [in draft].

Priority Ranking Index = (D*B*TH*S*C)

D = Species diversity: (3 = each federally listed species, 2 = threatened, 1 = not listed)

B = Extent of barrier: (Use values from FishXing: 0 = 80 to 100% passable, 1 = 60 to 80%, 2 = 40 to 60%, 3 = 20 to 40%, 4 = less than 20%, 5 = complete block)

Habitat quantity: (1 point for each 1000 ft distance as determined by limits of anadromous fish [up to sustained 8% gradient or field determined])

Habitat quality: (1.0 = good, 0.5 = fair, 0.25 = poor)

TH = Total habitat score: (habitat quantity x quality scores)

S = Sizing (risk of failure): (1 = low risk, sized for 100 year flow, 2 = 50-year flow, 3 = 25-year flow, 4 = 10- to 25-year flow, 5 = less than 10-year flow)

C = Current condition: (1 = good condition, 2 = fair, 3 = poor, 4 = extremely poor)

This is a considered a first cut ranking, which can be re-sorted for restoration funding sources by prioritizing sites with good to fair habitat first. Other considerations would include fish observations, the amount of road fill (risk to downstream), multiple road crossings requiring coordinated effort, costs, and other limiting factors (with the watershed level assessment taken into consideration).

Scappoose Bay Watershed Method

The method used for prioritizing 107 barrier in the Scappoose Bay Watershed was a combination of established and new methods, as follows:

1. Prioritize barriers by sub-watersheds, as defined in the Scappoose Bay Watershed Assessment (DEA 2000). Milton Creek and Scappoose Creek were identified as key sub-watersheds in the refugia analysis conducted as part of the watershed assessment, and thus are the highest priority sub-watersheds.

2. Prioritize barriers in each sub-watersheds by whether they were complete or partial barriers. Complete barriers to all fish species and sizes were considered the highest priority, followed by partial barriers. Velocity and outfall jump height criteria were used as barrier criteria. If the barrier was a barrier to all species and size ranges of fish for either velocity or leap height, it was considered a complete barrier; otherwise it was considered a partial barrier. The depth criteria was not used since this is a somewhat unreliable indicator.

3. Prioritize complete and partial barriers within each sub-watershed by a habitat index score (HI), where HI = (total upstream stream length in miles + upstream fish distribution) x (refugia score [no upstream refugia = 1, upstream refugia = 2]). Fish distribution included both resident and anadromous fish species, and included data sources used in the Scappoose Bay Watershed Assessment (DEA 2000). Anadromous fish distribution was not used independently since historical and potential anadromous fish distribution is less well known. The HI score assumes that there are no upstream artificial or natural barriers.

A second method was also used to prioritize barriers on a watershed-wide basis. Barriers were simply prioritized based on type of barrier and HI (score 2 and 3, above), without being sorted into sub-watersheds.

These prioritization methods are meant to be provisional and flexible to other considerations. The HI was used to rank barriers at the sub-watershed and watershed levels, not at the more detailed tributary level. Thus, numerous barriers on a single tributary might not be fixed in consecutive order (although they would be fixed in an upstream direction over time). In some cases, it might be desirable to fix all the barriers on one important tributary first, or to focus on a tributary with only one barrier on it to maximize the immediate gain. In addition, the cost of correction, condition of the barrier, and land ownership are not "mixed in" to a formula, but are included separately as adjoining data columns. These factors can obviously influence the order in which barriers are corrected, depending on the organization proposing the project and the funding available. The Council, forest land owner, or other project proponent needs to evaluate the barriers by geographic location and consider these multiple factors in making a final decision on which barriers to select first for projects.

RESULTS AND DISCUSSION

Results of the field surveys and analysis are contained in full on electronic Excel spreadsheets saved on Compact Disk (CD). The most pertinent summary data is linked to the GIS watershed database. Digital photographs, identified by crossing ID number, are also saved on the CD. File names are the same as the topics discussed below. A list and a description of the electronic data files are provided in Appendix C. In addition, a selection of the most pertinent data from the database for each topic area is included in hardcopy form in Appendix D. Prioritized lists of barriers are provided for each sub-watershed (Appendix E) and for the Scappoose Bay Watershed as a whole (Appendix F). Barrier profiles, consisting of one-page summaries of the field data and analyses results, including a photograph of each barrier, are attached as Appendix G.

Survey data is also summarized on three maps: two 11 x 17 maps (Figure 7: Barrier Locations Map and Figure 8: Barrier Types Map) and a large-scale 1:24,000 topographic map.

STAGE I: FIELD SURVEY

Phase I Survey

A total of 293 Phase I surveys were conducted of road crossings and other observed obstructions, such as dams. Three of these are culverts that were added to the Phase I list of barriers based on observations, since no survey data could be collected. A total of 23 crossings surveyed were GIS errors where roads did not actually cross the stream. Of the 270 actual crossings, 131 (49%) were considered potential barriers since they did not meet ODFW design criteria for slope, outfall drop, or inlet constriction (Table 4). All of the dams were considered potential barriers, as were most of the culverts, with the exception of some embedded or backwatered culverts. About one-third of the crossings were bridges, none of which were considered potential barriers (Appendix D, Table 5: Selected Phase I Survey Data).

Phase I surveys did not include Longview Fiber Co. lands, nor the properties of several landowners who refused permission to conduct a survey. The scope did not allow surveys on portions of Jackson, Joy, and Jones creeks. The Scappoose Bay Drainage District refused permission to survey lower Jackson Creek after an initial survey was conducted with permission at the diversion dam.

Table 4: Summary of Phase I Survey Results

Crossing Type	No. Surveyed	No. Barriers	Percent Barriers
Dam	13	13	100
Round culvert	140	111	79
Box culvert	8	5	63
Bridge	105	0	0
Other	4	2	50
Total	270	131	49

Phase II Survey

Of the 131 potential barriers identified in the Phase I surveys, 107 were selected for the more detailed Phase II survey due to the limited scope of work (100 barriers) (Appendix D, Table 6: Selected Phase II Survey Data). Potential barriers eliminated from consideration were those that would probably rank lowest in a prioritization based on amount of upstream habitat. Potential barriers with less than ½ mile of fish habitat and less than one mile of total stream distance upstream of the barrier were not included in Phase II surveys. Due to cost constraints, Phase II surveys were conducted on 105 of these selected barriers and Phase I data was used for the analysis of the remaining two barriers.

STAGE II: HYDROLOGIC, HYDRAULIC, AND BARRIER ASSESSMENT

The type and severity of 107 fish-bearing stream crossing barriers (dams and culverts) were analyzed. Figure 9, Figure 10, and Figure 11 summarize the hydraulic analysis results for depth, velocity, and leap barriers. Table 7, Table 8, and Table 9, in Appendix D provided selected analysis data for the Hydrologic, Hydraulic, and Barrier Assessments, respectively. If hydraulic analysis using the design flows indicated that the barrier did not meet fish passage criteria for the full range of salmonid species and life stages tested due to either high velocity or leap height, it was considered a complete barrier. Seventy-seven percent (77%) of the barriers were found to be complete barriers and the remainder were identified as partial barriers.

Culvert stability was also considered through an evaluation of whether the roadway became inundated during extreme flow events. This analysis, using the 100-year stream flow at each culvert, indicated that slightly more than 50% of the stream crossings exhibited roadway overtopping that would potentially reduce the overall crossing stability. Figure 12 and Figure 13 illustrate the results of the flood analysis for each stream crossing.

STAGE II: CONCEPTUAL DESIGN AND COST ESTIMATES

A conceptual design and cost estimate was also developed for each stream-crossing barrier. The designs alternatives were comprised of open and/or closed bottom culvert replacements, bridges, and/or complete barrier removal (Appendix D, Table 10: Selected Conceptual Design Data). The design alternatives that include an "arch" are intended as open-bottom arch designs with concrete footings, as preferred by ODFW. In some cases, large round or squash culverts with the same width and flow capacity may be a suitable, less costly alternative. The costs associated with these conceptual designs range from roughly $5,000 for the demolition of smaller dams to nearly $750,000 for the larger scale bridge construction (Appendix D, Table 11: Selected Cost Estimate Data). These cost estimates have been prepared for guidance in the evaluation and implementation of proposed construction. The final costs of the project will depend on actual labor, material costs, competitive market conditions, final project scope, implementation schedule, and other variables. As a result, the final costs may vary considerably from the estimates associated with this project. For this reason, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and funding.

Figure 7: Barrier Locations Map

(Note: This is a color, 11 x 17" insert which will replace this page)

Figure 8: Barrier Types Map

(Note: This is a color, 11 x 17" insert which will replace this page)

Figure 9: Depth Barrier Assessment

(Note: This is a color, 8½ x 11" insert which will replace this page)

Figure 10: Velocity Barrier Assessment: Prolonged and Burst Activity

(Note: This is a color, 8½ x 11” insert which will replace this page)

Figure 11: Leap Height Barrier Assessment

(Note: This is a color, 8½ x 11” insert which will replace this page)

Figure 12: 50-Year Flow: Depth Above Culvert Crown

(Note: This is a color, 8½ x 11” insert which will replace this page)

Figure 13: 100-Year Flow: Depth Above Roadway

(Note: This is a color, 8½ x 11" insert which will replace this page)

STAGE II: BARRIER PRIORITIZATION

A total of 131 potential barriers were found in Phase I field surveys, of which 107 potential barriers with the most upstream habitat were surveyed and evaluated in more detail. A Habitat Index (HI) was calculated for each of these barriers to estimate the upstream habitat gain in terms of length of upstream mapped habitat length and access to refugia identified in the Scappoose Bay Watershed Assessment (DEA 2000). The data used for calculating the HIs are provided in Appendix D, Table 12: Selected Upstream Habitat Data.

These 107 barriers were then prioritized by sub-watershed, by type of barrier (complete or partial), and by HI (Appendix E, Table 13 through Table 17). The sub-watershed method of prioritizing barriers can be used to implement the overall priorities recommended in the Scappoose Bay Watershed Assessment (DEA 2000). The Assessment identified five sub-watersheds: Scappoose, Milton, McNulty, Jackson, and Honeyman. Of these, Scappoose and Milton were identified as "key sub-watersheds," due to their larger size and greater fish species diversity and abundances, and were recommended as the highest priority areas for aquatic conservation and restoration.

In general, the HI scoring system and the focus on specific key sub-watersheds prioritizes projects that are along stream corridors that provide access to refugia and are within Scappoose and Milton Creek sub-watersheds (Figure 14: High Priority Stream Corridors Map). The "primary" refugia considered in the HI scoring consist of the headwater watershed refugia and the large wetlands of Scappoose Bay, as identified in the Watershed Assessment (DEA 2000). Barriers along streams that provide potential access only to small nodal habitat refugia ("secondary" refugia), both along Milton Creek and outside of the two key watersheds, were not given additional points in the HI index.

Barriers were also prioritized on a watershed-wide basis. Barriers were ranked by whether they were complete or partial barriers and then by Habitat Index (Appendix E, Table 13: Scappoose Sub-watershed Barrier Prioritization Summary). The watershed-wide perspective helps to ensure that barrier correction projects outside of priority sub-watersheds, but with relatively large upstream habitat gains in the watershed as a whole, are also considered.

The prioritization methods are meant to be provisional and flexible to other considerations. The methods result in barriers being ranked at the watershed or sub-watershed level, not at the more detailed tributary level. Thus, numerous barriers on a single tributary might not be fixed in consecutive order (although they would be fixed in an upstream direction over time). In some cases, it might be desirable to fix all the barriers on one important tributary first, or to focus on a tributary with only one barrier on it to maximize the immediate gain. In addition, the cost of correction, condition of the barrier, and land ownership are not "mixed in" to a formula, but are included separately as adjoining data columns. These factors can obviously influence the order in which barriers are corrected, depending on the organization proposing the project and the funding available. The Council, forest land owner, or other project proponent will need to evaluate the barrier locations on the map and consider these multiple factors in making a final decision on which barriers to select first for projects.

SUMMARY

This comprehensive assessment of fish passage barrier represents the "due diligence" that is intended to provide the foundation for the Council and other stakeholders to obtain funding to restore fish passage on many streams. The DEA team surveyed 293 road crossings, dams, and other human-caused obstructions of known fish-bearing streams. Of these, 131 potential barriers were identified. Of these barriers, the top 107 were surveyed in more detail, including fish sampling and surveys of upstream and downstream channel conditions. The detailed data was used in hydrologic and hydraulic analysis to determine the severity of the barriers for various sizes and species of fish, existing flood capacity, and design options. Conceptual designs were developed and preliminary cost estimates were prepared for each of the 107 barriers. These barriers were then prioritized based on the sub-watershed location, whether the barrier was partial (juvenile barrier only) or complete (adult and juvenile barrier), and based upon a Habitat Index score. A watershed-wide prioritized list was also prepared. This provisional ranking of barriers should be considered with other factors (listed separately), such as cost, culvert condition, barrier owner, and location in relation to other culverts. The bulk of the data is in electronic Excel spreadsheets and geo-referenced in a GIS database.

LITERATURE CITED

David Evans and Associates, Inc. (DEA). 2000. *Scappoose Bay watershed assessment*. Prepared for the Scappoose Bay Watershed Council. Scappoose, OR.

Harris, D.D., L.L. Hubbard, and L.E Hubbard. 1979. *Magnitude and frequency of floods in western Oregon*. Open-File Report 79-553, U.S. Geological Survey.

Leopold, L.B. 1994. *A view of the river*. Harvard University Press, Cambridge, Massachusetts.

Love, M. July 2000. *Field guide: Explanations and instructions for inventory and assessment of culverts on fish bearing streams*. FishXing Project.

Moore, K., K. Jones, J. Dambacher, J. Burke, C. Stein, and STEP biologists. 1999. *Aquatic inventory project, training materials and methods for stream habitat surveys*. Oregon Department of Fish and Wildlife. Portland, OR.

Oregon Department of Transportation (ODOT). 1999. *Hydraulics manual*. Salem, OR.

Robison, E.G., A. Mirati, and M. Allen. 1999. *Oregon road/stream crossing restoration guide*. Oregon Department of Forestry (ODF) and Oregon Department of Fish and Wildlife (ODFW), Advanced Fish Passage Training Version, June 8, Portland, OR.

Taylor, R.N. and M.A. Love. October 2000 (In-Draft). *California salmonid stream habitat restoration manual: Part X - fish passage evaluation at road crossings*. California Department of Fish and Game.

Washington Department of Fish and Wildlife (WDFW). 1998. *Fish Passage barrier assessment and prioritization manual*. Salmonid Screening, Habitat Enhancement, and Restoration (SSHEAR) Division, WDFW. Olympia, WA.

Washington Department of Fish and Wildlife (WDFW). 1999. *Fish passage design at road culverts*. Habitats and Lands Program, Environmental Engineering Division, WDFW. Olympia, WA.

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Figure 14: High Priority Stream Corridors Map

APPENDIX A: PHASE I FIELD DATA FORM

PHASE 1 Fish Passage Survey

Survey #_______

Date _______________________ (Month-Day-Year, 6-2-00)
===
Crossing ID # ________ (GIS map #)

Barrier ID # _____-______ (Existing barrier list # - od**FW**, **FO**, **OT**her)

GIS map error _______ (X if mapped crossing does NOT occur in field)

GIS location error ______ (X if location needs to be corrected [mark on GIS field map])

New Barrier ID# N-________ (Mark #N-__on GIS field map)
===
Basin Name________________________ (**SC**appoose, **MI**lton, **MC**Nulty, **HO**neyman, **JA**ckson)

Stream Name__________________________(Name of tributary or **NO** name, **SF, NF, SC**)

Topo Quad Name______________________ (**TRE, BAC, CHA, SAI, DIX, SAU, MEA, DEE**)
===
Start GPS 05-_____-________ Saved as WP#________

50-_____-________

End GPS 05-_____-________

50-_____-________
===
Road Owner ____________(**CO**unty, **CI**ty, **BL**m, **HA**ncock, **WI**lla., **ST**ate, **OT**her)

Road Name __________________________ (**HWY 30**, Cowder Rd,**UN**known)

Road Number ___________ (1220, **UN**known)

Road Milepost_________(1.2)

Location/Directions Notes ____
===
Photo Upstream _____ (continuous numbering until saved on hard disk)

Photo Inlet_____

Photo Downstream_____

Photo Outlet _____

Extra photo _____ of ____
===

Phase 1 Fish Passage Survey, continued

Survey Number________(same number as 1st page)
==
Crossing Type ______(**FO**rd, **BO**x Culvert, **CI**rcular culvert., **AB**-Arch culvert w Bottom, **AN**-No Bott., Bridge, **DA**m)

Crossing material _______ (**WO**od, **PL**astic, **CO**ncrete, **C**orrugated **M**etal, **S**mooth **M**etal, **OT**her)
==
Culvert diameter ______ (width measured)

Culvert average embedded depth _____ (for embedded section only, estimate or UNknown)

Diving or constricted flow at inlet _____ (**Y**es or **N**o)

Description of poor inlet conditions
____

Inlet bankful channel width _______

Wetted width ___________
==
Percent length clear of substrate ______ % (length with not embedded, no substrate)

Outlet survey height _______ *top*; _______ *middle*; _______ *bottom* — *survey notes here*

Inlet survey height _______ *top*; _______ *middle*; _______ *bottom*

Culvert length________ (measured)

Percent slope _______%

Backwater percent ______% (estimate of percent length of culvert backwatered)

Flow depth ________ (measured)

Dam or culvert outlet drop __________ (measured, inner lip of culvert to water surface))

Pool depth ______(only culverts with a drop) Pool depth elevation _________

Outlet grade control depth _________ (or downstream riffle depth) Control elevation _________
==
Barrier ___ -____/____/____/____ (**Y**es, **M**aybe, or **N**o- **OU**tlet drop, **IN**let constriction or drop, **SL**ope, **SH**allow)

Other unmapped barriers in vicinity____
Other notes ____

APPENDIX B: PHASE II FIELD DATA FORM

PHASE II Fish Passage Survey (Aug. 15, 2000 version)

Phase I Survey #________

Date ________________________ (Month-Day-Year, 6-2-00)
==

Basin Name_________________________ (**SC**appoose, **MI**lton, **MC**Nulty, **HO**neyman, **JA**ckson)

Stream Name___________________________(Name of tributary or **NO** name, **SF, NF, SC**)

Topo Quad Name_______________________ (**TRE, BAC, CHA, SAI, DIX, SAU, MEA, DEE**)
==
Start GPS 05-_____-________ Saved as WP#________

50-_____-________

==
Number of travel lanes _________

Type of road surface _______ (**P**avement, **G**ravel, **D**irt)

Road width ________

Top of fill width _________

Base of fill width ________ (along bottom of culvert)

Bottom of fill elevation ______ (outlet side)

Road surface to level height _______

==
Sketch in plan view of road approaches, lanes, width and general characteristics within 200' of crossing, show North arrow

Crossing sub-survey label _________ (if multi-pipe crossing, label sketch and do separate page for each)

Crossing Type ______ (**BO**x Culvert, **CI**rcular culvert., **AB**-Arch culvert w Bottom, **AN**-No Bott., **El**lipse culvert, **DA**m)

Crossing material ________ (**WO**od, **PL**astic, **CO**ncrete, **C**orrugated **M**etal, **S**mooth **M**etal, **OT**her)

Corrugation width ____ depth _____ shape _____ (**AN**nualar or **SP**iral)

Culvert width _____ height ______ (if not round)

Condition __________ (**GO**od, **BE**nt, **RU**sted through)

Condition notes ____

Percent culvert length clear of substrate ______ % (length not embedded, no substrate)

===

Outlet

Outlet type _______ (**ST**ream level, **FR**eefall into pool, **CA**scade over rock, **AP**ron)

Rustline elevation at outlet ______ (vertical ft. or **NO**t obvious)

Flow depth at outlet _____ (measured with ruler at a distance into culvert 3-4 times the flow depth)

Pool depth (within 5 feet of outlet) distance downstream ______ elevation _______

Tailwater control ________ (**PO**ol tailout, **LO**g weir, **BO**ulder weir, **CO**ncrete weir, **NO** pool, **SL**ough)

===

Inlet

Diving or constricted flow at inlet _____ (**Y**es or **N**o)

Description of poor inlet conditions ____

Inlet type______ (**PR**ojecting, **HE**eadwall, **Wi**ngwall, **MI**tered)

Rustline height inlet ______ (vertical ft. or **NO**t obvious)

Flow depth at inlet ____ (measured at a distance one culvert diameter into culvert)

Channel alignment in relation to inlet _______ (of 360 degrees)

===

	_______ *top*	*survey notes here*
Outlet stadia survey elev.	_______ *middle*	
	_______ *bottom*	
	_______ *top*	
Inlet stadia survey elev.	_______ *middle*	
	_______ *bottom*	

Culvert length________ (estimated) _______ (taped) Percent slope _______%

Backwater percent ______% (estimate of percent length of culvert backwatered)

Downstream channel characteristics

Tailwater control distance from outlet _______

TOB distance __*0*__ *D2*_____ *D3*_____ *D4*_____ *D5*_____ *D6*_____ *D7*_____ *D8*_____

TOB ELEVATIO _____ *E2*_____ *E3*_____ *E4*_____ *E5*_____ *E6*_____ *E7* _____ *E8*_____

Distance 1 (25) _____ ACW _______ WW _______ EL _____

Distance 2 (50) _____ ACW _______ WW _______ EL _____

Distance 3 (100) _____ ACW _______ WW _______ EL ______

Distance 4 (150) _____ ACW _______ WW _______ EL ______

Distance 5 (200) _____ ACW _______ WW _______ EL ______

Substrate percent SI/OR_____ SA _____ GR _____ CO _____ BO _____ BE ______
(average over reach) (pea to base.) (base. to bowl.)

Number of barriers within 200 feet downstream _____
Describe downstream barriers____
===

Upstream channel characteristics

Distance 1 (5) _____ ACW _______ WW _______ EL ______

Distance 2 (25) _____ ACW _______ WW _______ EL ______

Distance 3 (50) _____ ACW _______ WW _______ EL______

Distance 4 (100) _____ ACW _______ WW _______ EL ______

Distance 5 (150) _____ ACW _______ WW _______ EL ______

Distance 6 (200) _____ ACW _______ WW _______ EL ______

Cross-section *distance upstream* ______

AC Distance __*0*__ *D2*_____ *D3*_____ *D4*_____ *D5*_____ *D6*_____ *D7*_____ *D8*_____

AC Elevation _____ *E2*_____ *E3*_____ *E4*_____ *E5*_____ *E6*_____ *E7* _____ *E8*_____

Substrate Percent SI/OR_____ SA _____ GR _____ CO _____ BO _____ BE ______
(average over reach) (pea to base.) (base. to bowl.)

Number of barriers within 200 feet upstream _____

Describe any upstream barriers____

Fish observations and sampling

Fish traps set date _________________ time ______________ (or observations date)

Pickup date_________________ time ______________

==

Downstream fish trapping and observations

Trap 1 dist ____ Coho # ____ Cut #____ St #_____ Salm# ____ Sculp# _____ Stick#____ Craw#____
Other# ____ Descript____

Trap 2 dist ____ Coho # ____ Cut #____ St #_____ Salm# ____ Sculp# _____ Stick#____ Craw#____
Other# ____ Descript____

Trap 3 dist ____ Coho # ____ Cut #____ St #_____ Salm# ____ Sculp# _____ Stick#____ Craw#____
Other# ____ Descript____

Observations Coho # ____ Cut #____ St #_____ Salm# ____ Sculp# _____ Stick#____ Craw#____
Other# ____ Descript____

==

Upstream Fish Trapping or observations

Trap 1 dist ____ Coho # ____ Cut #____ St #_____ Salm# ____ Sculp# _____ Stick#____ Craw#____
Other# ____ Descript____

Trap 2 dist ____ Coho # ____ Cut #____ St #_____ Salm# ____ Sculp# _____ Stick#____ Craw#____
Other# ____ Descript____

Trap 3 dist ____ Coho # ____ Cut #____ St #_____ Salm# ____ Sculp# _____ Stick#____ Craw#____
Other# ____ Descript____

Observations Coho # ____ Cut #____ St #_____ Salm# ____ Sculp# _____ Stick#____ Craw#____
Other# ____ Descript____

Potential spawning habitat quality rating ________ (None, Low, Moderate, High)

Potential rearing habitat quality rating ________ (None, Low, Moderate, High)

Springflow influence _______ (Low, moderate, high)

Habitat notes ____
Photos Down#_____ Upstr#______ Outlet#______ Inlet#______

Misc. photo#_____ Description____
Misc. photo#_____ Description____

Crossing plan view

Crossing profile

Culvert inlet

Culvert outlet

APPENDIX C: LIST OF ELECTRONIC DATA FILES

DESCRIPTION OF ELECTRONIC DATA FILES PROVIDED ON COMPACT DISK

Field data folder

Phase1fielddata_to6-05-01.xls – Phase I field survey data
Phase2fielddata_to6-05-01.xls – Phase II field survey data

Digital photos folder

Phase1photos_final folder – Phase I field survey photos (.jpg files listed by photo # as referenced in field survey data for each crossing surveyed)
Phase2photos_final folder – Phase II field survey photos

Analysis folder

FishXing folder – contains files for each crossing analyzed and for designs. The five directories (each for an age classification analyzed) need to be placed in a particular location on the hard drive. When FishXing is installed on the hard drive, it creates a folder at the following location: C:\Program Files\FishXing V2\Projects. Copy the five FishXing folders into this "Projects" folder. When FishXing is opened, these five folders will now be recognized as five projects, and you can select one and run through the crossings in it.
Hydrology_final.xls – hydrologic analysis data and plots
FlowValidation_final.xls – flow validation analysis and plots
DamAnalysis_final.xls – analysis of dams with photos and plots
HighFlowAnalysis_final.xls – 50 and 100-year flow analysis and plots
BarrierAssessment_final.xls – leap, depth, and velocity barrier calls and plots
ConceptualDesign_final.xls – design choice and details
CostEstimate_final.xls – preliminary cost opinions with cost breakdown
BarrierRanking_final.xls – prioritized lists for sub-watershed and watershed

Barrier profiles data folder

BarrierForm_final.doc – master form used to merge in the barrier profiles data
Barrierprofilesdata_final.xls –summary data for 107 barriers analyzed

Report folder

FinalReport.doc – text and tables of final report
Tabs_final.doc – tab dividers inserted into final report
Figures_final.doc – color figures inserted into final report
BarrierProfiles_final.doc – 107 one page barrier profiles and photos
Cover_final.doc – Color cover page graphic used in final report
BarrierLocationsMap.jpg– jpg image of the 11x17 map in the final report
BarrierTypesMap.jpg – jpg image of the 11x17 map in the final report
PriorityStreamCorridors.jpg -. jpg image of the 11x17 map in the final report

Slide Presentation

FishPassage.ppt – powerpoint slide presentation

APPENDIX D: TABULAR DATA SUMMARIES

Table 5: Selected Phase I Survey Data

Survey ID No.	Sub-watershed	Stream Name	Crossing Owner	Road Name	General Crossing Type	Phase I Barrier[1]
1	Scappoose	South Scappoose Ck	City	E.M. Watts Rd.	Bridge	No
2	Scappoose	Coal Ck	County	E.M. Watts Rd.	Round culvert	No
3	Scappoose	South Scappoose Ck	County	Dutch Canyon Rd.	Bridge	No
4	Scappoose	South Scappoose Ck	Unknown	Branch Rd.	Bridge	No
5	Blank lines indicate crossing did not occur – GIS mapping error					
6	Scappoose	South Scappoose Ck	County	Raymond Ck. Rd.	Bridge	No
7	Scappoose	Salt Ck	County	Dutch Canyon Rd.	Bridge	No
8	Scappoose	Mud Ck	County	Dutch Canyon Rd.	Round culvert	Yes
9	Scappoose	South Scappoose Ck	County	Bankston Rd.	Bridge	No
10	Scappoose	Wolf Ck	County	Dutch Canyon Rd.	Round culvert	Yes
11	Scappoose	Lacey Ck	Hancock	Unknown	Round culvert	Yes
12	Scappoose	South Scappoose Ck	State	Highway 30	Bridge	No
13	Scappoose	North Scappoose Ck	Railroad	Railroad	Bridge	No
14	Scappoose	North Scappoose Ck	State	Highway 30	Bridge	No
15	Scappoose	Scappoose Ck	County	West Lane Rd.	Bridge	No
16	Honeyman	Honeyman Ck	State	Highway 30	Box culvert	Yes
17	Honeyman	Honeyman Ck	Railroad	Railroad	Bridge	No
18	Honeyman	Unknown	State	Highway 30	Box culvert	Yes
19	McNulty	Warren Ck	State	Highway 30	Box culvert	Yes
20	McNulty	McNulty Ck	State	Highway 30	Bridge	No
21	Milton	Milton Ck	State	Highway 30	Bridge	No
22	Milton	Milton Ck	City	Milton Way	Bridge	No
23	Milton	Milton Ck	County	Old Portland Rd	Bridge	No
24	Scappoose	South Scappoose Ck	County	Otto Miller Rd	Bridge	No
25	Scappoose	Lacey Ck	Hancock	Layton Rd	Dam	Yes
26	Scappoose	Lacey Ck	Hancock	Layton Rd	Round culvert	No
27						
28	Scappoose	Lacey Ck	Hancock	Unknown	Round culvert	Yes

[1] **Phase I Barrier = Does not meet ODFW design criteria and considered a potential barrier**

Table 5: Selected Phase I Survey Data (continued)

Survey ID No.	Sub-watershed	Stream Name	Crossing Owner	Road Name	General Crossing Type	Phase I Barrier[1]
29	Jackson	Jackson Ck	County	Old Portland Rd	Box culvert	No
30	Jackson	Jackson Ck	County	Watson Rd	Round culvert	Yes
31	Jackson	Unknown	Unknown	Unknown	Round culvert	Yes
32	Jackson	Jackson Ck	State	Highway 30	Box culvert	No
33	Jackson	Jackson Ck	Railroad	Railroad	Round culvert	No
34	Jackson	Jackson Ck	Unknown	Unknown	Dam	Yes
35	Scappoose	Gourlay Ck	Unknown	Unknown	Bridge	No
36	Scappoose	Gourlay Ck	Unknown	Unknown	Dam	Yes
37	Scappoose	Gourlay Ck	Unknown	Unknown	Dam	Yes
38	Scappoose	Wf Gourlay Ck	Unknown	Unknown	Round culvert	Yes
39						
40	Scappoose	South Scappoose Ck	City	Unknown	Dam	Yes
41	Scappoose	South Scappoose Ck	City	Unknown	Dam	Yes
42	Scappoose	South Scappoose Ck	County	Vernonia Hwy	Bridge	No
43	Scappoose	South Scappoose Ck	Unknown	Crown Z Logging Rd	Bridge	No
44	Scappoose	South Scappoose Ck	City	J P West Rd	Bridge	No
45	Scappoose	South Scappoose Ck	City	Nw Smith Rd	Bridge	No
46	Scappoose	Alder Ck	County	Nw Smith Rd	Round culvert	Yes
47	Scappoose	Alder Ck	County	Apple Valley Rd	Round culvert	Yes
48	Scappoose	Alder Ck	County	Vernonia Hwy	Round culvert	Yes
49	Scappoose	Alder Ck	Unknown	Crown Z Logging Rd	Round culvert	Yes
50	Scappoose	Unknown	Unknown	Unknown	Round culvert	Yes
51	Scappoose	Dooly Ck	Unknown	Unknown	Round culvert	Yes
52	Scappoose	South Scappoose Ck	Unknown	Unknown	Bridge	No
53	Scappoose	Mclafferty Ck	Unknown	Unknown	Round culvert	No
54						
55	Scappoose	South Scappoose Ck	Unknown	Unknown	Round culvert	Yes
56	Scappoose	South Scappoose Ck	Unknown	Unknown	Round culvert	Yes

[1] **Phase I Barrier = Does not meet ODFW design criteria and considered a potential barrier**

Table 5: Selected Phase I Survey Data (continued)

Survey ID No.	Sub-watershed	Stream Name	Crossing Owner	Road Name	General Crossing Type	Phase I Barrier[1]
57	Scappoose	Alder Ck	Unknown	Unknown	Round culvert	No
58						
59	Scappoose	North Scappoose Ck	County	Vernonia Hwy	Bridge	No
60	Scappoose	North Scappoose Ck	Unknown	Crown Z Logging Rd	Bridge	No
61	Scappoose	North Scappoose Ck	Unknown	Unknown	Bridge	No
62	Scappoose	North Scappoose Ck	Unknown	Unknown	Bridge	No
63	Scappoose	North Scappoose Ck	County	Unknown	Bridge	No
64	Scappoose	North Scappoose Ck	County	Vernonia Hwy	Bridge	No
65	Scappoose	Siercks Ck	County	Reid Rd	Bridge	No
66	Scappoose	Siercks Ck	Unknown	Reid Rd	Round culvert	Yes
67	Scappoose	Siercks Ck	County	Conifer Heights Dr	Bridge	No
68	Scappoose	Siercks Ck	County	Armstrong Rd	Round culvert	Yes
69	Scappoose	Siercks Ck	Unknown	Unknown	Round culvert	Yes
70	Scappoose	Siercks Ck	Unknown	Unknown	Round culvert	Yes
71	Scappoose	Siercks Ck	Unknown	Unknown	Round culvert	Yes
72						
73	Scappoose	North Scappoose Ck	County	Vernonia Hwy	Bridge	No
74	Scappoose	North Scappoose Ck	County	Wildwood Dr	Bridge	No
75	Scappoose	North Scappoose Ck	Unknown	Unknown	Bridge	No
76	Scappoose	North Scappoose Ck	County	Vernonia Hwy	Bridge	No
77	Scappoose	North Scappoose Ck	Unknown	Unknown	Bridge	No
78	Scappoose	North Scappoose Ck	County	Vernonia Hwy	Bridge	No
79	Scappoose	Alder Ck	County	Cater Rd	Round culvert	Yes
80	Scappoose	Alder Ck	Unknown	Unknown	Bridge	No
81	Scappoose	Unknown	County	Walker Rd	Round culvert	Yes
82	Scappoose	Alder Ck	County	Alder Ck Rd	Round culvert	No

[1] Phase I Barrier = Does not meet ODFW design criteria and considered a potential barrier

Table 5: Selected Phase I Survey Data (continued)

Survey ID No.	Sub-watershed	Stream Name	Crossing Owner	Road Name	General Crossing Type	Phase I Barrier[1]
83	McNulty	McNulty Ck	Railroad	Railroad	Bridge	No
84	Scappoose	Alder Ck	County	Bolin Dr	Round culvert	No
85	Scappoose	Alder Ck	Unknown	Unknown	Round culvert	Yes
86	Scappoose	Alder Ck	County	Alder Ck Rd	Round culvert	Yes
87	Scappoose	Alder Ck	Unknown	Unknown	Round culvert	Yes
88	Scappoose	Alder Ck	County	Alder Ck Rd	Round culvert	Yes
89	Scappoose	Alder Ck	Unknown	Unknown	Round culvert	Yes
90	Milton	Milton Ck	Railroad	Railroad	Bridge	No
91	Scappoose	Alder Ck	Unknown	Unknown	Round culvert	Yes
92	Scappoose	Alder Ck	County	Alder Ck Rd	Round culvert	No
93	Scappoose	North Scappoose Ck	County	Vernonia Hwy	Bridge	No
94	Scappoose	North Scappoose Ck	Unknown	Crown Z Logging Rd	Bridge	No
95	Scappoose	North Scappoose Ck	County	Vernonia Hwy	Bridge	No
96	Scappoose	North Scappoose Ck	Unknown	Crown Z Logging Rd	Bridge	No
97	Scappoose	North Scappoose Ck	County	Chapman Grange Rd	Bridge	No
98	Scappoose	Brush Ck	Unknown	Melanie Ln	Round culvert	No
99	Scappoose	North Scappoose Ck	County	Chapman Rd	Bridge	No
100	Scappoose	Lizzie Ck	County	Chapman Rd	Bridge	No
101	Scappoose	Lizzie Ck	Unknown	Unknown	Round culvert	Yes
102	Scappoose	Cedar Ck	County	Vernonia Hwy	Round culvert	Yes
103	Scappoose	Cedar Ck	Unknown	Crown Z Logging Rd	Round culvert	Yes
104	Scappoose	North Scappoose Ck	County	Chapman Rd	Round culvert	No
105	Scappoose	Mollenhour Ck	County	Chapman Rd	Round culvert	Yes
107	Scappoose	North Scappoose Ck	County	Chapman Rd	Round culvert	Yes
108	Scappoose	North Scappoose Ck	County	Chapman Rd	Round culvert	Yes
109	Scappoose	Un	Unknown	Unknown	Round culvert	Yes
110	Scappoose	Mollenhour Ck	County	Vernonia Hwy	Round culvert	Yes

[1] **Phase I Barrier = Does not meet ODFW design criteria and considered a potential barrier**

Table 5: Selected Phase I Survey Data (continued)

Survey ID No.	Sub-watershed	Stream Name	Crossing Owner	Road Name	General Crossing Type	Phase I Barrier[1]
111	Scappoose	North Scappoose Ck	County	Private Dr	Round culvert	No
112	Scappoose	North Scappoose Ck	County	Kingsley Rd	Round culvert	No
113	McNulty	McNulty Ck	Unknown	Na	Dam	Yes
114	Scappoose	North Scappoose Ck	County	Chapman Rd	Round culvert	Yes
115	Scappoose	North Scappoose Ck	Unknown	Unknown	Bridge	No
116	Scappoose	Cedar Ck	County	Cedar Ck Rd	Round culvert	Yes
117	Scappoose	Cedar Ck	Unknown	Unknown	Bridge	No
118	Scappoose	Cedar Ck	County	Cedar Ck Rd	Round culvert	Yes
119	McNulty	McNulty Ck	City	Mcnulty Way	Bridge	No
120	Milton	Milton Ck	Unknown	Railroad Ave	Bridge	No
121	Milton	Milton Ck	Unknown	Railroad Ave	Bridge	No
122	McNulty	McNulty Ck	County	Old Portland Rd	Box culvert	Yes
123	McNulty	Unknown	County	Millard Rd	Round culvert	Yes
124	McNulty	McNulty Ck	County	Millard Rd	Dam	Yes
125	McNulty	McNulty Ck	County	Ross Rd	Bridge	No
126	McNulty	McNulty Ck	Unknown	Unknown	Round culvert	Yes
127	McNulty	McNulty Ck	County	Millard Rd	Bridge	No
128	McNulty	McNulty Ck	County	Hazen Rd	Bridge	No
129	McNulty	Unknown	County	Hazen Rd	Round culvert	Yes
130	McNulty	McNulty Ck	Unknown	Unknown	Bridge	No
131	McNulty	McNulty Ck	County	Hazen Rd	Round culvert	Yes
132	McNulty	McNulty Ck	Unknown	Unknown	Round culvert	Yes
133	McNulty	McNulty Ck	Unknown	Unknown	Round culvert	Yes
134	McNulty	McNulty Ck	Unknown	Unknown	Round culvert	Yes
135	McNulty	McNulty Ck	County	Hazen Rd	Bridge	No
136	McNulty	McNulty Ck	Hancock	Unknown	Round culvert	Yes

[1] Phase I Barrier = Does not meet ODFW design criteria and considered a potential barrier

Table 5: Selected Phase I Survey Data (continued)

Survey ID No.	Sub-watershed	Stream Name	Crossing Owner	Road Name	General Crossing Type	Phase I Barrier[1]
137	Milton	Milton Ck	City	Columbia Blvd	Bridge	No
138	Milton	Milton Ck	City	Pittsburg Rd	Bridge	No
139	Milton	Perry Ck	County	Hanky Rd	Round culvert	Yes
140	Milton	Milton Ck	Unknown	Unknown	Bridge	No
141	Milton	Dart Ck	County	Robinette Rd	Round culvert	Yes
142	Milton	Milton Ck	County	Pittsburg Rd	Bridge	No
143	Milton	Milton Ck	County	West Kappler Rd	Bridge	No
144	Milton	Cox Ck	County	West Kappler Rd	Box culvert	No
145	Milton	Milton Ck	County	Brinn Rd	Bridge	No
146	Milton	Salmon Ck	County	Unknown	Bridge	No
147	Milton	Salmon Ck	County	Brinn Rd	Round culvert	Yes
148	Milton	Salmon Ck	Unknown	Unknown	Round culvert	Yes
149	Milton	Salmon Ck	County	Brinn Rd	Round culvert	No
150	Milton	Salmon Ck	County	Brinn Rd	Round culvert	Yes
151	Milton	Salmon Ck	Unknown	Unknown	Round culvert	Yes
152	Milton	Salmon Ck	Hancock	Unknown	Round culvert	Yes
153	Milton	Salmon Ck	Hancock	Unknown	Round culvert	Yes
154	Milton	Salmon Ck	Unknown	Unknown	Round culvert	Yes
155	Milton	Cox Ck	County	Brooks Rd	Round culvert	Yes
156	Milton	Cox Ck	Unknown	Unknown	Round culvert	Yes
157	Milton	Cox Ck	Unknown	Unknown	Round culvert	Yes
158	Milton	Cox Ck	Hancock	Unknown	Round culvert	Yes
159						
160	Milton	Cox Ck	Unknown	Unknown	Round culvert	Yes
161	Milton	Cox Ck	Unknown	Unknown	Bridge	No
162	Milton	Cox Ck	Unknown	Unknown	Round culvert	Yes
163	Milton	Milton Ck	Unknown	Amyette Rd	Bridge	No

[1] **Phase I Barrier = Does not meet ODFW design criteria and considered a potential barrier**

Table 5: Selected Phase I Survey Data (continued)

Survey ID No.	Sub-watershed	Stream Name	Crossing Owner	Road Name	General Crossing Type	Phase I Barrier[1]
164	Milton	Milton Ck	Unknown	Unknown	Bridge	No
165	Milton	Unknown	County	Pittsburg Rd	Round culvert	Yes
166	Milton	Unknown	County	Unknown	Round culvert	Yes
167	Milton	Unknown	Unknown	Unknown	Round culvert	Yes
168	Milton	Milton Ck	Unknown	Unknown	Round culvert	No
169	Milton	Milton Ck	Unknown	Unknown	Bridge	No
170	Milton	Milton Ck	Unknown	Unknown	Bridge	No
171	Milton	Salmonberry Ck	Unknown	Unknown	Round culvert	Yes
172	Milton	Milton Ck	Unknown	Unknown	Bridge	No
173	Milton	Milton Ck	County	Pittsburg Rd	Bridge	No
174	Scappoose	Raymond Ck	Unknown	Unknown	Bridge	No
175	Milton	Milton Ck	Unknown	Unknown	Round culvert	Yes
176	Milton	Milton Ck	County	Pittsburg Rd	Round culvert	Yes
177	Milton	Milton Ck	Unknown	Unknown	Round culvert	Yes
178	Milton	Milton Ck	County	Pittsburg Rd	Round culvert	Yes
179	Milton	Milton Ck	Unknown	Unknown	Round culvert	Yes
180	Milton	Milton Ck	County	Canaan Rd	Round culvert	No
181	Milton	Milton Ck	County	Canaan Rd	Round culvert	Yes
183	Milton	Milton Ck	County	Pinkney Rd	Bridge	No
184	Milton	Milton Ck	Unknown	Unknown	Other	No
185	Milton	Milton Ck	Unknown	Unknown	Bridge	No
186	Milton	Unknown	Unknown	Unknown	Round culvert	Yes
187	Milton	Milton Ck	Unknown	Unknown	Round culvert	Yes
189	Milton	Dart Ck	County	Gensman Rd	Round culvert	No
190	Milton	Dart Ck	Unknown	Unknown	Round culvert	No
191	Milton	Dart Ck	County	Barger Rd	Round culvert	Yes
192	Milton	Dart Ck	Unknown	Unknown	Round culvert	Yes

[1] **Phase I Barrier = Does not meet ODFW design criteria and considered a potential barrier**

Table 5: Selected Phase I Survey Data (continued)

Survey ID No.	Sub-watershed	Stream Name	Crossing Owner	Road Name	General Crossing Type	Phase I Barrier[1]
193	Milton	Dart Ck	Unknown	Unknown	Round culvert	Yes
194	Milton	Dart Ck	Unknown	Unknown	Round culvert	No
195	Milton	Dart Ck	Unknown	Unknown	Round culvert	Yes
196	Milton	Dart Ck	Unknown	Unknown	Round culvert	No
197	Milton	Dart Ck	Unknown	Unknown	Round culvert	Yes
198	Milton	Dart Ck	Unknown	Unknown	Round culvert	No
199						
200						
201						
202	Milton	Unknown	County	Dart Ck Rd	Round culvert	No
203	Milton	Dart Ck	Unknown	Unknown	Round culvert	No
204	Milton	Dart Ck	Unknown	Unknown	Round culvert	No
205	Milton	Dart Ck	Unknown	Unknown	Round culvert	Yes
206	Scappoose	Raymond Ck	Unknown	Unknown	Bridge	No
207	Scappoose	Raymond Ck	Unknown	Unknown	Bridge	No
208	Scappoose	Raymond Ck	Unknown	Baker Rd	Round culvert	No
209	Scappoose	Raymond Ck	Unknown	Baker Rd	Bridge	No
210	Scappoose	Raymond Ck	Unknown	Unknown	Round culvert	Yes
211						
212	Scappoose	Raymond Ck	Unknown	Unknown	Bridge	No
213	Scappoose	Raymond Ck	Unknown	Unknown	Bridge	No
214	Scappoose	Raymond Ck	Unknown	Unknown	Bridge	No
215	Scappoose	South Scappoose Ck	Unknown	Unknown	Bridge	No
216	Scappoose	Raymond Ck	Unknown	Unknown	Bridge	No
217	Honeyman	Honeyman Ck	County	Filbert Ln	Round culvert	No
218	Honeyman	Honeyman Ck	County	Oester Rd	Round culvert	No
220	Honeyman	Honeyman Ck	Unknown	Unknown	Round culvert	Yes

[1] **Phase I Barrier = Does not meet ODFW design criteria and considered a potential barrier**

Table 5: Selected Phase I Survey Data (continued)

Survey ID No.	Sub-watershed	Stream Name	Crossing Owner	Road Name	General Crossing Type	Phase I Barrier[1]
221						
222	Honeyman	Honeyman Ck	County	Stonebrook Rd	Bridge	No
223	Honeyman	Honeyman Ck	Unknown	Unknown	Bridge	No
224	Honeyman	Sly Ck	Hancock	Unknown	Round culvert	Yes
225	Honeyman	Honeyman Ck	Unknown	Unknown	Bridge	No
227	Honeyman	Unknown	County	Slavens Rd	Round culvert	Yes
229	McNulty	Warren Ck	County	Old Portland Rd	Box culvert	Yes
230	Honeyman	Unknown	County	Tarbell Rd	Round culvert	Yes
231	Scappoose	Raymond Ck	Unknown	Unknown	Round culvert	Yes
232	Scappoose	South Scappoose Ck	Unknown	Unknown	Bridge	No
233	Scappoose	South Scappoose Ck	Unknown	Unknown	Bridge	No
234	Jackson	Jackson Ck	County	Johnson Landing Rd	Round culvert	Yes
235	Jackson	Jackson Ck	Unknown	Unknown	Other	Yes
236	Jackson	Jackson Ck	Unknown	Unknown	Bridge	No
237	Scappoose	Salt Ck	County	Mckay Rd	Bridge	No
238	Scappoose	Salt Ck	County	Mckay Rd	Round culvert	Yes
239	Scappoose	Salt Ck	County	Mckay Rd	Bridge	No
240	Scappoose	Salt Ck	Hancock	R 072	Round culvert	Yes
241	Scappoose	Wolf Ck	Unknown	Unknown	Round culvert	Yes
242						
243						
244	Scappoose	South Scappoose Ck	Unknown	Unknown	Bridge	No
245	Scappoose	South Scappoose Ck	Unknown	Unknown	Bridge	No
246	Milton	Salmonberry Ck	Unknown	Unknown	Dam	Yes
247	Milton	Salmonberry Ck	Unknown	Unknown	Round culvert	Yes
248	Milton	Unknown	Unknown	Unknown	Other	Yes
249	Milton	Perry Ck	County	Unknown	Dam	Yes

[1] **Phase I Barrier = Does not meet ODFW design criteria and considered a potential barrier**

Table 5: Selected Phase I Survey Data (continued)

Survey ID No.	Sub-watershed	Stream Name	Crossing Owner	Road Name	General Crossing Type	Phase I Barrier[1]
250	Milton	Milton Ck	Unknown	Unknown	Dam	Yes
251	Honeyman	Honeyman Ck	Unknown	Unknown	Round culvert	Yes
252	Scappoose	Lizzie Ck	Unknown	Unknown	Bridge	No
253	Milton	Milton Ck	Unknown	Unknown	Dam	Yes
254	Milton	Cox Ck	Hancock	Unknown	Round culvert	Yes
255					0	
256					0	
257	Scappoose	Alder Ck	Unknown	Unknown	Round culvert	No
258	Honeyman	Unknown	Unknown	Unknown	Round culvert	Yes
259	Honeyman	Honeyman Ck	Unknown	Unknown	Round culvert	Yes
260	Honeyman	Unknown	Unknown	Unknown	Round culvert	Yes
261	Scappoose	Unknown	Unknown	Unknown	Round culvert	Yes
262	Honeyman	Honeyman Ck	Unknown	Unknown	Round culvert	Yes
263	Honeyman	Scappoose Bay	Unknown	Unknown	Bridge	No
264	Scappoose	Alder Ck	Hancock	Crown Z Logging Rd	Round culvert	Yes
265	Scappoose	Lizzie Ck	Unknown	Unknown	Round culvert	No
266	Scappoose	Raymond Ck	Unknown	Unknown	Bridge	No
267	Scappoose	North Scappoose Ck	Unknown	Unknown	Bridge	No
268	Scappoose	South Scappoose Ck	Unknown	Unknown	Bridge	No
269					0	
270	Milton	Cox Ck	Unknown	Unknown	Bridge	No
271	Milton	Cox Ck	County	Brooks Rd	Round culvert	Yes
272	Milton	Salmon Ck	Unknown	Unknown	Other	No
273	Milton	Dart Ck	Unknown	Unknown	Bridge	No
274					0	
275					0	
276	McNulty	McNulty Ck	Unknown	Unknown	Bridge	No

[1] Phase I Barrier = Does not meet ODFW design criteria and considered a potential barrier

Table 5: Selected Phase I Survey Data (continued)

Survey ID No.	Sub-watershed	Stream Name	Crossing Owner	Road Name	General Crossing Type	Phase I Barrier[1]
277	Milton	Milton Ck	NA	Na	Dam	Yes
278	Milton	Perry Ck	Unknown	Unknown	Round culvert	No
279	Milton	Unknown	Unknown	Unknown	Round culvert	Yes
280	Milton	Unknown	Unknown	Unknown	Round culvert	Yes
281	Milton	Unknown	Unknown	Unknown	Round culvert	Yes
282	Scappoose	Mclafferty Ck	Unknown	Unknown	Round culvert	No
283	Scappoose	Cedar Ck	Unknown	Unknown	Round culvert	Yes
284	Scappoose	North Scappoose Ck	Unknown	Unknown	Bridge	No
285	Scappoose	North Scappoose Ck	Unknown	Unknown	Bridge	No
286	Scappoose	Mollenhour Ck	Hancock	Old Crown Z Logging Rd	Round culvert	Yes
287	Scappoose	North Scappoose Ck	Unknown	Old Mill Rd	Bridge	No
288	Scappoose	Seircks Ck	County	Siercks Rd	Round culvert	Yes
289	Scappoose	Siercks Ck	Unknown	Unknown	Bridge	No
290	Scappoose	No Name Ck	Unknown	Unknown	Round culvert	Yes
291	Scappoose	Brush Ck			0	
292	Honeyman	Honeyman Ck	Unknown	Unknown	Bridge	No
293	Honeyman	Honeyman Ck	Unknown	Unknown	Round culvert	Yes
294	Scappoose	South Scappoose Ck	Railroad	Railroad	Bridge	No
295					0	
296					0	
297	Scappoose	Salt Ck	Unknown	Under Farm	Round culvert	Yes
298	Scappoose	Mud Ck	Unknown	Under Farm	Round culvert	Yes
299	Scappoose	Wolf Ck	Unknown		Round culvert	Yes

[1] Phase I Barrier = Does not meet ODFW design criteria and considered a potential barrier

Table 6: Selected Phase II Survey Data

Crossing ID No.	Barrier type	No. culverts	X-ing material	Culvert width	Culvert length	Culvert % slope	Leap height
8	Round culvert	1	Corrugated metal	3.0	40	-0.02	0.00
10	Round culvert	1	Corrugated metal	6.0	40	2.15	2.05
11	Round culvert	1	Corrugated metal	8.0	35	1.26	0.75
16	Box culvert	1	Concrete	10.0	207	0.71	0.00
18	Box culvert	1	Concrete	6.0	266	1.31	0.00
19	Box culvert	1	Concrete	4.0	238	3.21	0.37
25	Dam	NA	Concrete	NA	NA	NA	18.50
28	Round culvert	1	Corrugated metal	5.0	57	6.18	3.93
30	Round culvert	1	Concrete	3.0	59	4.08	1.80
34	Dam	NA	Concrete	NA	NA	NA	7.11
36	Dam	NA	Concrete	NA	NA	NA	7.55
37	Dam	NA	Concrete	NA	NA	NA	0.90
38	Round culvert	1	Corrugated metal	3.8	35	5.43	1.30
40	Dam	NA	Concrete	NA	NA	NA	1.14
41	Dam	NA	Concrete	NA	NA	NA	1.95
46	Round culvert	1	Corrugated metal	4.0	39	-0.03	1.78
48	Round culvert	2	Corrugated metal	5.8	40	-0.04	1.51
49	Round culvert	2	Corrugated metal	5.7	36.5	0.88	3.31
51	Round culvert	1	Corrugated metal	3.0	40	5.50	3.32
55	Round culvert	1	Corrugated metal	5.0	48	7.08	3.74
56	Round culvert	1	Plastic	3.0	32	0.56	5.14
66	Round culvert	1	Corrugated metal	6.5	30.1	2.52	0.00
68	Round culvert	1	Corrugated metal	2.5	31	0.32	2.36
69	Round culvert	2	Concrete	4.0	40	2.35	1.30
70	Round culvert	2	Concrete	3.0	36.2	4.06	6.12
71	Round culvert	1	Corrugated metal	4.5	40	1.57	2.60
79	Round culvert	1	Corrugated metal	10.0	48	2.23	0.30
85	Round culvert	2	Corrugated metal	5.0	24	1.21	0.93
86	Round culvert	1	Corrugated metal	6.0	30.5	-1.80	0.93
87	Round culvert	1	Corrugated metal	5.5	20.3	2.22	0.48
88	Round culvert	1	Corrugated metal	6.0	38.5	3.51	0.00
89	Round culvert	2	Corrugated metal	4.0	40.2	1.84	1.36
91	Round culvert	1	Smooth metal	3.7	38.8	-2.89	0.00
101	Round culvert	1	Corrugated metal	6.0	26	2.50	0.14
102	Round culvert	1	Corrugated metal	6.0	56	0.00	0.00
103	Round culvert	1	Corrugated metal	6.1	54.6	1.03	0.00
105	Round culvert	1	Corrugated metal	4.0	36	1.11	0.78
107	Round culvert	1	Corrugated metal	6.0	22.1	1.49	0.02
108	Round culvert	1	Corrugated metal	4.8	46.5	0.19	0.00
109	Round culvert	1	Smooth metal	4.3	31.4	2.13	1.60

Table 6: Selected Phase II Survey Data (continued)

Crossing ID No.	Barrier type	No. culverts	X-ing material	Culvert width	Culvert length	Culvert % slope	Leap height
110	Round culvert	1	Corrugated metal	4.0	191.2	8.00	0.70
113	Dam	NA	Concrete	NA	NA	NA	2.29
116	Round culvert	1	Corrugated metal	6.0	46.5	3.85	0.01
118	Round culvert	1	Corrugated metal	11.5	82.5	0.99	0.80
122	Box culvert	1	Concrete	11.0	86.8	0.62	0.00
124	Dam	NA	Concrete	NA	NA	NA	2.17
129	Round culvert	1	Corrugated metal	5.5	40	-1.00	0.24
131	Round culvert	1	Concrete	3.0	45	1.64	0.00
132	Round culvert	1	Corrugated metal	3.5	40.5	0.77	0.00
133	Round culvert	2	Corrugated metal	8.0	30.1	1.40	1.47
134	Round culvert	1	Smooth metal	6.8	23.8	1.85	0.00
136	Round culvert	1	Corrugated metal	5.0	60.4	1.59	2.73
139	Round culvert	1	Corrugated metal	3.5	60	4.38	2.67
141	Round culvert	1	Corrugated metal	5.9	97.4	0.94	1.56
147	Round culvert	1	Corrugated metal	9.0	60.1	-0.47	0.42
148	Round culvert	1	Corrugated metal	6.0	48.7	2.09	0.00
150	Round culvert	1	Corrugated metal	6.0	47	0.30	0.71
151	Round culvert	1	Corrugated metal	4.0	39.7	1.86	1.21
152	Round culvert	1	Corrugated metal	4.0	50.3	4.31	1.74
153	Round culvert	1	Corrugated metal	3.0	54	5.63	4.09
154	Round culvert	1	Corrugated metal	4.2	24	1.79	0.00
155	Round culvert	1	Corrugated metal	9.0	63.4	3.15	0.00
156	Round culvert	1	Corrugated metal	6.0	49.5	3.09	0.48
160	Round culvert	2	Corrugated metal	4.8	15.8	0.89	0.43
165	Round culvert	1	Corrugated metal	3.5	38.5	1.66	0.10
166	Round culvert	1	Corrugated metal	3.0	31	1.00	0.06
171	Round culvert	1	Corrugated metal	5.1	20	4.35	0.17
175	Round culvert	1	Corrugated metal	4.0	39	0.56	0.00
176	Round culvert	1	Corrugated metal	6.5	48.5	-0.43	0.00
177	Round culvert	4	Smooth metal	2.0	14.3	-6.15	0.00
178	Round culvert	1	Corrugated metal	4.0	38.2	1.60	1.47
179	Round culvert	1	Corrugated metal	4.0	32.5	0.46	0.19
181	Round culvert	2	Corrugated metal	7.0	41	1.20	0.00
187	Round culvert	2	Plastic	3.0	20	3.35	0.37
191	Round culvert	1	Corrugated metal	6.0	28	1.29	0.00
192	Round culvert	1	Concrete	3.5	36	0.44	0.08
193	Round culvert	1	Corrugated metal	4.0	20.1	1.00	0.00
197	Round culvert	2	Corrugated metal	5.0	33.5	2.48	0.94
210	Round culvert	1	Corrugated metal	7.8	28.4	1.55	1.84
220	Round culvert	2	Smooth metal	3.5	20.5	0.83	1.49

Table 6: Selected Phase II Survey Data (continued)

Crossing ID No.	Barrier type	No. culverts	X-ing material	Culvert width	Culvert length	Culvert % slope	Leap height
224	Round culvert	1	Corrugated metal	2.5	62	2.29	1.17
229	Box culvert	1	Concrete	8.0	43.7	1.35	0.73
230	Round culvert	1	Corrugated metal	3.0	77	0.51	0.00
234	Round culvert	1	Corrugated metal	8.0	61	0.41	0.00
235	Box/tidegate	2	Concrete	4.0	53.2	0.10	15.00
238	Round culvert	1	Corrugated metal	6.0	20	2.55	0.79
240	Round culvert	1	Corrugated metal	5.0	79	3.37	1.69
241	Round culvert	1	Corrugated metal	3.5	36	5.44	0.36
249	Dam	NA	Concrete	NA	NA	NA	19.00
250	Dam	NA	Concrete	NA	NA	NA	0.00
251	Round culvert	1	Corrugated metal	7.0	29.8	1.38	1.96
253	Dam	NA	Concrete	NA	NA	NA	1.39
258	Round culvert	1	Corrugated metal	6.0	30	2.07	0.00
259	Round culvert	2	Corrugated metal	6.0	29	1.90	0.00
260	Round culvert	1	Corrugated metal	2.0	21	-1.05	0.00
261	Round culvert	1	Corrugated metal	2.0	28	0.75	0.00
262	Round culvert	1	Corrugated metal	2.0	26	2.23	0.00
264	Round culvert	1	Corrugated metal	7.5	101.2	2.27	0.60
271	Round culvert	1	Corrugated metal	4.6	34.2	-0.64	1.73
277	Dam	NA	Concrete	NA	NA	NA	1.81
279	Round culvert	1	Corrugated metal	3.0	30	2.47	0.35
280	Round culvert	1	Corrugated metal	3.0	40	2.98	1.83
281	Round culvert	1	Corrugated metal	3.5	20	0.65	0.48
283	Round culvert	1	Corrugated metal	4.9	54	6.78	1.81
286	Round culvert	1	Corrugated metal	4.0	169.5	5.63	2.65
290	Round culvert	1	Corrugated metal	5.0	16	-0.88	0.00
293	Round culvert	1	Corrugated metal	NA	NA	NA	0.50

Table 7: Selected Hydrologic Assessment Data

Barrier ID No.	Area (Acres)	Q_{LOW} cfs	Q_{HIGH} cfs	$Q_{2\text{-}YEAR}$ cfs	Q_{50} cfs	Q_{100} cfs
8	478.3	0.15	32.36	32.36	97.67	114.10
10	476.3	0.15	32.24	32.24	97.32	113.68
11	1047.1	0.33	47.52	63.97	194.64	227.38
16	3108.6	0.99	65.68	164.87	507.11	592.40
18	385.3	0.12	26.81	26.81	80.75	94.33
19	381.1	0.12	26.55	26.55	79.98	93.43
25	726.0	0.23	44.37	46.52	141.02	164.73
28	605.8	0.19	39.74	39.74	120.25	140.48
30	638.3	0.20	41.59	41.59	125.91	147.09
34	1902.4	0.60	55.36	107.55	329.18	384.54
36	1560.6	0.50	52.30	90.53	276.53	323.04
37	1557.9	0.49	52.27	90.39	276.11	322.55
38	293.0	0.09	21.12	21.12	63.46	74.13
40	3874.6	1.23	71.95	199.70	615.58	719.12
41	3872.5	1.23	71.93	199.61	615.29	718.77
46	772.7	0.25	44.84	49.11	148.97	174.02
48	859.1	0.27	45.69	53.86	163.53	191.04
49	859.1	0.27	45.69	53.86	163.53	191.04
51	385.3	0.12	26.81	26.81	80.75	94.33
55	413.0	0.13	28.48	28.48	85.84	100.28
56	283.3	0.09	20.52	20.52	61.61	71.97
66	403.6	0.13	27.91	27.91	84.12	98.26
68	305.5	0.10	21.91	21.91	65.83	76.91
69	316.5	0.10	22.59	22.59	67.92	79.34
70	674.2	0.21	43.62	43.62	132.12	154.35
71	637.3	0.20	41.53	41.53	125.74	146.89
79	2334.1	0.74	59.13	128.49	394.09	460.37
85	1808.8	0.57	54.53	102.93	314.88	367.84
86	1765.6	0.56	54.14	100.79	308.26	360.10
87	1761.3	0.56	54.10	100.58	307.60	359.33
88	1627.8	0.52	52.90	93.91	286.98	335.25
89	1534.9	0.49	52.06	89.23	272.52	318.35
91	1791.0	0.57	54.37	102.05	312.16	364.66
101	2268.0	0.72	58.56	125.32	384.25	448.87
102	2100.7	0.67	57.10	117.24	359.19	419.60
103	2100.7	0.67	57.10	117.24	359.19	419.60
105	903.3	0.29	46.13	56.26	170.91	199.66
107	1186.7	0.38	48.84	71.33	217.30	253.85
108	1187.4	0.38	48.85	71.37	217.42	253.98
109	780.4	0.25	44.92	49.54	150.27	175.55
110	600.2	0.19	39.42	39.42	119.27	139.33
113	4442.1	1.41	76.49	224.92	694.26	811.03

Table 7: Selected Hydrologic Assessment Data (continued)

Barrier ID No.	Area (Acres)	Q_{LOW} cfs	Q_{HIGH} cfs	Q_{2-YEAR} cfs	Q_{50} cfs	Q_{100} cfs
116	1936.4	0.61	55.66	109.22	334.35	390.58
118	1806.4	0.57	54.51	102.81	314.52	367.41
122	5967.7	1.89	88.34	290.79	900.24	1051.65
124	497.6	0.16	33.49	33.49	101.13	118.14
129	573.5	0.18	37.89	37.89	114.59	133.87
131	404.3	0.13	27.95	27.95	84.25	98.41
132	402.4	0.13	27.84	27.84	83.90	98.01
133	2074.2	0.66	56.87	115.95	355.20	414.94
134	2077.9	0.66	56.90	116.13	355.76	415.59
136	761.1	0.24	44.72	48.47	147.00	171.72
139	673.7	0.21	43.59	43.59	132.04	154.24
141	2905.0	0.92	63.98	155.44	477.77	558.12
147	1848.0	0.59	54.88	104.87	320.88	374.85
148	1903.5	0.60	55.37	107.60	329.35	384.74
150	1436.0	0.46	51.16	84.21	257.01	300.23
151	1123.6	0.36	48.24	68.02	207.10	241.93
152	676.2	0.21	43.73	43.73	132.47	154.75
153	507.8	0.16	34.09	34.09	102.96	120.27
154	1354.9	0.43	50.41	80.05	244.19	285.26
155	2513.6	0.80	60.67	137.05	420.64	491.38
156	1463.1	0.46	51.41	85.59	261.27	305.21
160	2293.5	0.73	58.78	126.55	388.05	453.31
165	660.1	0.21	42.82	42.82	129.69	151.50
166	657.3	0.21	42.67	42.67	129.20	150.94
171	1224.8	0.39	49.20	73.32	223.43	261.01
175	911.8	0.29	46.21	56.72	172.33	201.31
176	1012.9	0.32	47.19	62.15	189.04	220.83
177	1083.6	0.34	47.86	65.91	200.60	234.34
178	703.6	0.22	44.15	45.27	137.18	160.25
179	703.5	0.22	44.15	45.26	137.16	160.23
181	3937.1	1.25	72.45	202.50	624.31	729.31
187	611.5	0.19	40.07	40.07	121.25	141.64
191	1152.7	0.37	48.52	69.55	211.82	247.44
192	1008.1	0.32	47.14	61.90	188.25	219.91
193	1003.1	0.32	47.09	61.63	187.43	218.95
197	2560.5	0.81	61.07	139.27	427.54	499.44
210	2090.3	0.66	57.01	116.74	357.63	417.78
220	2116.3	0.67	57.24	118.00	361.54	422.35
224	447.6	0.14	30.54	30.54	92.14	107.63
229	392.7	0.12	27.26	27.26	82.11	95.93
230	379.4	0.12	26.45	26.45	79.66	93.06
234	1902.8	0.60	55.36	107.57	329.24	384.61

Table 7: Selected Hydrologic Assessment Data (continued)

Barrier ID No.	Area (Acres)	Q_{LOW} cfs	Q_{HIGH} cfs	$Q_{2\text{-}YEAR}$ cfs	Q_{50} cfs	Q_{100} cfs
235	1902.8	0.60	55.36	107.57	329.24	384.61
238	1402.4	0.44	50.85	82.49	251.71	294.04
240	995.4	0.32	47.02	61.22	186.16	217.47
241	409.4	0.13	28.26	28.26	85.18	99.51
249	631.6	0.20	41.21	41.21	124.75	145.73
250	18899.1	5.99	178.69	792.73	2482.65	2900.20
251	3107.2	0.99	65.67	164.81	506.91	592.17
253	6103.7	1.94	89.38	296.54	918.27	1072.71
258	734.7	0.23	44.46	47.00	142.50	166.47
259	42156.4	13.37	322.76	1593.13	5029.52	5875.43
260	0.3	0.00	0.05	0.05	0.15	0.17
261	0.4	0.00	0.07	0.07	0.19	0.22
262	42129.9	13.36	322.61	1592.26	5026.74	5872.18
264	2394.1	0.76	59.65	131.36	402.99	470.77
271	646.8	0.21	42.07	42.07	127.39	148.81
277	19109.3	6.06	180.07	800.39	2506.93	2928.57
279	442.6	0.14	30.24	30.24	91.23	106.57
280	425.1	0.13	29.20	29.20	88.05	102.86
281	663.5	0.21	43.02	43.02	130.28	152.19
283	1617.2	0.51	52.81	93.38	285.34	333.33
286	888.3	0.28	45.98	55.45	168.41	196.74
290	612.8	0.19	40.14	40.14	121.48	141.91
293	2862.0	0.91	63.62	153.43	471.54	550.84

Table 8: Selected Hydraulic Assessment Data

Barrier ID No.	Min. Depth In Culvert (ft)	Max. Velocity (ft/s)	Leap Height (ft)	Roadway Overtopping Depth	
				50-yr (ft)	100-yr (ft)
8	2.37	4.58	0.00	No Overtopping	0.04
10	0.26	6.22	2.05	No Overtopping	No Overtopping
11	0.03	8.82	0.75	No Overtopping	No Overtopping
16	0.24	5.56	0.00	No Overtopping	No Overtopping
18	0.02	7.96	0.00	No Overtopping	No Overtopping
19	0.02	11.84	0.37	No Overtopping	No Overtopping
25	0.09	3.75	18.50	No Overtopping	No Overtopping
28	0.10	10.91	3.93	No Overtopping	No Overtopping
30	0.09	14.13	1.80	0.08	0.20
34	0.06	6.02	7.11	No Overtopping	No Overtopping
36	0.03	3.7	7.55	No Overtopping	No Overtopping
37	0.05	4.2	0.90	No Overtopping	No Overtopping
38	0.06	6.91	1.30	No Overtopping	No Overtopping
40	0.14	2.9	1.14	No Overtopping	No Overtopping
41	0.09	4.2	1.95	No Overtopping	No Overtopping
46	0.11	3.57	1.78	0.11	0.24
48	0.03	7.01	1.51	No Overtopping	No Overtopping
49	0.03	7.04	3.31	No Overtopping	No Overtopping
51	0.09	9.77	3.32	0.12	0.19
55	0.08	10.39	3.74	No Overtopping	No Overtopping
56	0.08	7.4	5.14	No Overtopping	0.06
66	0.02	6.15	0.00	No Overtopping	No Overtopping
68	0.04	4.46	2.36	0.11	0.17
69	0.07	8.36	1.30	No Overtopping	No Overtopping
70	0.09	13.02	6.12	0.38	0.46
71	0.03	9.23	2.60	0.05	0.18
79	0.04	6.6	0.30	No Overtopping	No Overtopping
85	0.17	7.74	0.93	No Overtopping	No Overtopping
86	0.05	9.01	0.93	0.52	0.66
87	0.07	8.63	0.48	0.70	0.82
88	0.06	3.23	0.00	0.61	0.73
89	0.16	9.18	1.36	0.61	0.73
91	0.06	10.98	0.00	No Overtopping	No Overtopping
101	0.21	8.73	0.14	0.47	0.65
102	0.17	6.8	0.00	No Overtopping	No Overtopping
103	0.26	9.68	0.00	No Overtopping	No Overtopping
105	0.12	10.12	0.78	0.33	0.43
107	0.06	9.02	0.02	0.26	0.39
108	0.74	6.46	0.00	No Overtopping	No Overtopping
109	0.11	10.04	1.60	0.12	0.24
110	0.09	9.98	0.70	No Overtopping	No Overtopping
113	0.12	4.6	2.29	No Overtopping	No Overtopping

Table 8: Selected Hydraulic Assessment Data (continued)

Barrier ID No.	Min. Depth In Culvert (ft)	Max. Velocity (ft/s)	Leap Height (ft)	Roadway Overtopping Depth	
				50-yr (ft)	100-yr (ft)
116	0.20	7.43	0.01	0.33	0.50
118	0.03	7.63	0.80	No Overtopping	No Overtopping
122	0.09	4.62	0.00	No Overtopping	No Overtopping
124	0.24	5.2	2.17	No Overtopping	No Overtopping
129	0.09	3.95	0.24	No Overtopping	No Overtopping
131	1.13	2.89	0.00	0.09	0.17
132	2.38	7.36	0.00	No Overtopping	No Overtopping
133	0.04	8.89	1.47	0.18	0.39
134	0.48	9.2	0.00	No Overtopping	0.22
136	0.10	10.22	2.73	No Overtopping	No Overtopping
139	0.12	10.05	2.67	No Overtopping	0.02
141	0.20	3.36	1.56	No Overtopping	0.25
147	0.04	9.51	0.42	No Overtopping	No Overtopping
148	0.21	9.17	0.00	No Overtopping	0.27
150	0.04	10.06	0.71	0.40	0.53
151	0.14	10.05	1.21	0.25	0.38
152	0.11	10.5	1.74	No Overtopping	No Overtopping
153	0.10	11.04	4.09	0.10	0.20
154	0.47	8.08	0.00	0.52	0.64
155	0.06	9.2	0.00	No Overtopping	0.04
156	0.17	8.32	0.48	No Overtopping	0.20
160	0.24	9.66	0.43	0.34	0.53
165	0.15	6.04	0.10	0.31	0.39
166	0.11	9.46	0.06	0.39	0.46
171	0.14	5.19	0.17	0.23	0.36
175	1.29	4.05	0.00	0.27	0.37
176	0.29	9.98	0.00	No Overtopping	No Overtopping
177	0.10	3.81	0.00	0.41	0.51
178	0.11	7.76	1.47	0.22	0.31
179	0.11	11.33	0.19	0.24	0.33
181	0.46	4.82	0.00	1.01	1.22
187	0.08	10.75	0.37	0.32	0.39
191	0.76	10.19	0.00	0.34	0.45
192	0.13	10.12	0.08	0.23	0.35
193	0.22	8.31	0.00	0.41	0.51
197	0.23	7.85	0.94	0.72	0.89
210	0.06	10.84	1.84	0.20	0.41
220	0.23	7.06	1.49	0.67	0.82
224	0.09	3.74	1.17	0.15	0.23
229	0.02	1.1	0.73	No Overtopping	No Overtopping
230	0.16	8.18	0.00	No Overtopping	No Overtopping
234	0.52	9.22	0.00	No Overtopping	No Overtopping

Table 8: Selected Hydraulic Assessment Data (continued)

Barrier ID No.	Min. Depth In Culvert (ft)	Max. Velocity (ft/s)	Leap Height (ft)	Roadway Overtopping Depth	
				50-yr (ft)	100-yr (ft)
235	0.02	9.78	15.00	No Overtopping	No Overtopping
238	0.17	9	0.79	0.04	0.24
240	0.14	8.82	1.69	No Overtopping	No Overtopping
241	0.09	6.6	0.36	No Overtopping	No Overtopping
249	0.06	2.2	19.00	No Overtopping	No Overtopping
250	0.44	4.3	0.00	No Overtopping	No Overtopping
251	0.06	8.64	4.38	0.89	1.07
253	0.17	6.8	1.39	No Overtopping	No Overtopping
258	0.13	3.88	0.00	No Overtopping	No Overtopping
259	0.01	9.53	0.00	5.64	6.38
260	Full	9.41	0.00	No Overtopping	No Overtopping
261	Full	4.47	0.00	No Overtopping	No Overtopping
262	0.01	12.24	0.00	6.50	7.21
264	0.50	11.22	0.60	No Overtopping	No Overtopping
271	0.03	6.7	1.73	0.27	0.35
277	0.12	7.7	1.81	No Overtopping	No Overtopping
279	0.12	8.7	0.35	0.30	0.35
280	0.08	9.7	1.83	0.28	0.33
281	0.14	10.7	0.48	0.31	0.39
283	0.15	11.7	1.81	0.40	0.55
286	0.12	12.7	2.65	No Overtopping	No Overtopping
290	3.10	13.7	0.00	No Overtopping	0.10
293	0.0	6.7	0.50	No Overtopping	No Overtopping

Table 9: Selected Barrier Assessment Data

Barrier ID No.	Leap	Depth	Velocity
8	Not Barrier	Not Barrier	Partial
10	Partial	Partial	Complete
11	Partial	Complete	Complete
16	Not Barrier	Partial	Partial
18	Not Barrier	Complete	Complete
19	Not Barrier	Complete	Complete
25	Complete	Complete	Partial
28	Partial	Complete	Complete
30	Partial	Complete	Complete
34	Complete	Complete	Complete
36	Complete	Complete	Partial
37	Partial	Complete	Partial
38	Partial	Complete	Complete
40	Partial	Complete	Partial
41	Fish Ladder	Complete	Partial
46	Partial	Complete	Partial
48	Partial	Complete	Complete
49	Partial	Complete	Complete
51	Partial	Complete	Complete
55	Partial	Complete	Complete
56	Complete	Complete	Complete
66	Not Barrier	Complete	Complete
68	Partial	Complete	Partial
69	Partial	Complete	Complete
70	Complete	Complete	Complete
71	Partial	Complete	Complete
79	Not Barrier	Complete	Complete
85	Partial	Complete	Complete
86	Partial	Complete	Complete
87	Not Barrier	Complete	Complete
88	Not Barrier	Complete	Partial
89	Partial	Complete	Complete
91	Not Barrier	Complete	Complete
101	Not Barrier	Partial	Complete
102	Not Barrier	Complete	Complete
103	Not Barrier	Partial	Complete
105	Partial	Complete	Complete
107	Not Barrier	Complete	Complete
108	Not Barrier	Partial	Complete
109	Partial	Complete	Complete
110	Partial	Complete	Complete
113	Partial	Complete	Partial

Table 9: Selected Barrier Assessment Data (continued)

Barrier ID No.	Leap	Depth	Velocity
116	Not Barrier	Partial	Complete
118	Partial	Complete	Complete
122	Not Barrier	Complete	Partial
124	Partial	Complete	Partial
129	Not Barrier	Complete	Partial
131	Not Barrier	Not Barrier	Partial
132	Not Barrier	Not Barrier	Complete
133	Partial	Complete	Complete
134	Not Barrier	Partial	Complete
136	Partial	Complete	Complete
139	Partial	Complete	Complete
141	Partial	Partial	Partial
147	Not Barrier	Complete	Complete
148	Not Barrier	Partial	Complete
150	Partial	Complete	Complete
151	Partial	Complete	Complete
152	Partial	Complete	Complete
153	Complete	Complete	Complete
154	Not Barrier	Partial	Complete
155	Not Barrier	Complete	Complete
156	Not Barrier	Complete	Complete
160	Not Barrier	Partial	Complete
165	Not Barrier	Complete	Complete
166	Not Barrier	Complete	Complete
171	Not Barrier	Complete	Partial
175	Not Barrier	Not Barrier	Partial
176	Not Barrier	Partial	Complete
177	Not Barrier	Complete	Partial
178	Partial	Complete	Complete
179	Not Barrier	Complete	Complete
181	Not Barrier	Partial	Partial
187	Not Barrier	Complete	Complete
191	Not Barrier	Partial	Complete
192	Not Barrier	Complete	Complete
193	Not Barrier	Partial	Complete
197	Partial	Partial	Complete
210	Partial	Complete	Complete
220	Partial	Partial	Complete
224	Partial	Complete	Partial
229	Partial	Complete	Not Barrier
230	Not Barrier	Complete	Complete
234	Not Barrier	Partial	Complete

Table 9: Selected Barrier Assessment Data (continued)

Barrier ID No.	Leap	Depth	Velocity
235	Complete	Complete	Complete
238	Partial	Complete	Complete
240	Partial	Complete	Complete
241	Not Barrier	Complete	Complete
249	Complete	Complete	Partial
250	Not Barrier	Partial	Partial
251	Partial	Complete	Complete
253	Partial	Complete	Partial
258	Not Barrier	Complete	Partial
259	Not Barrier	Not Barrier	Complete
260	Not Barrier	Complete	Complete
261	Not Barrier	Complete	Partial
262	Not Barrier	Not Barrier	Complete
264	Partial	Complete	Complete
271	Partial	Partial	Complete
277	Partial	Partial	Partial
279	Not Barrier	Complete	Complete
280	Partial	Complete	Complete
281	Not Barrier	Complete	Complete
283	Partial	Complete	Complete
286	Partial	Complete	Complete
290	Not Barrier	Not Barrier	Complete
293	Not Barrier	Complete	Complete

Table 10: Selected Conceptual Design Data

Barrier ID No.	Crossing Type Design[1]	Crossing Geometry		Culvert Length (ft)
		Span (ft)	Rise (ft)	
8	Arch	14' 0"	6' 0"	40.00
10	Arch	16' 0"	8' 7"	40.00
11	Railspan Bridge	N/A	N/A	N/A
16	Baffle Retrofit	N/A	N/A	N/A
18	Baffle Retrofit	N/A	N/A	N/A
19	Baffle Retrofit	N/A	N/A	N/A
25	Fish Ladder	N/A	N/A	N/A
28	Arch	17'	5' 3"	57.00
30	Arch	17' 0"	5' 3"	59.00
34	Dam Removal	N/A	N/A	N/A
36	Fish Ladder	N/A	N/A	N/A
37	Weir Notch	N/A	N/A	N/A
38	Arch	11' 0"	3' 6"	35.00
40	Fish Ladder	N/A	N/A	N/A
41	Weir Notch	N/A	N/A	N/A
46	Arch	16' 0"	5' 3"	39.00
48	Arch	12' 0"	5' 0"	40.00
49	Culvert Removal	N/A	N/A	N/A
51	ALBC #34C	16' 0"	5' 3"	40.00
55	Arch	17' 0"	5' 3"	48.00
56	Arch	11' 0"	3' 6"	32.00
66	Arch	12' 0"	4' 1"	30.10
68	Arch	9' 0"	2' 11"	31.00
69	Arch	8' 0"	5' 0"	40.00
70	ALBC #15B	11' 0"	2' 10"	36.20
71	Arch	13' 0"	4' 1"	40.00
79	Arch	14' 0"	7' 0"	48.00
85	MP Pipe-Arch	10' 8"	6' 11"	24.00
86	ALBC #30E	17' 0"	3' 10"	30.50
87	Arch	14' 0"	6' 0"	20.30
88	Bridge	N/A	N/A	N/A

[1] **Crossing Type Design Legend:**

Arch: Corrugated Metal Arch
ALBC: Aluminium Box Culvert
MP Pipe-Arch: Multiplate Pipe Arch
Culvert: Culvert Removal
Dam: Dam Removal
Dam: Fish Ladder
Notch: Weir Notch in Dam Face
Bridge: Prestressed Concrete Bridge
Railspan Bridge: Flatcar Bridge
OK: No Modifications Required

Table 10: Selected Conceptual Design Data (continued)

Barrier ID No.	Crossing Type Design[1]	Crossing Geometry		Culvert Length (ft)
		Span (ft)	Rise (ft)	
89	Arch	12' 0"	6' 6"	40.20
91	Arch	14' 0"	7' 0"	38.80
101	Arch	12' 0"	7' 6"	26.00
102	Arch	14' 0"	7' 0"	56.00
103	Culvert Removal	N/A	N/A	N/A
105	Arch	14' 0"	7' 0"	36.00
107	Arch	14' 0"	5' 6"	22.10
108	MP Pipe-Arch	11' 5"	7' 3"	46.50
109	Arch	20' 0"	6' 4"	31.40
110	Arch	15' 0"	4' 8"	191.20
113	Dam Removal	N/A	N/A	N/A
116	CMP Pipe-Arch	11' 5"	7' 3"	46.50
118	Arch	14' 0"	5' 7"	82.50
122	Baffle Retrofit	N/A	N/A	N/A
124	Dam Removal	N/A	N/A	N/A
129	MP Pipe-Arch	8' 7"	5' 11"	45.00
131	MP Pipe-Arch	9' 9"	6' 7"	40.50
132	Arch	8' 0"	8' 0"	30.10
133	MP Pipe-Arch	11' 10"	7' 7"	23.80
134	Arch	12' 0"	6' 9"	60.40
136	Arch	11' 0"	3' 6"	60.00
139	Arch	15' 0"	4' 8"	97.40
141	Arch	15' 0"	7' 6"	60.10
147	Arch	14' 0"	8' 3"	48.70
148	Arch	12' 0"	8' 0"	47.00
150	MP Pipe-Arch	11' 5"	7' 3"	39.70
151	Arch	14' 0"	5' 6"	50.30
152	Arch	14' 0"	4' 8"	54.00
153	Arch	12' 0"	4' 1"	24.00
154	Arch	14' 0"	6' 0"	63.40
155	Arch	20' 0"	6' 4"	49.50
156	MP Pipe-Arch	11' 5"	7' 3"	15.80
160	Railspan Bridge	N/A	N/A	N/A
165	Railspan Bridge	N/A	N/A	N/A
166	Arch	10' 0"	3' 6"	20.00
171	Railspan Bridge	N/A	N/A	N/A
175	Arch	13' 0"	4' 1"	48.50
176	Arch	19' 0"	6' 4"	14.30
177	Railspan Bridge	N/A	N/A	N/A

[1] **See Crossing Type Design Legend, page 86.**

Table 10: Selected Conceptual Design Data (continued)

Barrier ID No.	Crossing Type Design[1]	Crossing Geometry		Culvert Length (ft)
		Span (ft)	Rise (ft)	
178	Railspan Bridge	N/A	N/A	N/A
179	Railspan Bridge	N/A	N/A	N/A
181	Arch	18' 0"	8' 0"	41.00
187	Arch	12' 0"	5' 0"	20.00
191	Bridge	N/A	N/A	N/A
192	Arch	14' 0"	5' 0"	36.00
193	Bridge	N/A	N/A	N/A
197	Arch	13' 0"	6' 9"	33.50
210	ALBC #21A	13' 0"	3' 0"	28.40
220	Bridge	N/A	N/A	N/A
224	Arch	14' 0"	4' 8"	62.00
229	Arch	8' 0"	6' 6"	43.70
230	Arch	10' 0"	3' 6"	77.00
234	Arch	13' 0"	6' 9"	61.00
235	Bridge	N/A	N/A	N/A
238	Arch	16' 0"	5' 3"	20.00
240	Arch	22' 0"	6' 11"	79.00
241	Arch	13' 0"	4' 1"	36.00
249	Dam Removal	N/A	N/A	N/A
250	Dam Removal	N/A	N/A	N/A
251	Railspan Bridge	N/A	N/A	N/A
253	Dam Removal	N/A	N/A	N/A
258	Arch	12' 0"	8' 0"	30.00
259	Railspan Bridge	N/A	N/A	N/A
260	Railspan Bridge	N/A	N/A	N/A
261	Railspan Bridge	N/A	N/A	N/A
262	Railspan Bridge	N/A	N/A	N/A
264	Culvert Removal	N/A	N/A	N/A
271	Arch	14' 0"	4' 8"	34.20
277	Culvert Removal	N/A	N/A	N/A
279	Arch	11' 0"	3' 6"	30.00
280	Arch	18' 0"	5' 9"	40.00
281	Bridge	N/A	N/A	N/A
283	Railspan Bridge	N/A	N/A	N/A
286	Culvert Removal	N/A	N/A	N/A
290	Railspan Bridge	N/A	N/A	N/A
293	Railspan Bridge	N/A	N/A	N/A

[1] See Crossing Type Design Legend, page 86.

Table 11: Selected Cost Estimate Data

Disclaimer: These cost estimates have been prepared for guidance in the evaluation and implementation of proposed construction. The final costs of the project will depend on actual labor, material costs, competitive market conditions, final project scope, implementation schedule, and other variables. As a result, the final costs may vary considerably from the estimates associated with this project. For this reason, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and funding.

Barrier ID No.	Crossing Type Design[1]	Materials ($)	Earthworks ($)	Grade Control ($)	Total Cost ($)
8	Arch	$18,360.00	$4,789.19	$0.00	$56,037.41
10	Arch	$17,440.00	$3,296.04	$0.00	$51,537.65
11	Railspan Bridge	$7,000.00	$5,378.34	$0.00	$26,160.75
16	Baffle Retrofit	$11,500.00	$0.00	$0.00	$31,050.00
18	Baffle Retrofit	$11,500.00	$0.00	$0.00	$31,050.00
19	Baffle Retrofit	$11,500.00	$0.00	$0.00	$31,050.00
25	Fish Ladder	$188,040.00	$0.00	$0.00	$290,000.00
28	Arch	$25,137.00	$6,056.91	$0.00	$76,046.73
30	Arch	$26,019.00	$10,349.75	$0.00	$84,223.47
34	Dam Removal	$5,000.00	$5,000.00	$0.00	$20,250.00
36	Fish Ladder	$68,440.00	$0.00	$0.00	$105,550.00
37	Weir Notch	$0.00	$0.00	$0.00	$500.00
38	Arch	$14,105.00	$1,945.46	$0.00	$40,709.87
40	Fish Ladder	$54,750.00	$0.00	$0.00	$84,440.00
41	Weir Notch	$0.00	$0.00	$0.00	$500.00
46	Arch	$17,004.00	$3,398.21	$0.00	$50,498.38
48	Arch	$17,520.00	$2,847.51	$20,700.00	$79,093.14
49	Culvert Removal	$0.00	$4,070.00	$0.00	$4,477.00
51	ALBC #34C	$20,680.00	$3,175.26	$0.00	$60,122.60
55	Arch	$21,168.00	$6,835.31	$0.00	$66,381.27
56	Arch	$12,896.00	$1,461.53	$0.00	$36,792.27
66	Arch	$12,431.30	$2,117.43	$0.00	$36,423.04
68	Arch	$12,152.00	$1,320.17	$0.00	$34,592.63
69	Arch	$16,120.00	$1,277.11	$24,150.00	$77,850.60
70	ALBC #15B	$9,194.80	$1,567.33	$0.00	$26,941.86

[1] **Legend:**

Arch: Corregated Metal Arch
ALBC: Aluminium Box Culvert
MP Pipe-Arch: Multiplate Pipe Arch
Culvert: Culvert Removal
Dam: Dam Removal
Dam: Fish Ladder
Notch: Weir Notch in Dam Face
Bridge: Prestressed Concrete Bridge
Railspan Bridge: Flatcar Bridge
OK: No Modifications Required

Table 11: Selected Cost Estimate Data (continued)

Barrier ID No.	Crossing Type Design[1]	Materials ($)	Earthworks ($)	Grade Control ($)	Total Cost ($)
71	Arch	$16,680.00	$2,611.75	$0.00	$48,561.86
79	Arch	$22,032.00	$5,054.21	$17,250.00	$89,597.08
85	MP Pipe-Arch	$4,800.00	$1,591.64	$17,250.00	$38,396.22
86	ALBC #30E	$18,544.00	$2,124.08	$0.00	$52,936.31
87	Arch	$8,729.00	$1,202.97	$13,800.00	$43,822.31
88	Bridge	$71,439.61	$195.62	$0.00	$193,151.03
89	Arch	$17,085.00	$2,388.02	$20,700.00	$77,298.33
91	Arch	$17,809.20	$4,014.48	$13,800.00	$72,134.38
101	Arch	$11,388.00	$1,856.22	$13,800.00	$51,883.49
102	Arch	$25,704.00	$7,290.57	$6,900.00	$88,558.07
103	Culvert Removal	$0.00	$17,600	$0.00	$19,360.00
105	Arch	$15,480.00	$2,210.14	$17,250.00	$68,067.18
107	Arch	$9,503.00	$1,487.12	$10,350.00	$41,638.21
108	MP Pipe-Arch	$9,579.00	$4,206.81	$0.00	$31,542.50
109	Arch	$15,291.80	$3,222.91	$0.00	$45,638.79
110	Arch	$81,833.60	$242,486.95	$0.00	$548,308.10
113	Dam Removal	$5,000.00	$0.00	$0.00	$13,500.00
116	CMP Pipe-Arch	$9,579.00	$3,415.05	$20,700.00	$58,418.61
118	Arch	$35,722.50	$10,275.22	$0.00	$110,322.30
122	Baffle Retrofit	$5,000.00	$0.00	$0.00	$13,500.00
124	Dam Removal	$5,000.00	$0.00	$0.00	$13,500.00
129	MP Pipe-Arch	$7,740.00	$2,020.63	$10,350.00	$37,598.35
131	MP Pipe-Arch	$7,897.50	$2,575.06	$0.00	$24,799.58
132	Arch	$12,130.30	$1,342.06	$0.00	$34,563.60
133	MP Pipe-Arch	$5,117.00	$1,904.78	$20,700.00	$44,332.35
134	Arch	$26,636.40	$6,137.46	$0.00	$80,203.84
136	Arch	$24,180.00	$6,430.45	$0.00	$73,967.11
139	Arch	$41,687.20	$19,481.26	$0.00	$138,855.14
141	Arch	$27,886.40	$7,127.45	$27,600.00	$122,175.34
147	Arch	$22,353.30	$5,794.63	$10,350.00	$82,149.16
148	Arch	$19,975.00	$2,698.72	$10,350.00	$71,548.27
150	MP Pipe-Arch	$8,178.20	$3,393.32	$13,800.00	$45,292.12
151	Arch	$22,031.40	$5,036.91	$20,700.00	$94,229.61
152	Arch	$22,950.00	$5,599.08	$0.00	$69,523.76
153	Arch	$9,912.00	$1,904.19	$0.00	$29,333.06
154	Arch	$29,100.60	$6,337.64	$6,900.00	$96,442.43
155	Arch	$23,760.00	$6,182.00	$0.00	$72,497.70
156	MP Pipe-Arch	$3,254.80	$861.75	$31,050.00	$51,868.82
160	Railspan Bridge	$7,000.00	$189.30	$0.00	$19,155.55
165	Railspan Bridge	$7,000.00	$104.74	$0.00	$19,041.41
166	Arch	$7,960.00	$919.57	$0.00	$22,733.42

[1] See Crossing Type Legend, page 89.

Table 11: Selected Cost Estimate Data (continued)

Barrier ID No.	Crossing Type Design[1]	Materials ($)	Earthworks ($)	Grade Control ($)	Total Cost ($)
171	Railspan Bridge	$7,000.00	$295.24	$0.00	$19,298.57
175	Arch	$20,224.50	$3,697.54	$0.00	$59,597.83
176	Arch	$7,007.00	$1,628.49	$0.00	$21,117.37
177	Railspan Bridge	$7,000.00	$221.47	$0.00	$19,198.98
178	Railspan Bridge	$7,000.00	$175.25	$0.00	$19,136.59
179	Railspan Bridge	$7,000.00	$136.19	$0.00	$19,083.86
181	Arch	$19,311.00	$5,091.38	$13,800.00	$77,643.06
187	Arch	$8,260.00	$997.67	$13,800.00	$42,278.86
191	Bridge	$43,997.16	$205.70	$0.00	$119,070.03
192	Arch	$16,524.00	$4,559.14	$10,350.00	$64,742.14
193	Bridge	$20,568.24	$141.97	$0.00	$55,725.91
197	Arch	$14,773.50	$2,949.97	$0.00	$43,870.90
210	ALBC #21A	$8,094.00	$2,033.68	$0.00	$24,599.27
220	Bridge	$22,034.49	$182.88	$0.00	$59,740.01
224	Arch	$26,350.00	$7,179.13	$0.00	$80,836.83
229	Arch	$17,611.10	$4,008.81	$0.00	$52,961.87
230	Arch	$30,646.00	$8,399.90	$0.00	$94,084.07
234	Arch	$27,206.00	$8,345.15	$0.00	$84,722.15
235	Bridge	$82,880.00	$958.22	$0.00	$225,069.60
238	Arch	$8,720.00	$1,752.37	$0.00	$25,909.70
240	Arch	$38,473.00	$22,744.61	$0.00	$134,582.33
241	Arch	$15,516.00	$3,141.96	$0.00	$46,134.85
249	Dam Removal	$5,000.00	$0.00	$0.00	$13,500.00
250	Dam Removal	$5,000.00	$0.00	$0.00	$13,500.00
251	Railspan Bridge	$7,000.00	$200.37	$0.00	$19,170.50
253	Dam Removal	$5,000.00	$0.00	$0.00	$13,500.00
258	Arch	$13,140.00	$2,481.69	$0.00	$38,828.29
259	Railspan Bridge	$7,000.00	$3,971.00	$0.00	$24,260.85
260	Railspan Bridge	$7,000.00	$2,068.00	$0.00	$21,691.80
261	Railspan Bridge	$7,000.00	$2,442.00	$0.00	$22,196.70
262	Railspan Bridge	$7,000.00	$3,135.00	$0.00	$23,132.25
264	Culvert Removal	$0.00	$127,600.00	$0.00	$140,360.00
271	Arch	$14,535.00	$1,491.20	$0.00	$41,257.63
277	Dam Removal	$5,000.00	$0.00	$0.00	$13,500.00
279	Arch	$12,090.00	$878.85	$0.00	$33,829.45
280	Arch	$19,200.00	$2,160.62	$0.00	$54,756.84
281	Bridge	$20,659.59	$113.54	$0.00	$55,934.18
283	Railspan Bridge	$176,976.84	$664.57	$0.00	$19,797.17
286	Culvert Removal	$0.00	$544,500.00	$0.00	$598,95.00
290	Railspan Bridge	$14,000.00	$174.53	$0.00	$38,132.82
293	Railspan Bridge	$14,000.00	$0.00	$0.00	$37,800.00

[1] **See Crossing Type Legend, page 89.**

Table 12: Selected Upstream Habitat Data

Upstream Habitat (miles)							
Survey #	All streams	Fish-bearing	Anadromous	All + Fish-bearing	Refugia Score	Habitat Index[1]	Barrier Call
8	1.36	0.94	0.00	2.30	1	2.30	Partial
10	1.23	0.97	0.00	2.20	1	2.20	Complete
11	3.34	1.70	1.70	5.04	2	10.09	Complete
16	9.93	6.02	6.02	15.96	1	15.96	Partial
18	1.06	1.06	0.00	2.12	1	2.12	Complete
19	0.80	0.51	0.00	1.31	1	1.31	Complete
25	2.57	0.95	0.95	3.51	2	7.03	Complete
28	2.23	0.59	0.59	2.81	2	5.63	Complete
30	2.64	0.00	0.00	2.64	1	2.64	Complete
34	7.97	1.94	1.94	9.92	1	9.92	Complete
36	4.21	1.55	0.57	5.76	2	11.52	Complete
37	4.18	1.52	0.54	5.70	2	11.40	Partial
38	1.21	0.55	0.00	1.76	2	3.52	Complete
40	13.47	7.10	2.77	20.56	2	41.13	Partial
41	13.46	7.09	2.76	20.54	2	41.09	Partial
46	2.55	0.04	0.00	2.59	1	2.59	Partial
48	3.03	0.49	0.00	3.53	1	3.53	Complete
49	3.04	0.50	0.00	3.54	1	3.54	Complete
51	1.17	0.93	0.00	2.10	2	4.19	Complete
55	1.79	1.25	0.00	3.04	2	6.08	Complete
56	1.11	1.01	0.00	2.12	2	4.25	Complete
66	1.67	0.00	0.00	1.67	1	1.67	Complete
68	0.98	0.07	0.00	1.05	1	1.05	Partial
69	1.01	0.10	0.00	1.11	1	1.11	Complete
70	2.17	0.82	0.56	2.99	1	2.99	Complete
71	2.14	0.60	0.33	2.73	1	2.73	Complete
79	5.79	3.33	2.45	9.11	2	18.23	Complete
85	4.33	2.45	1.87	6.78	2	13.55	Complete
86	4.20	2.32	1.74	6.52	2	13.03	Complete
87	4.12	2.24	1.66	6.36	2	12.71	Complete
88	4.00	2.08	1.51	6.08	2	12.16	Partial
89	3.77	1.88	1.31	5.65	2	11.30	Complete
91	4.22	2.33	1.76	6.55	2	13.10	Complete
101	8.20	2.60	0.00	10.81	2	21.61	Complete
102	6.44	3.51	1.93	9.95	2	19.90	Complete
103	6.44	3.51	1.93	9.95	2	19.90	Complete
105	3.21	1.69	0.00	4.90	2	9.79	Complete
107	4.82	0.91	0.00	5.73	2	11.45	Complete
108	4.83	0.92	0.00	5.75	2	11.50	Complete
109	3.28	1.39	0.00	4.66	2	9.33	Complete

[1] **Habitat Index formula = (Upstream total length (all streams) + Fish-bearing length) * (Refugia score)**

Table 12: Selected Upstream Habitat Data (continued)

Upstream Habitat (miles)							
Survey #	All streams	Fish-bearing	Anadromous	All + Fish-bearing	Refugia Score	Habitat Index[1]	Barrier Call
110	2.22	0.67	0.00	2.89	2	5.78	Complete
113	14.65	5.81	5.81	20.47	1	20.47	Partial
116	5.93	2.97	1.39	8.89	2	17.79	Complete
118	5.57	2.58	1.00	8.15	2	16.30	Complete
122	18.26	7.52	7.52	25.78	1	25.78	Partial
124	14.49	5.65	5.65	20.13	1	20.13	Partial
129	1.63	1.11	1.11	2.74	1	2.74	Partial
131	1.60	1.00	1.00	2.60	1	2.60	Partial
132	1.58	0.97	0.97	2.56	1	2.56	Complete
133	7.56	2.00	2.00	9.56	1	9.56	Complete
134	7.65	2.08	2.08	9.73	1	9.73	Complete
136	2.13	0.47	0.47	2.61	1	2.61	Complete
139	2.57	1.76	0.00	4.33	1	4.33	Complete
141	8.80	5.04	1.82	13.84	1	13.84	Partial
147	4.57	2.83	1.57	7.40	2	14.79	Complete
148	4.78	3.03	1.77	7.81	2	15.62	Complete
150	3.18	2.40	1.12	5.58	2	11.15	Complete
151	2.35	1.69	0.43	4.04	2	8.08	Complete
152	1.93	1.21	0.00	3.14	2	6.28	Complete
153	1.36	0.69	0.00	2.05	2	4.10	Complete
154	3.07	2.23	0.97	5.29	2	10.59	Complete
155	5.32	4.12	2.61	9.44	2	18.87	Complete
156	3.59	2.62	1.38	6.21	2	12.41	Complete
160	5.00	3.80	2.29	8.79	2	17.59	Complete
165	1.02	0.85	0.00	1.87	1	1.87	Complete
166	0.98	0.82	0.00	1.80	1	1.80	Complete
171	3.73	1.67	0.00	5.40	1	5.40	Partial
175	3.39	2.29	0.00	5.68	1	5.68	Partial
176	3.66	2.57	0.00	6.23	1	6.23	Complete
177	3.95	2.85	0.00	6.80	1	6.80	Partial
178	1.35	1.35	0.00	2.70	1	2.70	Complete
179	1.32	1.32	0.00	2.64	1	2.64	Complete
181	12.21	9.53	1.86	21.74	1	21.74	Partial
187	1.51	1.51	0.00	3.03	1	3.03	Complete
191	3.50	0.84	0.00	4.34	1	4.34	Complete
192	2.46	1.20	0.00	3.66	1	3.66	Complete
193	2.43	1.25	0.00	3.68	1	3.68	Complete
197	7.92	4.16	0.94	12.08	1	12.08	Complete

[1] **Habitat Index formula = (Upstream total length (all streams) + Fish-bearing length) * (Refugia score)**

Table 12: Selected Upstream Habitat Data (continued)

Upstream Habitat (miles)							
Survey #	All streams	Fish-bearing	Anadromous	All + Fish-bearing	Refugia Score	Habitat Index[1]	Barrier Call
210	8.33	3.14	2.04	11.47	2	22.94	Complete
220	6.90	3.91	3.91	10.82	1	10.82	Complete
224	1.04	0.47	0.47	1.51	1	1.51	Partial
229	0.85	0.56	0.00	1.41	1	1.41	Partial
230	0.98	0.98	0.00	1.95	1	1.95	Complete
234	8.05	2.02	2.02	10.07	1	10.07	Complete
235	8.75	2.74	2.74	11.48	1	11.48	Complete
238	4.99	2.45	0.00	7.45	1	7.45	Complete
240	3.67	1.75	0.00	5.41	1	5.41	Complete
241	1.00	0.69	0.00	1.69	1	1.69	Complete
249	2.38	1.55	0.00	3.93	1	3.93	Complete
250	53.67	39.18	20.67	92.85	2	185.70	Partial
251	9.81	5.91	5.91	15.72	1	15.72	Complete
253	17.83	13.54	4.27	31.37	1	31.37	Complete
258	2.14	2.14	0.97	4.28	2	8.55	Partial
259	12.24	7.69	7.69	19.92	2	39.85	Complete
260	0.74	0.74	0.74	1.48	2	2.95	Complete
261	0.62	0.62	0.62	1.24	2	2.47	Partial
262	11.77	7.23	7.23	19.01	2	38.02	Complete
264	6.02	3.56	2.69	9.59	2	19.17	Complete
271	1.40	1.03	0.63	2.43	2	4.85	Complete
277	56.79	41.81	21.46	98.60	2	197.20	Complete
279	0.63	0.47	0.00	1.10	1	1.10	Complete
280	0.57	0.43	0.00	1.00	1	1.00	Complete
281	1.08	0.91	0.00	1.99	1	1.99	Complete
283	5.37	2.43	0.85	7.80	2	15.60	Complete
286	3.02	1.50	0.00	4.52	2	9.04	Complete
290	1.32	1.32	0.15	2.64	1	2.64	Complete
293	8.94	5.63	5.63	14.57	1	14.57	Complete

[1] **Habitat Index formula = (Upstream total length (all streams) + Fish-bearing length) * (Refugia score)**

APPENDIX E: SUB-WATERSHED BARRIER PRIORITIZATION SUMMARIES

Table 13: Scappoose Sub-watershed Barrier Prioritization Summary
Table 14: Milton Sub-watershed Barrier Prioritization Summary
Table 15: McNulty Sub-watershed Barrier Prioritization Summary
Table 16: Jackson Sub-watershed Barrier Prioritization Summary
Table 17: Honeyman Sub-watershed Barrier Prioritization Summary

Table 13: Scappoose Sub-watershed Barrier Prioritization Summary

Rank-ing	Crossing ID No.	Sub-watershed	Barrier summary	Habitat index	Stream	Road	Barrier owner	Barrier type	Barrier condition	Design type	Total cost
1	210	Scappoose	Complete	22.94	Raymond Ck	Unknown	Unknown	Round culvert	Poor	Aluminium box culvert #21A	$24,599.27
2	101	Scappoose	Complete	21.61	Lizzie Ck	Unknown	Unknown	Round culvert	Fair-Poor	Corrugated metal arch	$51,883.49
3	102	Scappoose	Complete	19.90	Cedar Ck	Vernonia Hwy	County	Round culvert	Fair-Poor	Corrugated metal arch	$88,558.07
4	103	Scappoose	Complete	19.90	Cedar Ck	Crown Z Logging Rd	Unknown	Round culvert	Fair-Poor	Culvert Removal	$19,360.00
5	264	Scappoose	Complete	19.17	Alder Ck	Crown Z Logging Rd	Hancock	Round culvert	Good-Fair	Culvert Removal	$140,360.00
6	79	Scappoose	Complete	18.23	Alder Ck	Cater Rd	County	Round culvert	Fair-Poor	Corrugated metal arch	$89,597.08
7	116	Scappoose	Complete	17.79	Cedar Ck	Cedar Ck Rd	County	Round culvert	Fair-Poor	Multiplate Pipe Arch	$58,418.61
8	118	Scappoose	Complete	16.30	Cedar Ck	Cedar Ck Rd	County	Round culvert	Good-Fair	Corrugated metal arch	$110,322.30
9	283	Scappoose	Complete	15.60	Cedar Ck	Unknown	Unknown	Round culvert	Fair-Poor	Railspan Bridge	$19,797.17
10	85	Scappoose	Complete	13.55	Alder Ck	Unknown	Unknown	Round culvert	Fair-Poor	Multiplate Pipe Arch	$38,396.22
11	91	Scappoose	Complete	13.10	Alder Ck	Unknown	Unknown	Round culvert	Poor	Corrugated metal arch	$72,134.38
12	86	Scappoose	Complete	13.03	Alder Ck	Alder Ck Rd	County	Round culvert	Good-Fair	Aluminium box culvert #30E	$52,936.31
13	87	Scappoose	Complete	12.71	Alder Ck	Unknown	Unknown	Round culvert	Fair-Poor	Corrugated metal arch	$43,822.31
14	36	Scappoose	Complete	11.52	Gourlay Ck	Unknown	City-Scap.	Dam	Good-Fair	Fish Ladder	$105,550.00
15	108	Scappoose	Complete	11.50	N. Scappoose Ck	Chapman Rd	County	Round culvert	Good-Fair	Multiplate Pipe Arch	$31,542.50
16	107	Scappoose	Complete	11.45	N. Scappoose Ck	Chapman Rd	County	Round culvert	Fair-Poor	Corrugated metal arch	$41,638.21
17	89	Scappoose	Complete	11.30	Alder Ck	Unknown	Unknown	Round culvert	Fair-Poor	Corrugated metal arch	$77,298.33
18	11	Scappoose	Complete	10.09	Lacey Ck	Unknown	Hancock	Round culvert	Good-Fair	Railspan Bridge	$26,160.75
19	105	Scappoose	Complete	9.79	Mollenhour Ck	Chapman Rd	County	Round culvert	Good-Fair	Corrugated metal arch	$68,067.18
20	109	Scappoose	Complete	9.33	Unknown	Unknown	Unknown	Round culvert	Poor	Corrugated metal arch	$45,638.79
21	286	Scappoose	Complete	9.04	Mollenhour Ck	Crown Z Logging Rd	Hancock	Round culvert	Good-Fair	Culvert Removal	$598,950.00
22	238	Scappoose	Complete	7.45	Salt Ck	Mckay Rd	County	Round culvert	Good-Fair	Corrugated metal arch	$25,909.70
23	25	Scappoose	Complete	7.03	Lacey Ck	Layton Rd	City-Scap.	Dam	Good-Fair	Fish Ladder	$290,000.00
24	55	Scappoose	Complete	6.08	S. Scappoose Ck	Unknown	Unknown	Round culvert	Good-Fair	Corrugated metal arch	$66,381.27
25	110	Scappoose	Complete	5.78	Mollenhour Ck	Vernonia Hwy	County	Round culvert	Good-Fair	Corrugated metal arch	$548,308.10
26	28	Scappoose	Complete	5.63	Lacey Ck	Unknown	Hancock	Round culvert	Good-Fair	Corrugated metal arch	$76,046.73
27	240	Scappoose	Complete	5.41	Salt Ck	R 072	Hancock	Round culvert	Good-Fair	Corrugated metal arch	$134,582.33
28	56	Scappoose	Complete	4.25	S. Scappoose Ck	Unknown	Unknown	Round culvert	Good-Fair	Corrugated metal arch	$36,792.27
29	51	Scappoose	Complete	4.19	Dooly Ck	Unknown	Unknown	Round culvert	Good-Fair	Aluminium box culvert #34C	$60,122.60
30	49	Scappoose	Complete	3.54	Alder Ck	Crown Z Logging Rd	Unknown	Round culvert	Poor	Culvert Removal	$4,477.00

Table 13: Scappoose Sub-watershed Barrier Prioritization Summary (continued)

Rank-ing	Crossing ID No.	Sub-watershed	Barrier summary	Habitat index	Stream	Road	Barrier owner	Barrier type	Barrier condition	Design type	Total cost
31	48	Scappoose	Complete	3.53	Alder Ck	Vernonia Hwy	County	Round culvert	Good-Fair	Corrugated metal arch	$79,093.14
32	38	Scappoose	Complete	3.52	Wf Gourlay Ck	Unknown	Unknown	Round culvert	Good-Fair	Corrugated metal arch	$40,709.87
33	70	Scappoose	Complete	2.99	Siercks Ck	Unknown	Unknown	Round culvert	Good-Fair	Aluminium box culvert #15B	$26,941.86
34	71	Scappoose	Complete	2.73	Siercks Ck	Unknown	Unknown	Round culvert	Good-Fair	Corrugated metal arch	$48,561.86
35	290	Scappoose	Complete	2.64	Unknown	Unknown	Unknown	Round culvert	Good-Fair	Railspan Bridge	$38,035.62
36	10	Scappoose	Complete	2.20	Wolf Ck	Dutch Canyon Rd	County	Round culvert	Good-Fair	Corrugated metal arch	$51,537.65
37	241	Scappoose	Complete	1.69	Wolf Ck	Unknown	Unknown	Round culvert	Fair-Poor	Corrugated metal arch	$46,134.85
38	66	Scappoose	Complete	1.67	Siercks Ck	Reid Rd	Unknown	Round culvert	Good-Fair	Corrugated metal arch	$36,423.04
39	69	Scappoose	Complete	1.11	Siercks Ck	Unknown	Unknown	Round culvert	Good-Fair	Corrugated metal arch	$77,850.60
40	40	Scappoose	Partial	41.13	S. Scappoose Ck	Unknown	City-Scap.	Dam	Good-Fair	Fish Ladder	$84,440.00
41	41	Scappoose	Partial	41.09	S. Scappoose Ck	Unknown	City-Scap.	Dam	Good-Fair	Weir Notch	$500.00
42	88	Scappoose	Partial	12.16	Alder Ck	Alder Ck Rd	County	Round culvert	Fair-Poor	Bridge	$193,151.03
43	37	Scappoose	Partial	11.40	Gourlay Ck	Unknown	City-Scap.	Dam	Good-Fair	Weir Notch	$500.00
44	46	Scappoose	Partial	2.59	Alder Ck	Nw Smith Rd	County	Round culvert	Poor	Corrugated metal arch	$50,498.38
45	261	Scappoose	Partial	2.47	Unknown	Unknown	Unknown	Round culvert	Poor	Railspan Bridge	$22,196.70
46	8	Scappoose	Partial	2.30	Mud Ck	Dutch Canyon Rd	County	Round culvert	Fair-Poor	Corrugated metal arch	$56,037.41
47	68	Scappoose	Partial	1.05	Siercks Ck	Armstrong Rd	County	Round culvert	Good-Fair	Corrugated metal arch	$34,592.63

Table 14: Milton Sub-watershed Barrier Prioritization Summary

Rank-ing	Crossing ID No.	Sub-watershed	Barrier summary	Habitat index	Stream	Road	Barrier owner	Barrier type	Barrier condition	Design type	Total cost
1	155	Milton	Complete	18.87	Cox Ck	Brooks Rd	County	Round culvert	Poor	Corrugated metal arch	$72,497.70
2	160	Milton	Complete	17.59	Cox Ck	Unknown	Unknown	Round culvert	Poor	Railspan Bridge	$19,155.55
3	148	Milton	Complete	15.62	Salmon Ck	Unknown	Unknown	Round culvert	Fair-Poor	Corrugated metal arch	$71,548.27
4	147	Milton	Complete	14.79	Salmon Ck	Brinn Rd	County	Round culvert	Good-Fair	Corrugated metal arch	$82,149.16
5	156	Milton	Complete	12.41	Cox Ck	Unknown	Unknown	Round culvert	Poor	Multiplate Pipe Arch	$51,868.82
6	197	Milton	Complete	12.08	Dart Ck	Unknown	Unknown	Round culvert	Fair-Poor	Corrugated metal arch	$43,870.90
7	150	Milton	Complete	11.15	Salmon Ck	Brinn Rd	County	Round culvert	Fair-Poor	Multiplate Pipe Arch	$45,292.12
8	154	Milton	Complete	10.59	Salmon Ck	Unknown	Unknown	Round culvert	Fair-Poor	Corrugated metal arch	$96,442.43
9	151	Milton	Complete	8.08	Salmon Ck	Unknown	Unknown	Round culvert	Fair-Poor	Corrugated metal arch	$94,229.61
10	152	Milton	Complete	6.28	Salmon Ck	Unknown	Hancock	Round culvert	Good-Fair	Corrugated metal arch	$69,523.76
11	176	Milton	Complete	6.23	Milton Ck	Pittsburg Rd	County	Round culvert	Good-Fair	Corrugated metal arch	$21,117.37
12	271	Milton	Complete	4.85	Cox Ck	Brooks Rd	County	Round culvert	Good-Fair	Corrugated metal arch	$41,257.63
13	191	Milton	Complete	4.34	Dart Ck	Barger Rd	County	Round culvert	Good-Fair	Bridge	$119,070.03
14	139	Milton	Complete	4.33	Perry Ck	Hanky Rd	County	Round culvert	Good-Fair	Corrugated metal arch	$138,855.14
15	153	Milton	Complete	4.10	Salmon Ck	Unknown	Hancock	Round culvert	Good-Fair	Corrugated metal arch	$29,333.06
16	249	Milton	Complete	3.93	Perry Ck	Unknown	City-St.Helen	Dam	Fair-Poor	Dam Removal	$13,500.00
17	193	Milton	Complete	3.68	Dart Ck	Unknown	Unknown	Round culvert	Poor	Bridge	$55,725.91
18	192	Milton	Complete	3.66	Dart Ck	Unknown	Unknown	Round culvert	Fair-Poor	Corrugated metal arch	$64,742.14
19	187	Milton	Complete	3.03	Milton Ck	Unknown	Unknown	Round culvert	Poor	Corrugated metal arch	$42,278.86
20	178	Milton	Complete	2.70	Milton Ck	Pittsburg Rd	County	Round culvert	Good-Fair	Railspan Bridge	$19,136.59
21	179	Milton	Complete	2.64	Milton Ck	Unknown	Unknown	Round culvert	Good-Fair	Railspan Bridge	$19,083.86
22	281	Milton	Complete	1.99	Unknown	Unknown	Unknown	Round culvert	Good-Fair	Bridge	$55,934.18
23	165	Milton	Complete	1.87	Unknown	Pittsburg Rd	County	Round culvert	Good-Fair	Railspan Bridge	$19,041.41
24	166	Milton	Complete	1.80	Unknown	Unknown	County	Round culvert	Good-Fair	Corrugated metal arch	$22,733.42
25	279	Milton	Complete	1.10	Unknown	Unknown	Unknown	Round culvert	Good-Fair	Corrugated metal arch	$33,829.45
26	280	Milton	Complete	1.00	Unknown	Unknown	Unknown	Round culvert	Good-Fair	Corrugated metal arch	$54,756.84
27	277	Milton	Partial	197.20	Milton Ck	Na	City-St.Helen	Dam	Fair-Poor	Dam Removal	$13,500.00
28	250	Milton	Partial	185.70	Milton Ck	Unknown	Unknown	Dam	Poor	Dam Removal	$13,500.00
29	253	Milton	Partial	31.37	Milton Ck	Unknown	City-St.Helen	Dam	Poor	Dam Removal	$13,500.00
30	181	Milton	Partial	21.74	Milton Ck	Canaan Rd	County	Round culvert	Good-Fair	Corrugated metal arch	$77,643.06

Table 14: Milton Sub-watershed Barrier Prioritization Summary (continued)

Rank-ing	Crossing ID No.	Sub-watershed	Barrier summary	Habitat index	Stream	Road	Barrier owner	Barrier type	Barrier condition	Design type	Total cost
31	141	Milton	Partial	13.84	Dart Ck	Robinette Rd	County	Round culvert	Good-Fair	Corrugated metal arch	$122,175.34
32	177	Milton	Partial	6.80	Milton Ck	Unknown	Unknown	Round culvert	Fair-Poor	Railspan Bridge	$19,198.98
33	175	Milton	Partial	5.68	Milton Ck	Unknown	Unknown	Round culvert	Good-Fair	Corrugated metal arch	$59,597.83
34	171	Milton	Partial	5.40	Salmonberry Ck	Unknown	Unknown	Round culvert	Fair-Poor	Railspan Bridge	$19,298.57

Table 15: McNulty Sub-watershed Barrier Prioritization Summary

Rank-ing	Crossing ID No.	Sub-watershed	Barrier summary	Habitat index	Stream	Road	Barrier owner	Barrier type	Barrier condition	Design type	Total cost
1	134	McNulty	Complete	9.73	McNulty Ck	Unknown	Unknown	Round culvert	Fair-Poor	Corrugated metal arch	$80,203.84
2	133	McNulty	Complete	9.56	McNulty Ck	Unknown	Unknown	Round culvert	Good-Fair	Multiplate Pipe Arch	$44,332.35
3	136	McNulty	Complete	2.61	McNulty Ck	Unknown	Hancock	Round culvert	Good-Fair	Corrugated metal arch	$73,967.11
4	132	McNulty	Complete	2.56	McNulty Ck	Unknown	Unknown	Round culvert	Good-Fair	Corrugated metal arch	$34,563.60
5	19	McNulty	Complete	1.31	Warren Ck	Hwy 30	State	Box culvert	Good-Fair	Baffles	$31,050.00
6	122	McNulty	Partial	25.78	McNulty Ck	Old Portland Rd	County	Box culvert	Good-Fair	Baffles	$13,500.00
7	113	McNulty	Partial	20.47	McNulty Ck	No road	Unknown	Dam	Fair-Poor	Dam Removal	$13,500.00
8	124	McNulty	Partial	20.13	McNulty Ck	Near Millard Rd	Unknown	Dam	Fair-Poor	Dam Removal	$13,500.00
9	129	McNulty	Partial	2.74	Unknown	Hazen Rd	County	Round culvert	Fair-Poor	Multiplate Pipe Arch	$37,598.35
10	131	McNulty	Partial	2.60	McNulty Ck	Hazen Rd	County	Round culvert	Good-Fair	Multiplate Pipe Arch	$24,799.58
11	229	McNulty	Partial	1.41	Warren Ck	Old Portland Rd	County	Box culvert	Good-Fair	Corrugated metal arch	$52,961.87

Table 16: Jackson Sub-watershed Barrier Prioritization Summary

Rank-ing	Crossing ID No.	Sub-watershed	Barrier summary	Habitat index	Stream	Road	Barrier owner	Barrier type	Barrier condition	Design type	Total cost
1	235	Jackson	Complete	11.48	Jackson Ck	Unknown	Unknown	Box / tidegate	Good-Fair	Bridge	$225,069.60
2	234	Jackson	Complete	10.07	Jackson Ck	Johnson Landing Rd	County	Round culvert	Good-Fair	Corrugated metal arch	$84,722.15
3	34	Jackson	Complete	9.92	Jackson Ck	Unknown	Irr. District	Dam	Good-Fair	Dam Removal	$20,250.00
4	30	Jackson	Complete	2.64	Jackson Ck	Watson Rd	County	Round culvert	Poor	Corrugated metal arch	$84,223.47

Table 17: Honeyman Sub-watershed Barrier Prioritization Summary

Rank-ing	Crossing ID No.	Sub-watershed	Barrier summary	Habitat index	Stream	Road	Barrier owner	Barrier type	Barrier condition	Design type	Total cost
1	259	Honeyman	Complete	39.85	Honeyman Ck	Unknown	Unknown	Round culvert	Fair-Poor	Railspan Bridge	$24,260.85
2	262	Honeyman	Complete	38.02	Honeyman Ck	Unknown	Unknown	Round culvert	Fair-Poor	Railspan Bridge	$23,132.25
3	251	Honeyman	Complete	15.72	Honeyman Ck	Unknown	Unknown	Round culvert	Poor	Railspan Bridge	$19,170.50
4	293	Honeyman	Complete	14.57	Honeyman Ck	Unknown	Unknown	Round culvert	Good-Fair	Railspan Bridge	$37,800.00
5	220	Honeyman	Complete	10.82	Honeyman Ck	Unknown	Unknown	Round culvert	Fair-Poor	Bridge	$59,740.01
6	260	Honeyman	Complete	2.95	Unknown	Unknown	Unknown	Round culvert	Fair-Poor	Railspan Bridge	$21,691.80
7	18	Honeyman	Complete	2.12	Unknown	Hwy 30	State	Box culvert	Good-Fair	Redo baffles	$31,050.00
8	230	Honeyman	Complete	1.95	Unknown	Tarbell Rd	County	Round culvert	Good-Fair	Corrugated metal arch	$94,084.07
9	16	Honeyman	Partial	15.96	Honeyman Ck	Hwy 30	State	Box culvert	Good-Fair	Baffles	$31,050.00
10	258	Honeyman	Partial	8.55	Unknown	Unknown	Unknown	Round culvert	Fair-Poor	Corrugated metal arch	$38,828.29
11	224	Honeyman	Partial	1.51	Sly Ck	Unknown	Hancock	Round culvert	Fair-Poor	Corrugated metal arch	$80,836.83

APPENDIX F: WATERSHED-WIDE BARRIER PRIORITIZATION SUMMARY

Table 18: Watershed-Wide Barrier Prioritization Summary

Table 18: Watershed-Wide Barrier Prioritization Summary

Rank-ing	Crossing ID No.	Sub-watershed	Barrier summary	Habitat index	Stream	Road	Barrier owner	Barrier type	Barrier condition	Design type	Total cost
1	259	Honeyman	Complete	39.85	Honeyman Ck	Unknown	Unknown	Round culvert	Fair-Poor	Railspan Bridge	$24,260.85
2	262	Honeyman	Complete	38.02	Honeyman Ck	Unknown	Unknown	Round culvert	Fair-Poor	Railspan Bridge	$23,132.25
3	210	Scappoose	Complete	22.94	Raymond Ck	Unknown	Unknown	Round culvert	Poor	Aluminium box culvert #21A	$24,599.27
4	101	Scappoose	Complete	21.61	Lizzie Ck	Unknown	Unknown	Round culvert	Fair-Poor	Corrugated metal arch	$51,883.49
5	102	Scappoose	Complete	19.90	Cedar Ck	Vernonia Hwy	County	Round culvert	Fair-Poor	Corrugated metal arch	$88,558.07
6	103	Scappoose	Complete	19.90	Cedar Ck	Crown Z Logging Rd	Unknown	Round culvert	Fair-Poor	Culvert Removal	$19,360.00
7	264	Scappoose	Complete	19.17	Alder Ck	Crown Z Logging Rd	Hancock	Round culvert	Good-Fair	Culvert Removal	$140,360.00
8	155	Milton	Complete	18.87	Cox Ck	Brooks Rd	County	Round culvert	Poor	Corrugated metal arch	$72,497.70
9	79	Scappoose	Complete	18.23	Alder Ck	Cater Rd	County	Round culvert	Fair-Poor	Corrugated metal arch	$89,597.08
10	116	Scappoose	Complete	17.79	Cedar Ck	Cedar Ck Rd	County	Round culvert	Fair-Poor	Multiplate Pipe Arch	$58,418.61
11	160	Milton	Complete	17.59	Cox Ck	Unknown	Unknown	Round culvert	Poor	Railspan Bridge	$19,155.55
12	118	Scappoose	Complete	16.30	Cedar Ck	Cedar Ck Rd	County	Round culvert	Good-Fair	Corrugated metal arch	$110,322.30
13	251	Honeyman	Complete	15.72	Honeyman Ck	Unknown	Unknown	Round culvert	Poor	Railspan Bridge	$19,170.50
14	148	Milton	Complete	15.62	Salmon Ck	Unknown	Unknown	Round culvert	Fair-Poor	Corrugated metal arch	$71,548.27
15	283	Scappoose	Complete	15.60	Cedar Ck	Unknown	Unknown	Round culvert	Fair-Poor	Railspan Bridge	$19,797.17
16	147	Milton	Complete	14.79	Salmon Ck	Brinn Rd	County	Round culvert	Good-Fair	Corrugated metal arch	$82,149.16
17	293	Honeyman	Complete	14.57	Honeyman Ck	Unknown	Unknown	Round culvert	Good-Fair	Railspan Bridge	$37,800.00
18	85	Scappoose	Complete	13.55	Alder Ck	Unknown	Unknown	Round culvert	Fair-Poor	Multiplate Pipe Arch	$38,396.22
19	91	Scappoose	Complete	13.10	Alder Ck	Unknown	Unknown	Round culvert	Poor	Corrugated metal arch	$72,134.38
20	86	Scappoose	Complete	13.03	Alder Ck	Alder Ck Rd	County	Round culvert	Good-Fair	Aluminium box culvert #30E	$52,936.31
21	87	Scappoose	Complete	12.71	Alder Ck	Unknown	Unknown	Round culvert	Fair-Poor	Corrugated metal arch	$43,822.31
22	156	Milton	Complete	12.41	Cox Ck	Unknown	Unknown	Round culvert	Poor	Multiplate Pipe Arch	$51,868.82
23	197	Milton	Complete	12.08	Dart Ck	Unknown	Unknown	Round culvert	Fair-Poor	Corrugated metal arch	$43,870.90
24	36	Scappoose	Complete	11.52	Gourlay Ck	Unknown	City-Scap.	Dam	Good-Fair	Fish Ladder	$105,550.00
25	108	Scappoose	Complete	11.50	N. Scappoose Ck	Chapman Rd	County	Round culvert	Good-Fair	Multiplate Pipe Arch	$31,542.50
26	235	Jackson	Complete	11.48	Jackson Ck	Unknown	Unknown	Box/tidegate	Good-Fair	Bridge	$225,069.60

Table 18: Watershed-wide Barrier Prioritization Summary (continued)

Rank-ing	Crossing ID No.	Sub-watershed	Barrier summary	Habitat index	Stream	Road	Barrier owner	Barrier type	Barrier condition	Design type	Total cost
27	107	Scappoose	Complete	11.45	N. Scappoose Ck	Chapman Rd	County	Round culvert	Fair-Poor	Corrugated metal arch	$41,638.21
28	89	Scappoose	Complete	11.30	Alder Ck	Unknown	Unknown	Round culvert	Fair-Poor	Corrugated metal arch	$77,298.33
29	150	Milton	Complete	11.15	Salmon Ck	Brinn Rd	County	Round culvert	Fair-Poor	Multiplate Pipe Arch	$45,292.12
30	220	Honeyman	Complete	10.82	Honeyman Ck	Unknown	Unknown	Round culvert	Fair-Poor	Bridge	$59,740.01
31	154	Milton	Complete	10.59	Salmon Ck	Unknown	Unknown	Round culvert	Fair-Poor	Corrugated metal arch	$96,442.43
32	11	Scappoose	Complete	10.09	Lacey Ck	Unknown	Hancock	Round culvert	Good-Fair	Railspan Bridge	$26,160.75
33	234	Jackson	Complete	10.07	Jackson Ck	Johnson Landing Rd	County	Round culvert	Good-Fair	Corrugated metal arch	$84,722.15
34	34	Jackson	Complete	9.92	Jackson Ck	Unknown	Irr. District	Dam	Good-Fair	Dam Removal	$20,250.00
35	105	Scappoose	Complete	9.79	Mollenhour Ck	Chapman Rd	County	Round culvert	Good-Fair	Corrugated metal arch	$68,067.18
36	134	McNulty	Complete	9.73	McNulty Ck	Unknown	Unknown	Round culvert	Fair-Poor	Corrugated metal arch	$80,203.84
37	133	McNulty	Complete	9.56	McNulty Ck	Unknown	Unknown	Round culvert	Good-Fair	Multiplate Pipe Arch	$44,332.35
38	109	Scappoose	Complete	9.33	Unknown	Unknown	Unknown	Round culvert	Poor	Corrugated metal arch	$45,638.79
39	286	Scappoose	Complete	9.04	Mollenhour Ck	Crown Z Logging Rd	Hancock	Round culvert	Good-Fair	Culvert Removal	$598,950.00
40	151	Milton	Complete	8.08	Salmon Ck	Unknown	Unknown	Round culvert	Fair-Poor	Corrugated metal arch	$94,229.61
41	238	Scappoose	Complete	7.45	Salt Ck	Mckay Rd	County	Round culvert	Good-Fair	Corrugated metal arch	$25,909.70
42	25	Scappoose	Complete	7.03	Lacey Ck	Layton Rd	City-Scap.	Dam	Good-Fair	Fish Ladder	$290,000.00
43	152	Milton	Complete	6.28	Salmon Ck	Unknown	Hancock	Round culvert	Good-Fair	Corrugated metal arch	$69,523.76
44	176	Milton	Complete	6.23	Milton Ck	Pittsburg Rd	County	Round culvert	Good-Fair	Corrugated metal arch	$21,117.37
45	55	Scappoose	Complete	6.08	S. Scappoose Ck	Unknown	Unknown	Round culvert	Good-Fair	Corrugated metal arch	$66,381.27
46	110	Scappoose	Complete	5.78	Mollenhour Ck	Vernonia Hwy	County	Round culvert	Good-Fair	Corrugated metal arch	$548,308.10
47	28	Scappoose	Complete	5.63	Lacey Ck	Unknown	Hancock	Round culvert	Good-Fair	Corrugated metal arch	$76,046.73
48	240	Scappoose	Complete	5.41	Salt Ck	R 072	Hancock	Round culvert	Good-Fair	Corrugated metal arch	$134,582.33
49	271	Milton	Complete	4.85	Cox Ck	Brooks Rd	County	Round culvert	Good-Fair	Corrugated metal arch	$41,257.63
50	191	Milton	Complete	4.34	Dart Ck	Barger Rd	County	Round culvert	Good-Fair	Bridge	$119,070.03
51	139	Milton	Complete	4.33	Perry Ck	Hanky Rd	County	Round culvert	Good-Fair	Corrugated metal arch	$138,855.14
52	56	Scappoose	Complete	4.25	S. Scappoose Ck	Unknown	Unknown	Round culvert	Good-Fair	Corrugated metal arch	$36,792.27

Table 18: Watershed-wide Barrier Prioritization Summary (continued)

Rank-ing	Crossing ID No.	Sub-watershed	Barrier summary	Habitat index	Stream	Road	Barrier owner	Barrier type	Barrier condition	Design type	Total cost
53	51	Scappoose	Complete	4.19	Dooly Ck	Unknown	Unknown	Round culvert	Good-Fair	Aluminium box culvert #34C	$60,122.60
54	153	Milton	Complete	4.10	Salmon Ck	Unknown	Hancock	Round culvert	Good-Fair	Corrugated metal arch	$29,333.06
55	249	Milton	Complete	3.93	Perry Ck	Unknown	City-St.Helen	Dam	Fair-Poor	Dam Removal	$13,500.00
56	193	Milton	Complete	3.68	Dart Ck	Unknown	Unknown	Round culvert	Poor	Bridge	$55,725.91
57	192	Milton	Complete	3.66	Dart Ck	Unknown	Unknown	Round culvert	Fair-Poor	Corrugated metal arch	$64,742.14
58	49	Scappoose	Complete	3.54	Alder Ck	Crown Z Logging Rd	Unknown	Round culvert	Poor	Culvert Removal	$4,477.00
59	48	Scappoose	Complete	3.53	Alder Ck	Vernonia Hwy	County	Round culvert	Good-Fair	Corrugated metal arch	$79,093.14
60	38	Scappoose	Complete	3.52	Wf Gourlay Ck	Unknown	Unknown	Round culvert	Good-Fair	Corrugated metal arch	$40,709.87
61	187	Milton	Complete	3.03	Milton Ck	Unknown	Unknown	Round culvert	Poor	Corrugated metal arch	$42,278.86
62	70	Scappoose	Complete	2.99	Siercks Ck	Unknown	Unknown	Round culvert	Good-Fair	Aluminium box culvert #15B	$26,941.86
63	260	Honeyman	Complete	2.95	Unknown	Unknown	Unknown	Round culvert	Fair-Poor	Railspan Bridge	$21,691.80
64	71	Scappoose	Complete	2.73	Siercks Ck	Unknown	Unknown	Round culvert	Good-Fair	Corrugated metal arch	$48,561.86
65	178	Milton	Complete	2.70	Milton Ck	Pittsburg Rd	County	Round culvert	Good-Fair	Railspan Bridge	$19,136.59
66	30	Jackson	Complete	2.64	Jackson Ck	Watson Rd	County	Round culvert	Poor	Corrugated metal arch	$84,223.47
67	179	Milton	Complete	2.64	Milton Ck	Unknown	Unknown	Round culvert	Good-Fair	Railspan Bridge	$19,083.86
68	290	Scappoose	Complete	2.64	Unknown	Unknown	Unknown	Round culvert	Good-Fair	Railspan Bridge	$38,035.62
69	136	McNulty	Complete	2.61	McNulty Ck	Unknown	Hancock	Round culvert	Good-Fair	Corrugated metal arch	$73,967.11
70	132	McNulty	Complete	2.56	McNulty Ck	Unknown	Unknown	Round culvert	Good-Fair	Corrugated metal arch	$34,563.60
71	10	Scappoose	Complete	2.20	Wolf Ck	Dutch Canyon Rd	County	Round culvert	Good-Fair	Corrugated metal arch	$51,537.65
72	18	Honeyman	Complete	2.12	Unknown	Hwy 30	State	Box culvert	Good-Fair	Redo baffles	$31,050.00
73	281	Milton	Complete	1.99	Unknown	Unknown	Unknown	Round culvert	Good-Fair	Bridge	$55,934.18
74	230	Honeyman	Complete	1.95	Unknown	Tarbell Rd	County	Round culvert	Good-Fair	Corrugated metal arch	$94,084.07
75	165	Milton	Complete	1.87	Unknown	Pittsburg Rd	County	Round culvert	Good-Fair	Railspan Bridge	$19,041.41
76	166	Milton	Complete	1.80	Unknown	Unknown	County	Round culvert	Good-Fair	Corrugated metal arch	$22,733.42
77	241	Scappoose	Complete	1.69	Wolf Ck	Unknown	Unknown	Round culvert	Fair-Poor	Corrugated metal arch	$46,134.85
78	66	Scappoose	Complete	1.67	Siercks Ck	Reid Rd	Unknown	Round culvert	Good-Fair	Corrugated metal arch	$36,423.04
79	19	McNulty	Complete	1.31	Warren Ck	Hwy 30	State	Box culvert	Good-Fair	Baffles	$31,050.00

Table 18: Watershed-wide Barrier Prioritization Summary (continued)

Rank-ing	Crossing ID No.	Sub-watershed	Barrier summary	Habitat index	Stream	Road	Barrier owner	Barrier type	Barrier condition	Design type	Total cost
80	69	Scappoose	Complete	1.11	Siercks Ck	Unknown	Unknown	Round culvert	Good-Fair	Corrugated metal arch	$77,850.60
81	279	Milton	Complete	1.10	Unknown	Unknown	Unknown	Round culvert	Good-Fair	Corrugated metal arch	$33,829.45
82	280	Milton	Complete	1.00	Unknown	Unknown	Unknown	Round culvert	Good-Fair	Corrugated metal arch	$54,756.84
83	277	Milton	Partial	197.20	Milton Ck	Na	City-St.Helen	Dam	Fair-Poor	Dam Removal	$13,500.00
84	250	Milton	Partial	185.70	Milton Ck	Unknown	Unknown	Dam	Poor	Dam Removal	$13,500.00
85	40	Scappoose	Partial	41.13	S. Scappoose Ck	Unknown	City-Scap.	Dam	Good-Fair	Fish Ladder	$84,440.00
86	41	Scappoose	Partial	41.09	S. Scappoose Ck	Unknown	City-Scap.	Dam	Good-Fair	Weir Notch	$500.00
87	253	Milton	Partial	31.37	Milton Ck	Unknown	City-St.Helen	Dam	Poor	Dam Removal	$13,500.00
88	122	McNulty	Partial	25.78	McNulty Ck	Old Portland Rd	County	Box culvert	Good-Fair	Baffles	$13,500.00
89	181	Milton	Partial	21.74	Milton Ck	Canaan Rd	County	Round culvert	Good-Fair	Corrugated metal arch	$77,643.06
90	113	McNulty	Partial	20.47	McNulty Ck	No road	Unknown	Dam	Fair-Poor	Dam Removal	$13,500.00
91	124	McNulty	Partial	20.13	McNulty Ck	Near Millard Rd	Unknown	Dam	Fair-Poor	Dam Removal	$13,500.00
92	16	Honeyman	Partial	15.96	Honeyman Ck	Hwy 30	State	Box culvert	Good-Fair	Baffles	$31,050.00
93	141	Milton	Partial	13.84	Dart Ck	Robinette Rd	County	Round culvert	Good-Fair	Corrugated metal arch	$122,175.34
94	88	Scappoose	Partial	12.16	Alder Ck	Alder Ck Rd	County	Round culvert	Fair-Poor	Bridge	$193,151.03
95	37	Scappoose	Partial	11.40	Gourlay Ck	Unknown	City-Scap.	Dam	Good-Fair	Weir Notch	$500.00
96	258	Honeyman	Partial	8.55	Unknown	Unknown	Unknown	Round culvert	Fair-Poor	Corrugated metal arch	$38,828.29
97	177	Milton	Partial	6.80	Milton Ck	Unknown	Unknown	Round culvert	Fair-Poor	Railspan Bridge	$19,198.98
98	175	Milton	Partial	5.68	Milton Ck	Unknown	Unknown	Round culvert	Good-Fair	Corrugated metal arch	$59,597.83
99	171	Milton	Partial	5.40	Salmonberry Ck	Unknown	Unknown	Round culvert	Fair-Poor	Railspan Bridge	$19,298.57
100	129	McNulty	Partial	2.74	Unknown	Hazen Rd	County	Round culvert	Fair-Poor	Multiplate Pipe Arch	$37,598.35
101	131	McNulty	Partial	2.60	McNulty Ck	Hazen Rd	County	Round culvert	Good-Fair	Multiplate Pipe Arch	$24,799.58
102	46	Scappoose	Partial	2.59	Alder Ck	Nw Smith Rd	County	Round culvert	Poor	Corrugated metal arch	$50,498.38
103	261	Scappoose	Partial	2.47	Unknown	Unknown	Unknown	Round culvert	Poor	Railspan Bridge	$22,196.70
104	8	Scappoose	Partial	2.30	Mud Ck	Dutch Canyon Rd	County	Round culvert	Fair-Poor	Corrugated metal arch	$56,037.41
105	224	Honeyman	Partial	1.51	Sly Ck	Unknown	Hancock	Round culvert	Fair-Poor	Corrugated metal arch	$80,836.83
106	229	McNulty	Partial	1.41	Warren Ck	Old Portland Rd	County	Box culvert	Good-Fair	Corrugated metal arch	$52,961.87
107	68	Scappoose	Partial	1.05	Siercks Ck	Armstrong Rd	County	Round culvert	Good-Fair	Corrugated metal arch	$34,592.63

APPENDIX G: BARRIER PROFILES