DRAFT

CHEHALIS RIVER BASIN COMPREHENSIVE SALMONID HABITAT ENHANCEMENT PLAN

Prepared for

Chehalis River Basin Flood Authority

Lewis County Board of County Commissioners

315 NW North Street, Room 209

Chehalis, Washington 98532

Prepared by

Anchor QEA, LLC

720 Olive Way, Suite 1900

Seattle, Washington 98101

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LIST OF ACRONYMS AND ABBREVIATIONS

DNR	Washington Department of Natural Resources
LCCD	Lewis County Conservation District
LiDAR	Light Detection and Ranging
LWD	large woody debris
MCD	Mason Conservation District
MU	Management Unit
NOAA	National Oceanic and Atmospheric Administration
PFC	properly functioning condition
RHW	Remand Habitat Workgroup
USACE	U.S. Army Corps of Engineers
VSP	viable salmonid population
WAU	Watershed Administrative Unit
WDFW	Washington Department of Fish and Wildlife
WRIA	Water Resource Inventory Area

EXECUTIVE SUMMARY

As the second largest river system in the State of Washington outside the Columbia River basin, the Chehalis River supports numerous species and runs of salmonids. Current conditions in the watershed limit fisheries production. Limiting factors for salmonids include fish passage blockages (e.g., impassable culverts), floodplain conditions (e.g., incised channels or drainage and filling of wetlands), streambed substrate (e.g., mass wasting or low large woody debris levels), riparian conditions (e.g., tree canopy loss), water quality (e.g., high water temperature or low dissolved oxygen), and water quantity (e.g., low summer base flows) in the Chehalis River basin (Smith and Wegner 2001).

In order to support salmonid enhancement planning in the Chehalis River basin, the Chehalis River Basin Flood Authority (Flood Authority) contracted with Anchor QEA, LLC, to develop a Comprehensive Salmonid Habitat Enhancement Plan that identifies potential opportunities to improve habitat conditions. This work was completed in two steps:

- Development of a comprehensive list of opportunities based on compilation from other sources and the identification of additional opportunities, particularly side channels.
- Prioritization of identified opportunities to help inform which opportunities provide the greatest benefits to meet the habitat needs of the watershed.

Three methods were used to identify salmonid habitat enhancement opportunities in the Chehalis River watershed:

- Review existing reports and databases
- Conduct interviews and a workshop with basin stakeholders
- Analyze Light Detection and Ranging (LiDAR) data and aerial photography to identify potential side channel habitat restoration projects along the Chehalis, South Fork Chehalis, Newaukum, and Skookumchuck rivers

Eighty-nine floodplain and riparian projects were identified in the first phase of this plan. Fifty-three projects were carried forward to the level of estimating costs, setting prioritization, and estimating benefits to fisheries habitat. The projects not carried forward contained general strategies and did not contain enough detail to prioritize.

Floodplain and riparian habitat restoration projects were prioritized using four criteria:

- Limiting Factors Addressed
- Salmon Species Present
- Size of Project
- Certainty of Response

Implementation factors such as cost, property ownership, and difficulty of permitting were not included in the prioritization criteria. Only criteria specific to fisheries were used. The floodplain and riparian habitat restoration projects were scored and ranked to provide a list of projects that can be used by the Flood Authority and others when developing mitigation strategies for flood reduction projects. The total estimated cost of the floodplain and riparian habitat restoration projects is $130.9 million.

Within the Water Resource Inventory Area (WRIA) 23 study area, there are 643 barrier culverts (WDFW 2012). Mason Conservation District (MCD) and Lewis County Conservation District (LCCD) have prioritized the top 300 culverts for replacement, which was used for this plan. The cost of replacing those culverts is estimated to be $21.4 million.

An approach to estimating fisheries benefits for the enhancement projects was presented. The approach was formulated because a fish population model for the entire WRIA 23 study area, including the tributaries, was not available. Although the SHIRAZ fish population model was used for the Chehalis River Flood Storage Dam Fish Population Study (Anchor QEA 2012) to determine potential habitat impacts from a dam on the mainstem Chehalis River, the SHIRAZ model only addressed impacts to the mainstem Chehalis River and did not cover the tributaries. The data needed to prepare a SHIRAZ model that includes tributaries is not available and could not be developed in the timeframe and budget allowed for this study. Instead, another simpler but adaptive approach was used to estimate the enhancement benefits throughout WRIA 23. However, the approach used was informed by the results of the SHIRAZ modeling.

The approach assumed that all of the 53 floodplain and riparian habitat restoration projects would be implemented along with the 300 culvert replacement projects. The approach estimates a habitat value that is a percentage of optimal habitat condition for current

conditions and future conditions with all the enhancement projects implemented. The habitat value was multiplied by an egg-to-smolt survival relationship for Chinook and coho salmon, and steelhead trout to estimate the potential difference in egg-to-smolt survival. Three habitat improvement scenarios were analyzed to estimate a range of potential improvements in juvenile salmon survival. The low scenario estimates an improvement of 14 percent in Chinook and coho salmon, and steelhead trout egg to smolt survival. The middle scenario estimates an improvement of 44 percent and the high scenario estimates an improvement of 73 percent. The potential improvements in juvenile Chinook and coho salmon, and steelhead trout egg-to-smolt survival from implementation of the enhancement projects described in this report ranges from 14 to 73 percent.

The approach to estimating fisheries benefits is adaptive and basin stakeholders can easily modify the input assumptions to incorporate new information or to estimate benefits for a partial list of projects. The calculations are provided in spreadsheets that have been transmitted to the Flood Authority for future use.

1 INTRODUCTION

As the second largest river system in the State of Washington outside the Columbia River basin, the Chehalis River supports numerous species and runs of salmonids; however, current conditions in the watershed limit fisheries production. Smith and Wenger (2001) conducted a comprehensive assessment of habitat-limiting factors for salmonids throughout the watershed. The authors identified the following categories of habitat-limiting factors for salmonids in one or more parts of the watershed:

- Loss of access to habitat (e.g., impassable culverts)
- Floodplain conditions (e.g., incised channels or drainage and filling of wetlands)
- Streambed sediment conditions (e.g., excessive fine substrates)
- Riparian conditions (e.g., tree canopy loss)
- Water quality (e.g., high water temperature or low dissolved oxygen)
- Water quantity (e.g., low summer base flows)

To support salmonid enhancement planning in the Chehalis River basin, the Chehalis River Basin Flood Authority (Flood Authority) contracted with Anchor QEA, LLC, to develop a Comprehensive Salmonid Habitat Enhancement Plan to identify potential opportunities to improve habitat conditions to address the habitat-limiting factors. This work was completed in two phases.

- **Phase 1:** Development of a comprehensive list of salmonid habitat enhancement opportunities based on a compilation from other sources and the identification of additional opportunities, particularly side channels.
- **Phase 2:** Prioritization of identified opportunities to identify which opportunities provide the greatest benefits to meet the salmonid habitat needs of the watershed.

The Phase 1 Report was delivered to the Flood Authority in February 2012 and included a list of potential projects identified within the basin that provide enhancement options including culvert replacement and riparian and floodplain connectivity restoration. An updated version of the Phase 1 Report is included as Appendix A of this report. Updates include some changes in project identifications and the addition or removal of projects due to completed construction or additional aerial photography review.

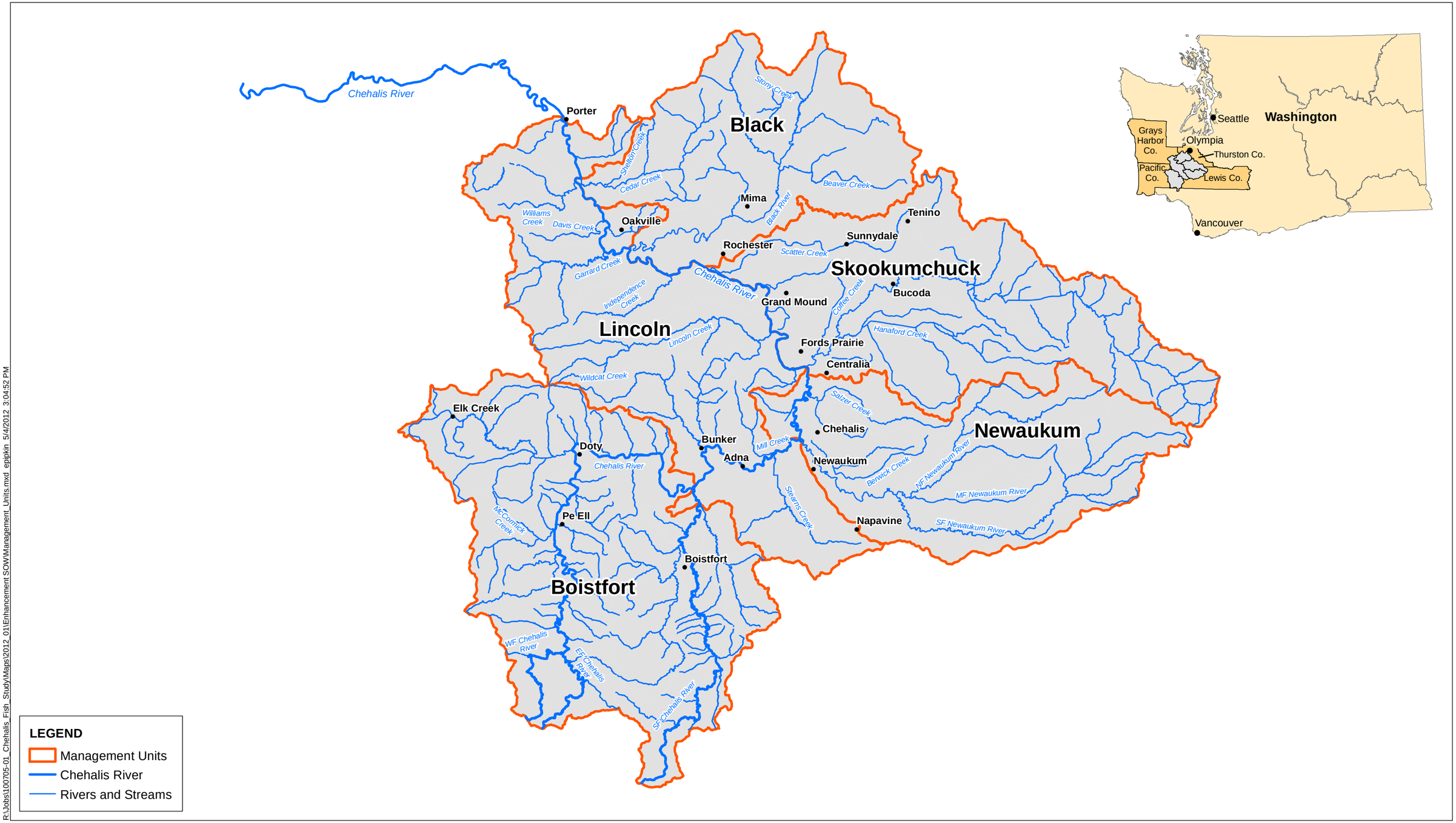
This report describes Phase 2, the prioritization of enhancement projects to help inform which opportunities provide the greatest benefits to meet the salmonid habitat needs of the watershed. This report also presents estimated costs of the projects and benefits in term of fisheries production.

1.1 Study Area

The Chehalis River basin encompasses 2,520 square miles and drains 2,660 square miles flowing through the Cascade, Puget Lowland, and Coast Range ecoregions and emptying into Grays Harbor near Aberdeen (Omernik 1987). It is divided into the Lower Chehalis Basin (Water Resource Inventory Area [WRIA] 22) and the Upper Chehalis Basin (WRIA 23); this assessment is focused on WRIA 23. Within WRIA 23, the watershed was divided into six management units (MU) (subbasins) representing the major watersheds (Figure 1):

- Black (BL) MU (includes Black River and Porter Creek subbasins)
- Boisfort (BF) MU (Upper Chehalis, South Fork Chehalis, Stillman Creek, Lake Creek, and other smaller creeks)
- Chehalis Mainstem (CH) MU
- Lincoln (LI) MU (Lincoln Creek, Independence Creek, Garrard Creek, Gaddis Creek, Rock/Williams Creek, Bunker Creek, Scammon Creek, Mill Creek, Stearns Creek, and other smaller creeks)
- Newaukum (NE) MU (Newaukum mainstem, North Fork Newaukum, Middle Fork Newaukum, Salzer Creek, Coal Creek, Dillenbaugh Creek, Berwick Creek, China Creek, and other smaller creeks)
- Skookumchuck (SK) MU (Skookumchuck River, Scatter Creek, and other smaller creeks)

Management units were delineated based on Watershed Administrative Units (WAUs) from the Washington Department of Natural Resources (DNR). Those WAUs did not match exactly with the watershed boundaries in *The Chehalis Basin Salmon Habitat Restoration and Preservation Strategy for WRIA 22 and 23 Work Plan* (Grays Harbor County Lead Entity 2011); however, the WAU boundaries available in GIS were more recent, so those WAUs were used in this analysis. The DNR WAUs were thus grouped into management units that closely approximate those described in the Work Plan.



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ANCHOR QEA

Figure 1
Management Units
Chehalis River WRIA 23 Enhancement Opportunities
Lewis County Flood Authority

1.2 Goal of Restoration

Defining the overall goal of restoration is an important first step for identifying the most appropriate approach for prioritizing projects (Beechie et al. 2008). Generally, the goal for WRIA 23 is to attain a healthy and diverse population of wild salmonids through the restoration, enhancement, and protection of riparian, floodplain, and stream habitat (Grays Harbor County Lead Entity 2011).

2 IDENTIFICATION OF PROJECTS (PHASE 1)

Potential projects were identified in the Phase 1 report (see Appendix A) based on an assessment of the common limiting factors within WRIA 23. Seven limiting factors have been identified that have impacts on both physical processes within the watershed and salmonids (Grays Harbor County Lead Entity 2011):

- **Fish Passage Conditions:** Poor fish passage conditions typically result from improperly sized water crossing structures and result in loss of access to spawning and rearing habitat.
- **Floodplain Conditions:** Degraded floodplain conditions typically result from floodplain filling, dike and levee construction, and streambank armoring and result in loss of backwater and side channels used for spawning, rearing, and refugia during high flows.
- **Riparian Conditions:** Poor riparian conditions typically result from intentional removal of vegetation, usually associated with land use conversion or timber harvest, and results in limiting shade, nutrients, and large woody debris (LWD) availability.
- **Large Woody Debris:** Lack of LWD usually results from poor riparian conditions and removal of woody debris from the channel.
- **Water Quality:** Poor water quality typically is associated with water temperature, suspended solids, and chemical composition usually resulting from poor riparian conditions and stormwater runoff problems.
- **Water Quantity:** Low summer flows typically result from altered hydrology (landscape changes that allows rapid surface runoff).
- **Streambed Sediment:** High contributions of sediment typically are associated with land use management practices including logging roads, landscapes without vegetation, and areas of excessive streambank erosion resulting in filling in of pools and spawning gravels.

The Grays Harbor County Lead Entity Habitat Work Group (Habitat Work Group) has indicated that replacing culverts to improve fish passage and access to additional habitat, riparian revegetation, and restoring floodplain functions are a priority (Grays Harbor County Lead Entity 2011). However, riparian conditions and LWD also are of concern within WRIA 23 (Smith and Wenger 2001), and projects necessary to enhance these factors were identified

as well. The other three limiting factors also may be addressed as part of enhancements in any of the first four. For example, improvement in riparian conditions will also reduce the amount of sediment that can be deposited into streams within the watershed and will provide additional vegetative cover, thereby improving water quality by reducing stream temperatures. Based on this, the primary focus for assessment was on four limiting factors: floodplain conditions, riparian conditions, LWD, and fish passage conditions.

The WRIA 22-23 Habitat Work Group has developed a prioritization strategy based on the general features of each subbasin, type and status of anadromous fish stocks, land use activities, and limiting factor analysis. This strategy prioritized the degree of impact created by each limiting factor on the fitness and survival of targeted stocks by assigning a ranking into three tiers. Tier 1 concerns represent the most pressing limiting factors impacting the targeted stocks and projects targeting these areas will likely provide the greatest benefit to fish. The subbasins with a Tier 1 concern for any of these limiting factors were identified to develop a master list of potential projects. Projects that also addressed other limiting factors were included in the assessment if information was readily available.

A summary of the tiered concerns for each limiting factor separated by management unit was compiled to begin development of the potential project list (Appendix A, Table 1). Tier 1 concerns for floodplain conditions, riparian conditions, and fish passage conditions were used to identify subbasins for targeted projects. In addition, fish use within each subbasin was summarized for integration into the prioritization process (Appendix A, Table 2).

A master list of potential projects was developed for WRIA 23 (Appendix A, Table 3). Projects are listed by management unit and the major tributary is identified. The type of enhancement and limiting factor addressed are provided, with multiple limiting factors addressed for some projects. In addition, a general description of the project and potential area of upstream habitat available are provided. For each potential project identified as part of this task, each limiting factor that may be addressed was identified (Appendix A, Table 3).

Eighty-nine potential programs or specific projects were identified within WRIA 23; 6 were identified to enhance floodplain conditions, 27 for fish passage conditions, 7 for riparian conditions, and 49 addressed multiple limiting factors (Appendix A, Table 3).

Fish passage barriers within the basin were identified based on several efforts (WDFW 2012; MCD 2010; LCCD 2009; LCCD 2007; LCCD 2006). Barrier culverts were identified based on the inventory data available to date; no additional field surveys were conducted. The Mason Conservation District (MCD), in collaboration with other basin entities, identified 2,677 barriers within the WRIA 22 and 23 (MCD 2010). The current WDFW culvert database, which includes the MCD culvert database, lists 2,292 culvert barriers in WRIA 22 and 23 (WDFW 2012). Within the WRIA 23 study area, there are 643 culvert barriers (WDFW 2012). These barriers are shown as black triangles (WDFW database) and yellow, orange, and red dots on Appendix A, Figures 2 through 6. As part of the MCD effort, the barriers were ranked according to the number of species that may utilize upstream habitat, the length of stream upstream of the barrier, and the percent passability of the barrier. The rankings were then converted to percentiles to assign barriers to three tiers. The top 25 percent of sites were included in Tier 1 (top priority), sites in the 50th to 74th percentile were included in Tier 2, and the remaining sites (0 to 49th percentile) were assigned to Tier 3. The sites in Tier 1 represent sites with the most available stream length upstream and species utilization. Appendix A, Table 4, provides a complete list of barriers that were ranked as Tier 1 in WRIA 23 and are still in need of funding for removal. Lewis County Conservation District (LCCD) has updated the MCD barrier database with additional habitat data that was physically collected upstream of 99 barriers (LCCD 2006, 2007, and 2009; included on Appendix A, Figures 2 through 6 as purple circles). These top 99 culverts identified by LCCD are included in Appendix A, Table 5 (30 of these are also found in the MCD data table).

Specific floodplain and riparian project locations are located on Appendix A, Figures 4 through 12). Several of these projects came from the Draft Twin Cities Flood Reduction Project, Mitigation Site Evaluations Appendix A (U.S. Army Corps of Engineers 2011). These projects have conceptual plans prepared for them. Anchor QEA prepared an analysis of mainstem floodplain conditions using Light Detection and Ranging (LiDAR) mapping. Maps show floodplain elevations relative to mainstem river thalweg and potential areas of floodplain, off channel, and side channel habitat restoration in the mainstem Chehalis, Skookumchuck, and South Fork Chehalis Rivers. Additional information is needed to understand current land uses and ownership within these areas to determine if restoration of these habitats is feasible.

GIS files with data on the potential enhancement projects were delivered to the Flood Authority. These files display the location and extent of each proposed project. The files also contain metadata related to each project. The metadata includes prioritization and cost estimate information.

The amount of information and site-specific data available influence how restoration goals can be met and the variables used to prioritize projects. For consistency in evaluation, the same types of information are needed from each potential project. This was considered as various criteria that could be used to prioritize and rank the projects that were identified in WRIA 23.

3 PROJECT PRIORITIZATION (PHASE 2)

3.1 Prioritization Approach

Anchor QEA formulated a prioritization approach that links the restoration goal of WRIA 23 (see Section 1.2) to salmonid species and their habitat. Projects identified in Phase 1 were prioritized so that restoration activities can achieve the best result possible within potential constraints such as funding, landowner permission, permitting, and other implementation issues. This prioritization can help guide the process of deciding which restoration actions contribute most to the re-establishment of desirable habitat characteristics within a given management unit. The approach is also flexible, as it can be modified by basin stakeholders to place more or less emphasis on certain criterion.

In addition, the prioritization of identified projects will provide the Flood Authority with a hierarchical path to select mitigation for future flood hazard mitigation projects. This prioritization will allow the Flood Authority to select the projects with the greatest ecological lift when continued feasibility and design work proceeds for future flood hazard mitigation projects.

Two different prioritization approaches were used, one for floodplain and riparian projects, and the other for culvert projects that provide fish passage.

3.2 River and Floodplain Projects Prioritization Approach

The prioritization approach developed for river and floodplain projects was based on a paper by Beechie et al. (2008), which describes different approaches for prioritizing habitat restoration actions based on available information. Beechie et al. (2008) identified six general strategies for prioritizing river and floodplain restoration actions. These general strategies are also broken into logical and quantitative approaches. For this project, a logical decision support system (one of the six strategies identified by Beechie et al.) was used to rank projects. The simplest and most transparent form of a logical decision support system, a scoring system, was used to rank projects. In this system, a set of evaluation criteria are scored, summed, and weighted to obtain a total score for each project. These scores were used to prioritize the list of restoration actions in Table 3 of the Phase 1 report (see Appendix A). These projects consisted of large-scale floodplain and riparian restoration actions on the

Chehalis River mainstem, Skookumchuck River, Newaukum River, South Fork Chehalis River, and some smaller tributaries in the floodplain of the mainstem Chehalis and Newaukum rivers.

As part of the development of the prioritization approach for the large scale floodplain and riparian restoration actions, numerous potential criteria were examined including:

- Limiting Factors Addressed
- Salmonid Species Present
- Size of Project
- Certainty of Project Response
- Location in the Watershed
- Salmonid Life Stages Present
- Ownership
- Likelihood of Funding
- Educational Value
- Economic Impact
- Difficulty of Project Design and Permitting
- Cost

The above criteria were listed in Beechie et al. (2008) as possible criteria to examine. A subset of the criteria was deemed suitable for use in the prioritization based on the amount of information available for each project. The subsections below describe the criteria and indicate if there was enough information to include in the prioritization. Several criteria, while important in overall assessment, are not carried further due to their focus on economics, social impact, or implementation issues. For this assessment, the focus was on ecological attributes and, ultimately, which criteria directly related to salmonid populations in the watershed. Cost, ownership, and other implementation factors are not included in this prioritization. However, cost estimates are provided in Section 6 of this report. As more information is developed on the projects, implementation issues can be brought into this prioritization approach.

3.2.1 Criteria Included in Prioritization

3.2.1.1 Limiting Factors Addressed

The Habitat Work Group has developed a prioritization strategy, including a limiting factor analysis (Grays Harbor County Lead Entity Habitat Work Group 2011). This strategy included development of a tiered ranking of the degree of impact created by each limiting factor on the fitness and survival of targeted stocks. Tier 1 concerns represent the most pressing limiting factors impacting the targeted salmonid species and projects targeting these areas will likely provide the greatest benefit to fish. Therefore, this criterion was used in the prioritization.

3.2.1.2 Salmonid Species Present

Many species of salmonids are found within the WRIA 23 watershed including spring and fall Chinook, coho, fall chum salmon, winter steelhead, and cutthroat trout. Presence/absence information for these species is available in Washington Department of Fish and Wildlife's (WDFW's) Salmonscape web application found at http://wdfw.wa.gov/mapping/salmonscape/. These species are the focus of habitat restoration within WRIA 23. If an area has multiple species present, it may indicate greater use by salmonids and availability of more diverse habitats. Therefore, the more salmonid species there are in the vicinity of a project, the higher the ranking. This criterion was used in the prioritization.

3.2.1.3 Size of Project

The length of side-channel or off-channel restoration, as well as the area of riparian restoration was estimated for each specific restoration project. Reconnecting off-channel habitats will increase juvenile salmonid rearing and possibly adult holding habitat. The greater the area of riparian restoration, the more benefits there are to water quality (temperature) and LWD recruitment. The greater the length of the side-channel or off-channel restoration/reconnection and the larger the area of riparian restoration, the greater the benefit provided to the salmonid species present. Therefore, this criterion was used in the prioritization.

3.2.1.4 Certainty of Response

Certainty of response includes assessment of the longevity, response time, and probability and variability of success of a restoration project (Beechie et al. 2008, Roni et al. 2002). Restoration activities that have a long life, high likelihood of success, low variability among projects, and relatively quick response times should be prioritized over other activities. Project techniques that typically produce consistent results would be favored over those that may be inconsistent. Protecting high-quality habitats and reconnecting isolated habitats has been identified as offering a quick biological response and has a high likelihood of success and would be favored over projects related to longer response times, such as riparian restoration and instream habitat (Roni et al. 2002). Each potential project was classified based on Roni et al. (2002) as preservation, reconnection, watershed process restoration, or instream habitat. Therefore, this criterion was used in the prioritization.

3.2.2 Criteria Not Included in Prioritization

3.2.2.1 Life Stages Present

The life stage present in a section of the river reflects the type of habitat present. If an area has more life stages present, it likely contains some suitable habitat and may benefit from enhancements to that habitat or an increase in that type of habitat. However, detailed distribution of salmonid life stages in WRIA 23 is not well known and the presence or absence of a species is already covered in the salmonid species present criterion. Therefore, this criterion was not used in the prioritization.

3.2.2.2 Location in the Watershed

Each reach within a stream network can produce a limited range of habitat characteristics depending on its position within the watershed and site-specific physical characteristics (Roni et al. 2002). By understanding where in the watershed a project is located, restoration can focus on natural processes in that area to restore conditions to which local fish stocks are adapted, thereby benefitting all species and life stages. For this prioritization, location in the watershed was already accounted for in the selection of floodplain and riparian restoration projects. Therefore, this criterion was not used in the prioritization.

3.2.2.3 Ownership

Although this is an important consideration, at this stage of project development, ownership was not included as part of the prioritization approach. The list of projects was generated and ranked without considering ownership. Ownership is a sensitive issue and any proposed project will need to have owner permission before any further planning or design. This criterion was not used in the prioritization.

3.2.2.4 Likelihood of Funding

Although this is an important consideration, at this stage of project development, funding was not included as part of the prioritization approach. This criterion was not used in the prioritization.

3.2.2.5 Educational Value

Although this is an important consideration, at this stage of project development, educational value was not included as part of prioritizing projects. This criterion was not used in the prioritization.

3.2.2.6 Economic Impact

Although this is an important consideration, at this stage of project development, economic impact was not included as part of the prioritization approach. This criterion was not used in the prioritization.

3.2.2.7 Difficulty of Project Design and Permitting

Although this is an important consideration, at this stage of project development, project design and permitting were not included as part of the prioritization approach. This criterion was not used in the prioritization.

3.2.2.8 Cost

Although this is an important consideration, at this stage of project development, implementation costs were not included as part of the prioritization approach. This criterion

was not used in the prioritization. However, cost estimates were prepared and are detailed in Section 6.

3.3 Culvert Projects Prioritization Approach

To prioritize culverts, a prioritization approach that has been previously applied in the Chehalis River Basin by MCD and LCCD was used. The MCD approach ranked culverts into tiers (i.e., 1, 2, and 3) based on estimated percent passable (i.e., does culvert create full barrier to passage or partial barrier to passage), number of fish species, and stream miles available upstream. The LCCD approach used WDFW protocols to develop a priority index score based on estimated percent passable, number of salmonid species present, and area of habitat upstream of the culvert. The LCCD approach differed from the MCD approach in that the quality of habitat upstream of the barrier was actually calculated. The LCCD culvert ranking by priority index is more accurate than the tiered approach used by MCD. Therefore, the existing culvert ranking prepared by LCCD was used in this report.

4 PROJECT PRIORITIZATION

4.1 Floodplain and Riparian Projects

Out of the 89 floodplain and riparian projects identified in the Phase 1 report, 53 projects were prioritized based on the four selected criteria described in Section 3.2.1. The criteria were:

- Limiting Factors Addressed
- Salmonid Species Present
- Size of Project
- Certainty of Response

The projects from the Phase 1 report that were not prioritized contained general strategies for management units that did not contain enough detail to prioritize. For example, project BL-1 from the Phase 1 Report was a management unit-wide recommendation to correct barrier culverts (Grays Harbor County Lead Entity 2011). Therefore, it was not included in the prioritization.

The scoring system for each criterion is discussed in Sections 4.1.1 to 4.1.4. The contributions of the four criteria were weighted to reflect the relative importance of each criterion to the overall prioritization score. The limiting factors addressed and salmonid species present criteria were weighted more heavily than the size of the project and certainty of response criteria (Table 1). Limiting factors and salmonid species present were given an equal weighting of 33 percent. Project size and certainty of response were weighted less than the other two criteria, but equally at 17 percent. The number of criteria used in the analysis and the weighting of these criteria can be adjusted if habitat conditions in the basin change, new information is obtained, or opinions of basin fish biologists differ from that of Anchor QEA. The prioritization process is meant to be a flexible and adaptive approach that is readily adjusted.

Table 1
Weight for Each Criterion Applied in Prioritization of Floodplain and Riparian Projects

Criterion	Maximum Points (unweighted)	Percent of Points (unweighted)	Weight (percent)	Weighting Factor	Maximum Weighted Points
Limiting Factors Addressed	15	30	33	33/30 = 1.100	16.5
Salmonid Species Present	18	36	33	33/36 = 0.916	16.5
Size of the Project	10	20	17	17/20 = 0.850	8.5
Certainty of Response	7	14	17	17/14 = 1.214	8.5
Total	50	100	100	-	50

4.1.1 Limiting Factors Addressed

The habitat limiting factors identified by the Grays Harbor Lead Entity (2011) were included in the prioritization. These habitat limiting factors were floodplain conditions, riparian conditions, and LWD. The other three limiting factors (water quality, water quantity, and sediment) also may be addressed as part of restoration projects focused on any of the first three habitat limiting factors. For example, improvement in riparian conditions could also reduce bank erosion and the amount of sediment that can be deposited into streams within the watershed. It can also provide additional vegetative cover, thereby improving water quality by reducing stream temperatures.

In the analysis of habitat limiting factors, the Grays Harbor Lead Entity (2011) assigned each habitat limiting factor to a tier to reflect the relative degree of degradation. Tier 1 concerns represented the most pressing limiting factors that are impacting the viable salmonid population (VSP) parameters of abundance, productivity, diversity, and spatial structure. Two other categories of concern were identified: Tier 2 was intermediate, and Tier 3 indicated it was a concern, but less than Tier 1 and Tier 2. Tier 1 concerns ordinarily would be first in line for implementation due to their potential to provide the greatest benefit to fish. Tiers 2 and 3 follow in the same vein, although decreasingly reduced in priority due to their lesser benefit to fish. The habitat limiting factors and their categories were determined separately for each of the management units of the watershed. The category assignments

were independent among each habitat limiting factor; therefore, multiple habitat limiting factors could receive the same tier category and often did.

In the prioritization, scores were assigned to projects based on the habitat limiting factors addressed and their tiers. For each Tier 1 limiting factor addressed by a project, it received a score of 5 points. Tier 2 and Tier 3 limiting factors addressed by a project received a score of 3 points or 1 point, respectively. If a limiting factor did not apply to a MU or if the habitat limiting factor was not addressed, it received a score of 0. Thus, for the three habitat limiting factors evaluated, the maximum score received for these criteria was 15 points. The scoring assignment for each project is presented in Table 2. Maps of the project locations are provided in Appendix A, Figures 2 to 12. More detailed information about each project is provided in Appendix A, Table 3.

Table 2
Limiting Factors Addressed by Project and Scores for Prioritization

Project Identifier	Location	Limiting Factor Addressed and Tier (Tier 1 = 5 pts, Tier 2 = 3 pts, Tier 3 = 1 pt)			Total	Weighted Total
		Riparian Conditions	Floodplain Conditions	LWD		
BL-6	Black River Preservation	5	1	3	9	9.9
BF-4	South Fork Chehalis	5	1	0	6	6.6
BF-5	South Fork Chehalis Confluence	5	1	0	6	13.2
BF-6	Elk Creek Preservation	5	1	3	9	9.9
CH-1	River Miles 66 to 81	5	5	3	13	14.3
CH-6	State Route 6 Oxbow	5	5	3	13	14.3
CH-7	Oxbow Lake Reconnection	5	5	3	13	14.3
CH-8	WDFW Pheasant Farm	5	5	0	10	11.0
CH-9	Scheuber Ditch	5	5	3	13	14.3
CH-10	Near Gaddis Creek Confluence RM 34	5	5	3	13	14.3
CH-11	Near RM 36	5	5	3	13	14.3
CH-12	Near RM 42	5	5	3	13	14.3
CH-13	Near RM 43	5	5	3	13	14.3

Project Identifier	Location	Limiting Factor Addressed and Tier (Tier 1 = 5 pts, Tier 2 = 3 pts, Tier 3 = 1 pt)			Total	Weighted Total
		Riparian Conditions	Floodplain Conditions	LWD		
CH-14	Near Garrard Creek Confluence Chehalis RM 46	5	5	3	13	14.3
CH-15	Near RM 50	5	5	3	13	14.3
CH-16	Near Chehalis Village Chehalis RM 54	5	5	3	13	14.3
CH-17	Near RM 56-58	5	5	3	13	14.3
CH-17a	Near RM 58	5	5	3	13	14.3
CH-18	Dry Creek Confluence Chehalis RM 60	5	5	3	13	14.3
CH-20	Near RM 68	5	5	3	13	14.3
CH-21	Near RM 78	5	5	3	13	14.3
CH-22	Near RM 79	5	5	3	13	14.3
CH-23	Near RM 82	5	5	3	13	14.3
CH-24	Near RM 83	5	5	3	13	14.3
CH-25	Near RM 85	5	5	3	13	14.3
CH-26	Near RM 88	5	5	3	13	14.3
LI-12	Gaddis Creek Floodplain Near Chehalis RM 34	3	5	3	11	12.1
LI-13	Rock/Williams Creek Floodplain Near Chehalis RM 40	3	5	3	11	12.1
LI-14	Bunker Creek Floodplain Near Chehalis RM 85	3	5	3	11	12.1
NE-8	Dillenbaugh Creek	5	1	3	9	9.9
NE-9	Newaukum River	5	3	0	8	8.8
NE-10a	Salzer Creek Lower Mile Oxbow Reconnection and Riparian Restoration	5	3	1	9	9.9
NE-10b	Salzer Creek I-5 to BNRR Riparian and In-Channel Restoration	5	3	1	9	9.9
NE-10c	Salzer-Coal Creek Fairgrounds Floodplain and Channel Restoration	5	3	0	8	8.8

Project Identifier	Location	Limiting Factor Addressed and Tier (Tier 1 = 5 pts, Tier 2 = 3 pts, Tier 3 = 1 pt)			Total	Weighted Total
		Riparian Conditions	Floodplain Conditions	LWD		
NE-10d	Salzer Creek at Centralia Alpha Road Floodplain Storage and Riparian Restoration	5	3	1	9	9.9
NE-10e	Salzer Creek at Proffitt Road Riparian Restoration	5	3	1	9	9.9
NE-13	Newaukum River/Newaukum Valley Golf Course	5	3	0	8	8.8
NE-15	Newaukum Confluence	5	3	1	9	9.9
NE-16	Stan Hedwall Park Floodplain Reconnection	5	3	1	9	9.9
NE-17	Rice Road Floodplain/Side Channel Restoration	5	3	1	9	9.9
NE-18	North Fork/South Fork Newaukum Confluence Riparian Restoration	5	0	1	6	6.6
NE-19	North Fork Newaukum River at Tauscher Road	5	0	1	6	6.6
NE-20	Middle Fork Newaukum	5	0	0	5	5.5
NE-21	Middle Fork Newaukum Preservation	5	1	1	7	7.7
SK-5	Scatter Creek	5	1	5	11	12.1
SK-8a	Near RM 6	5	5	1	11	12.1
SK-8b	Near RM 6.5	5	5	1	11	12.1
SK-9	Near RM 7	5	5	1	11	12.1
SK-11	Near RM 10	5	5	1	11	12.1
SK-12	Near RM 11	5	5	1	11	12.1
SK-13	Near RM 12	5	5	1	11	12.1
SK-14	Near RM 13	5	5	1	11	12.1
SK-15	Near RM 14	5	5	1	11	12.1

BF = Boisfort
BL = Black
CH= Chehalis Mainstem
LI = Lincoln
NE = Newaukum
SK = Skookumchuck

4.1.2 Salmonid Species Present

Points were assigned based on the number of salmonid species (excluding whitefish) whose distributions include the specific project area (i.e., CH-7). Three points were assigned for each salmonid species present (Table 3). For the purposes of this analysis, spring and fall Chinook salmon were considered separate species. Six salmonid species were evaluated: spring Chinook, fall Chinook, coho, and chum salmon, and steelhead and cutthroat trout. Salmonid species presence was determined using fish distribution data from WDFW that was available on the SalmonScape website (http://wdfw.wa.gov/mapping/salmonscape/) and Grays Harbor Lead Entity (2011).

Table 3
Salmonid Species Present by Project and Scores for Prioritization

Project Identifier	Location	Salmonid Species (3 points per species)						Total	Weighted Total
		Spring Chinook	Fall Chinook	Coho	Winter Steelhead	Chum	Cutthroat Trout		
BL-6	Black River	0	3	3	3	3	3	15	13.75
BF-4	South Fork Chehalis	3	3	3	3	0	3	15	13.75
BF-5	South Fork Chehalis Confluence	3	3	3	3	0	3	15	13.75
BF-6		3	3	3	3	0	3	15	13.75
CH-1	River Miles 66 to 81	3	3	3	3	0	3	15	13.75
CH-6	State Route 6 oxbow	3	3	3	3	0	3	15	13.75
CH-7	Oxbow Lake Reconnection	3	3	3	3	0	3	15	13.75
CH-8	WDFW Pheasant Farm	3	3	3	3	0	3	15	13.75
CH-9	Scheuber Ditch	3	3	3	3	0	3	15	13.75
CH-10	Near Gaddis Creek Confluence RM 34	3	3	3	3	0	3	15	13.75
CH-11	Near RM 36	3	3	3	3	0	3	15	13.75
CH-12	Near RM 42	3	3	3	3	0	3	15	13.75
CH-13	Near RM 43	3	3	3	3	0	3	15	13.75
CH-14	Near Garrard Creek Confluence Chehalis RM 46	3	3	3	3	0	3	15	13.75
CH-15	Near RM 50	3	3	3	3	0	3	15	13.75
CH-16	Near Chehalis Village Chehalis RM 54	3	3	3	3	0	3	15	13.75

Project Identifier	Location	Salmonid Species (3 points per species)						Total	Weighted Total
		Spring Chinook	Fall Chinook	Coho	Winter Steelhead	Chum	Cutthroat Trout		
CH-17	Near RM 56-58	3	3	3	3	0	3	15	13.75
CH-17a	Near RM 58	3	3	3	3	0	3	15	13.75
CH-18	Dry Creek confluence Chehalis RM 60	3	3	3	3	0	3	15	13.75
CH-20	Near RM 68	3	3	3	3	0	3	15	13.75
CH-21	Near RM 78	3	3	3	3	0	3	15	13.75
CH-22	Near RM 79	3	3	3	3	0	3	15	13.75
Ch-23	Near RM 82	3	3	3	3	0	3	15	13.75
CH-24	Near RM 83	3	3	3	3	0	3	15	13.75
CH-25	Near RM 85	3	3	3	3	0	3	15	13.75
CH-26	Near RM 88	3	3	3	3	0	3	15	13.75
LI-12	Gaddis Creek floodplain Near Chehalis RM 34	0	0	3	0	0	3	6	5.5
LI-13	Rock/Williams Creek floodplain Near Chehalis RM 40	3	3	3	3	0	3	15	13.75
LI-14	Bunker Creek floodplain Near Chehalis RM 85	0	0	3	3	0	3	9	8.25
NE-8	Dillenbaugh Creek	0	0	3	0	0	3	6	5.5
NE-9	Newaukum River	3	3	3	3	0	3	15	13.75
NE-10a	Salzer Creek Lower Mile Oxbow Reconnection and Riparian Restoration	0	0	3	0	0	3	6	5.5
NE-10b	Salzer Creek I-5 to BNRR Riparian and In-Channel Restoration	0	0	3	0	0	3	6	5.5
NE-10c	Salzer-Coal Creek Fairgrounds Floodplain and Channel Restoration	0	0	3	0	0	3	6	5.5
NE-10d	Salzer Creek at Centralia Alpha Road Floodplain Storage and Riparian Restoration	0	0	3	0	0	3	6	5.5
NE-10e	Salzer Creek at Proffitt Road Riparian Restoration	0	0	3	0	0	3	6	5.5
NE-13	Newaukum River/Newaukum Valley Golf Course	3	3	3	3	0	3	15	13.75

Project Identifier	Location	Salmonid Species (3 points per species)						Total	Weighted Total
		Spring Chinook	Fall Chinook	Coho	Winter Steelhead	Chum	Cutthroat Trout		
NE-15	Newaukum Confluence	3	3	3	3	0	3	15	13.75
NE-16	Stan Hedwall Park Floodplain Reconnection	3	3	3	3	0	3	15	13.75
NE-17	Rice Road Floodplain/Side Channel Restoration	3	3	3	3	0	3	15	13.75
NE-18	North Fork/South Fork Newaukum Confluence Riparian Restoration	3	3	3	3	0	3	15	13.75
NE-19	North Fork Newaukum River at Tauscher Road	3	3	3	3	0	3	15	13.75
NE-20	Middle Fork Newaukum	0	0	3	3	0	3	9	8.25
NE-21	Middle Fork Newaukum Preservation	0	0	3	3	0	3	9	8.25
SK-5	Scatter Creek	0	0	3	0	0	3	6	5.5
SK-8a	Near RM 6	3	3	3	3	0	3	15	13.75
SK-8b	Near RM 6.5	3	3	3	3	0	3	15	13.75
SK-9	Near RM 7	3	3	3	3	0	3	15	13.75
SK-11	Near RM 10	3	3	3	3	0	3	15	13.75
SK-12	Near RM 11	3	3	3	3	0	3	15	13.75
SK-13	Near RM 12	3	3	3	3	0	3	15	13.75
SK-14	Near RM 13	3	3	3	3	0	3	15	13.75
SK-15	Near RM 14	3	3	3	3	0	3	15	13.75

BF = Boisfort
BL = Black
CH= Chehalis Mainstem
LI = Lincoln
NE = Newaukum
SK = Skookumchuck

4.1.3 Size of Project

The length of off-channel and side-channel habitats created or restored, as well as the area of riparian vegetation restoration was used as a criterion. It was assumed that the more off-channel and side-channel habitats and riparian acreage restored, the bigger the benefit to salmonid habitat. The length of habitat restored was estimated using GIS software. The estimated amount of off-channel and side-channel habitat restored in each project was

scored in the following way: greater than 10,000 feet off-channel habitat restored = 5 points; between 1,000 and 10,000 feet = 3 points; and less than 1,000 feet = 1 point (Table 4). The estimated amount of riparian acreage restored in each project was scored in a similar manner: greater than 100 acres riparian = 5 points; between 10 and 100 acres = 3 points; and less than 10 acres = 1 point.

Table 4

Estimated Amount of Habitat Restored by Project and Size Scores for Prioritization

		Estimated Amount of Habitat Restored					
		Side channel/off channel: >10,000 feet = 5 pts, between 1,000-10,000 feet = 3 pts, <1,000 = 1 pt		Riparian: >100 acres riparian = 5 pts, between 10-100 acres = 3 pts, <10 acres = 1 pt			
		Side-channel/Off-channel		Riparian			
Project Identifier	Location	Length (ft)	Points	Area (acres)	Points	Total	Weighted Total
BL-6	Black River Preservation	0	0	200	5	5	4.3
BF-4	South Fork Chehalis	0	0	197	5	5	4.3
BF-5	South Fork Chehalis Confluence	0	0	7	1	1	0.9
BF-6	Elk Creek Preservation	0	0	200	5	5	4.3
CH-1	River Miles 66 to 81	0	0	389	5	5	4.3
CH-6	State Route 6 oxbow	5,450	3	74	3	6	5.1
CH-7	Oxbow Lake Reconnection	5,077	3	12	3	6	5.1
CH-8	WDFW Pheasant Farm	3,495	3	8	1	4	3.4
CH-9	Scheuber Ditch	12,600	5	79	3	8	6.8
CH-10	Near Gaddis Creek Confluence RM 34	13,744	5	35	3	8	6.8
CH-11	Near RM 36	8,754	3	20	3	6	5.1
CH-12	Near RM 42	4,381	3	10	3	6	5.1
CH-13	Near RM 43	16,075	5	49	3	8	6.8
CH-14	Near Garrard Creek Confluence Chehalis RM 46	7,062	3	16	3	6	5.1
CH-15	Near RM 50	5,409	3	17	3	6	5.1
CH-16	Near Chehalis Village Chehalis RM 54	8,868	3	25	3	6	5.1

Project Identifier	Location	Estimated Amount of Habitat Restored				Total	Weighted Total
		Side channel/off channel: >10,000 feet = 5 pts, between 1,000-10,000 feet = 3 pts, <1,000 = 1 pt		Riparian: >100 acres riparian = 5 pts, between 10-100 acres = 3 pts, <10 acres = 1 pt			
		Side-channel/Off-channel		Riparian			
		Length (ft)	Points	Area (acres)	Points		
CH-17	Near RM 56-58	11,995	5	27	3	8	6.8
CH-17a	Near RM 58	1,951	3	9	1	4	3.4
CH-18	Dry Creek confluence Chehalis RM 60	2,423	3	6	1	4	3.4
CH-20	Near RM 68	285	1	2	1	2	1.7
CH-21	Near RM 78	2,350	3	12	3	6	5.1
CH-22	Near RM 79	893	1	2	1	2	1.7
Ch-23	Near RM 82	1,061	3	2	1	4	3.4
CH-24	Near RM 83	876	1	16	3	4	3.4
CH-25	Near RM 85	0	0	33	3	3	2.6
CH-26	Near RM 88	6,042	3	16	3	6	5.1
LI-12	Gaddis Creek floodplain Near Chehalis RM 34	0	0	0	0	0	0.0
LI-13	Rock/Williams Creek floodplain Near Chehalis RM 40	0	0	0	0	0	0.0
LI-14	Bunker Creek floodplain Near Chehalis RM 85	0	0	0	0	0	0.0
NE-8	Dillenbaugh Creek	1,550	3	22	3	6	5.1
NE-9	Newaukum River	0	0	347	3	3	
NE-10a	Salzer Creek Lower Mile Oxbow Reconnection and Riparian Restoration	950	1	27	3	4	3.4
NE-10b	Salzer Creek I-5 to BNRR Riparian and In-Channel Restoration	0	0	11	3	3	2.6
NE-10c	Salzer-Coal Creek Fairgrounds Floodplain and Channel Restoration	0	0	59	3	3	2.6

Project Identifier	Location	Estimated Amount of Habitat Restored				Total	Weighted Total
		Side channel/off channel: >10,000 feet = 5 pts, between 1,000-10,000 feet = 3 pts, <1,000 = 1 pt		Riparian: >100 acres riparian = 5 pts, between 10-100 acres = 3 pts, <10 acres = 1 pt			
		Side-channel/Off-channel		Riparian			
		Length (ft)	Points	Area (acres)	Points		
NE-10d	Salzer Creek at Centralia Alpha Road Floodplain Storage and Riparian Restoration	0	0	16	3	3	2.6
NE-10e	Salzer Creek at Proffitt Road Riparian Restoration	0	0	15	3	3	2.6
NE-13	Newaukum River/Newaukum Valley Golf Course	0	0	0	0	0	0.0
NE-15	Newaukum Confluence	0	0	6	1	1	0.9
NE-16	Stan Hedwall Park Floodplain Reconnection	600	1	48	3	4	3.4
NE-17	Rice Road Floodplain/Side Channel Restoration	0	0	15	3	3	2.6
NE-18	North Fork/South Fork Newaukum Confluence Riparian Restoration	0	0	30	3	3	2.6
NE-19	North Fork Newaukum River at Tauscher Road	0	0	8	1	1	0.9
NE-20	Middle Fork Newaukum	0	0	16	3	3	2.6
NE-21	Middle Fork Newaukum Preservation	0	0	200	5	5	4.25
SK-5	Scatter Creek	0	0	10	3	3	2.6
SK-8a	Near RM 6	548	1	1	1	2	1.7
SK-8b	Near RM 6.5	807	1	2	1	2	1.7
SK-9	Near RM 7	846	1	2	1	2	1.7
SK-11	Near RM 10	1,012	3	2	1	4	3.4
SK-12	Near RM 11	1,553	3	4	1	4	3.4
SK-13	Near RM 12	2,589	3	6	1	4	3.4
SK-14	Near RM 13	1,266	3	3	1	4	3.4
SK-15	Near RM 14	976	1	2	1	2	1.7

BF = Boisfort

BL = Black
CH= Chehalis Mainstem
LI = Lincoln
NE = Newaukum
SK = Skookumchuck

4.1.4 Certainty of Response

Restoration activities that have a long life, high likelihood of success, low variability among projects, and relatively quick response times should be prioritized over other activities (Roni et al. 2002). The hierarchy is to preserve intact habitats first; remove migration barriers (i.e., reconnect floodplain with off channel and side channel habitats) second; restore watershed processes third; and enhance instream habitat last. For this report, preservation projects received 7 points; floodplain reconnection projects received 5 points; watershed processes restoration projects received 3 points; and instream habitat enhancement projects received 1 point (Table 5). Each project was assigned one score based on primary project type. For example, CH-10 received 3 points because it is a riparian restoration project that restores the riparian watershed process. CH-7 received 5 points because it reconnects the floodplain to an existing oxbow.

Table 5
Certainty of Project Response and Scores for Prioritization

Project Identifier	Location	Certainty of Project Success (preservation = 7 pts, reconnect floodplain habitats = 5 pts, restore watershed processes = 3 pts, instream habitat enhancement = 1 pt)	Weighted Total
BL-6	Black River Preservation	7	8.5
BF-4	South Fork Chehalis	3	3.6
BF-5	South Fork Chehalis Confluence	3	3.6
BF-6	Elk Creek Preservation	7	8.5
CH-1	River Miles 66 to 81	3	3.6
CH-6	State Route 6 oxbow	5	6.1
CH-7	Oxbow Lake Reconnection	5	6.1
CH-8	WDFW Pheasant Farm	5	6.1
CH-9	Scheuber Ditch	5	6.1
CH-10	Near Gaddis Creek Confluence RM 34	3	3.6

Project Identifier	Location	Certainty of Project Success (preservation = 7 pts, reconnect floodplain habitats = 5 pts, restore watershed processes = 3 pts, instream habitat enhancement = 1 pt)	Weighted Total
CH-11	Near RM 36	5	6.1
CH-12	Near RM 42	3	3.6
CH-13	Near RM 43	5	6.1
CH-14	Near Garrard Creek Confluence Chehalis RM 46	3	3.6
CH-15	Near RM 50	3	3.6
CH-16	Near Chehalis Village Chehalis RM 54	3	3.6
CH-17	Near RM 56-58	3	3.6
CH-17a	Near RM 58	5	6.1
CH-18	Dry Creek confluence Chehalis RM 60	3	3.6
CH-20	Near RM 68	5	6.1
CH-21	Near RM 78	3	3.6
CH-22	Near RM 79	3	3.6
Ch-23	Near RM 82	3	3.6
CH-24	Near RM 83	3	3.6
CH-25	Near RM 85	3	3.6
CH-26	Near RM 88	3	3.6
LI-12	Gaddis Creek floodplain Near Chehalis RM 34	3	3.6
LI-13	Rock/Williams Creek floodplain Near Chehalis RM 40	3	3.6
LI-14	Bunker Creek floodplain Near Chehalis RM 85	3	3.6
NE-8	Dillenbaugh Creek	5	6.1
NE-9	Newaukum River	3	3.6
NE-10a	Salzer Creek Lower Mile Oxbow Reconnection and Riparian Restoration	5	6.1
NE-10b	Salzer Creek I-5 to BNRR Riparian and In-Channel Restoration	3	3.6
NE-10c	Salzer-Coal Creek Fairgrounds Floodplain and Channel Restoration	3	3.6
NE-10d	Salzer Creek at Centralia Alpha Road Floodplain Storage and Riparian Restoration	3	3.6

Project Identifier	Location	Certainty of Project Success (preservation = 7 pts, reconnect floodplain habitats = 5 pts, restore watershed processes = 3 pts, instream habitat enhancement = 1 pt)	Weighted Total
NE-10e	Salzer Creek at Proffitt Road Riparian Restoration	3	3.6
NE-13	Newaukum River/Newaukum Valley Golf Course	3	3.6
NE-15	Newaukum Confluence	3	3.6
NE-16	Stan Hedwall Park Floodplain Reconnection	5	6.1
NE-17	Rice Road Floodplain/Side Channel Restoration	5	6.1
NE-18	North Fork/South Fork Newaukum Confluence Riparian Restoration	3	3.6
NE-19	North Fork Newaukum River at Tauscher Road	3	3.6
NE-20	Middle Fork Newaukum	5	6.1
NE-21	Middle Fork Newaukum Preservation	7	8.5
SK-5	Scatter Creek	3	3.6
SK-8a	Near RM 6	3	3.6
SK-8b	Near RM 6.5	3	3.6
SK-9	Near RM 7	5	6.1
SK-11	Near RM 10	5	6.1
SK-12	Near RM 11	3	3.6
SK-13	Near RM 12	5	6.1
SK-14	Near RM 13	5	6.1
SK-15	Near RM 14	5	6.1

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LI = Lincoln
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SK = Skookumchuck

4.1.5 Project Ranking

A composite score for each floodplain and riparian project was calculated based on the scoring assignments described above (Sections 4.1 through 4.1.4) and the weighting factor assigned to each habitat limiting factor. The following formula describes this calculation.

$(HLF_{SC} * HLF_{WGT}) + (Species_{SC} * Species_{WGT}) + (Size_{SC} * Size_{WGT}) + (Certainty_{SC} * Certainty_{WGT})$
(Prioritization Score)

where:
HLF = habitat limiting factors
Species = Number of salmonid species
Size = Size of project
Certainty = Certainty of project success
SC = score
WGT = weighting factor

The prioritization scores for each project are presented in Table 6, which shows the projects ranked from highest score (i.e., highest priority) to lowest score (i.e., lowest priority). The highest ranked floodplain and riparian projects are located in the mainstem of Chehalis River. The Chehalis mainstem scored high because all the salmonid species use this area either as a migration corridor, spawning grounds, or rearing habitat. The size of these projects was also relatively large.

Table 6

Ranking of WRIA 23 Floodplain and Riparian Projects from Highest to Lowest

Project Identifier	Location	Type of Project	Limiting Factors Addressed	Number of Species	Size of Project	Certainty of Response	Total Score	Rank
CH-13	Near RM 43	Oxbow reconnection, side channel/floodplain enhancement	11.9	16.5	6.8	6.1	41.3	1
CH-11	Near RM 36	Oxbow reconnection, side channel/floodplain enhancement	11.9	16.5	5.1	6.1	39.6	2
CH-6	State Route 6 oxbow	Oxbow reconnection, riparian restoration, install LWD	11.9	16.5	5.1	6.1	39.6	2
CH-7	Oxbow Lake Reconnection	Oxbow reconnection, riparian restoration, install LWD	11.9	16.5	5.1	6.1	39.6	2
CH-17	Near RM 56-58	Side channel/floodplain enhancement	11.9	16.5	6.8	3.6	38.9	3
CH-10	Near Gaddis Creek Confluence RM 34	Side channel/floodplain enhancement	11.9	16.5	6.8	3.6	38.9	3
CH-17a	Near RM 58	Side channel/floodplain enhancement	11.9	16.5	3.4	6.1	37.9	4
BL-6	Black River, R M 0-10	Preservation	8.3	16.5	4.3	8.5	37.5	5
BF-6	Elk Creek Preservation	Preservation	8.3	16.5	4.3	8.5	37.5	5
CH-14	Near Garrard Creek Confluence Chehalis RM 46	Side channel/floodplain enhancement	11.9	16.5	5.1	3.6	37.2	6
CH-15	Near RM 50	Side channel/floodplain enhancement	11.9	16.5	5.1	3.6	37.2	6
CH-21	Near RM 78	Oxbow reconnection, side channel/floodplain enhancement	11.9	16.5	5.1	3.6	37.2	6
CH-16	Near Chehalis Village Chehalis RM 54	Side channel/floodplain enhancement	11.9	16.5	5.1	3.6	37.2	6
CH-12	Near RM 42	Floodplain enhancement	11.9	16.5	5.1	3.6	37.2	6

Project Identifier	Location	Type of Project	Limiting Factors Addressed	Number of Species	Size of Project	Certainty of Response	Total Score	Rank
CH-26	Near RM 89	Floodplain enhancement	11.9	16.5	5.1	3.6	37.2	6
CH-1	RM 66 to 81	Riparian restoration	11.9	16.5	4.3	3.6	36.3	7
CH-20	Near RM 68	Oxbow reconnection, side channel/floodplain enhancement	11.9	16.5	1.7	6.1	36.2	8
SK-14	Near RM 13	Side channel/floodplain enhancement	10.1	16.5	3.4	6.1	36.1	9
SK-13	Near RM 12	Side channel/floodplain enhancement	10.1	16.5	3.4	6.1	36.1	9
SK-11	Near RM 10	Floodplain enhancement	10.1	16.5	3.4	6.1	36.1	9
CH-18	Dry Creek confluence Chehalis RM 60	Floodplain enhancement	11.9	16.5	3.4	3.6	35.5	10
CH-23	Near RM 82	Side channel/floodplain enhancement	11.9	16.5	3.4	3.6	35.5	10
CH-24	Near RM 83	Floodplain enhancement	11.9	16.5	3.4	3.6	35.5	10
CH-8	WDFW Pheasant Farm	High-flow side channel restoration, wetland restoration, riparian restoration	9.2	16.5	3.4	6.1	35.1	11
CH-25	Near RM 85	Floodplain enhancement	11.9	16.5	2.6	3.6	34.6	12
SK-15	Near RM 14	Side channel/floodplain enhancement	10.1	16.5	1.7	6.1	34.4	13
SK-9	Near RM 8	Side channel/floodplain enhancement	10.1	16.5	1.7	6.1	34.4	13
NE-16	Stan Hedwall Park Floodplain Reconnection	Floodplain, riparian restoration, install LWD	8.3	16.5	3.4	6.1	34.2	14
CH-22	Near RM 79	Floodplain enhancement	11.9	16.5	1.7	3.6	33.8	15
SK-12	Near RM 11	Side channel/floodplain enhancement	10.1	16.5	3.4	3.6	33.6	16

Project Identifier	Location	Type of Project	Limiting Factors Addressed	Number of Species	Size of Project	Certainty of Response	Total Score	Rank
NE-17	Rice Road Floodplain/Side Channel Restoration	Floodplain, riparian restoration, install LWD	8.3	16.5	2.6	3.6	33.4	17
SK-8a	Near RM 7	Riparian restoration	10.1	16.4	1.7	3.6	31.9	18
SK-8b	Near RM 7.5	Side channel/floodplain enhancement	10.1	16.5	1.7	3.6	31.9	19
LI-13	Rock/Williams Creek Floodplain Near Chehalis RM 40	Floodplain enhancement	10.1	16.5	0	3.6	30.2	20
NE-9	Newaukum River	Riparian restoration	7.3	16.5	2.6	3.6	30.0	21
BF-4	South Fork Chehalis	Riparian restoration	5.5	16.5	4.3	3.6	29.9	22
NE-15	Newaukum Confluence	Riparian restoration, install LWD	8.3	16.5	0.9	3.6	29.2	23
NE-13	Newaukum River/Newaukum Valley Golf Course	In-channel enhancements	7.3	16.5	0	3.6	29.2	23
NE-21	Middle Fork Newaukum Preservation	Preservation	6.4	9.9	4.3	8.5	29.1	24
NE-18	North Fork/South Fork Newaukum Confluence Riparian Restoration	Riparian restoration	5.5	16.5	2.6	3.6	28.2	25
CH-9	Scheuber Ditch	Floodplain, riparian restoration, install LWD	11.9	3.3	6.8	6.1	28.1	26
NE-20	Middle Fork Newaukum	Riparian preservation and restoration	6.4	9.9	2.6	8.5	27.4	27
NE-19	North Fork Newaukum River at Tauscher Road	Riparian restoration, install LWD	5.5	16.5	0.9	3.6	26.5	28
BF-5	South Fork Chehalis Confluence	Riparian Restoration	5.5	16.5	0.9	3.6	26.5	28

Project Identifier	Location	Type of Project	Limiting Factors Addressed	Number of Species	Size of Project	Certainty of Response	Total Score	Rank
NE-8	Dillenbaugh Creek	Oxbow reconnection	8.3	6.6	5.1	6.1	26.0	29
NE-10a	Salzer Creek Lower Mile Oxbow Reconnection and Riparian Restoration	Oxbow reconnection, riparian restoration, install LWD, wetland creation and restoration	8.3	6.6	3.4	6.1	24.3	30
SK-5	Scatter Creek	Riparian Restoration	10.1	6.6	2.6	3.6	22.9	31
LI-14	Bunker Creek floodplain Near Chehalis RM 85	Floodplain enhancement	10.1	9.9	0	1.2	21.2	32
NE-10b	Salzer Creek I-5 to BNRR Riparian and In-channel Restoration	Stream and riparian restoration	8.3	6.6	2.6	3.6	21.0	33
NE-10d	Salzer Creek at Centralia Alpha Road Floodplain Storage and Riparian Restoration	Stream and riparian restoration, install LWD, wetland creation and restoration	8.3	6.6	2.6	3.6	21.0	33
NE-10e	Salzer Creek at Proffitt Road Riparian Restoration	Riparian restoration, install LWD	8.3	6.6	2.6	3.6	21.0	33
LI-12	Gaddis Creek floodplain Near Chehalis RM 34	Floodplain enhancement	10.1	6.6	0	3.6	20.3	34
NE-10c	Salzer Creek Lower Mile Oxbow Reconnection and Riparian Restoration	Relocate levee, stream and riparian restoration, wetland creation and restoration	7.3	6.6	2.6	3.6	20.1	35

BF = Boisfort
BL = Black
CH= Chehalis Mainstem
LI = Lincoln
NE = Newaukum
SK = Skookumchuck

If several projects received the same score in Table 6, then they also received the same rank. Based on the prioritization approach, the highest ranked projects have the highest potential to benefit salmonids.

4.2 Culvert Projects

Within the study area of WRIA 23, there are 643 barrier culverts (WDFW 2012). Those barriers are shown as yellow, orange, and red dots on Appendix A, Figures 2 through 6. MCD ranked 2,677 barriers within the Chehalis basin (MCD 2010; Appendix A, Figures 2 through 6). Appendix A, Table 4, provides a complete list of barriers that were ranked by MCD as Tier 1 in WRIA 23 and are still in need of funding for removal. LCCD has updated the MCD barrier database with habitat data collected upstream of each barrier using WDFW protocols (LCCD 2006, 2007, and 2009; Appendix A, Figures 2 through 6). Cost estimates of the combined MCD Tier 1 culverts and LCCD prioritized culverts (300 total) are provided in Section 5 and Appendix C of this report. The owners of these culverts include private, city, county, state, and federal entities. Any culvert replacement would require owner permissions before being conducted.

Culverts identified and prioritized by LCCD using WDFW protocols are included in Table 7 (30 of these are also found in the MCD Tier 1 list). Each of these culverts was given a priority index score based on percent passable, number of salmonid species present, and area of habitat upstream of the culvert. This list of culvert projects from LCCD should be given priority when considering which culverts to replace first.

Table 7
LCCD Prioritized Culvert Projects in WRIA 23

Culvert Identifier	Management Unit	Priority Index	Stream Name	Comments
125 1404W15A	Lincoln	33.83	Bunker Creek	
125 1403W34A	Lincoln	25.93	Mill Creek	
125 1303W31A	Boisfort	24.37	Unnamed	
021(31013)(02557)	Lincoln	23.88	Ripple Creek	Identified in MCD 2010
021(24002)(01505)	Lincoln	20.74	Mill Creek	Identified in MCD 2010
125 1303W06A	Lincoln	20.46	Unnamed	

Culvert Identifier	Management Unit	Priority Index	Stream Name	Comments
1303W06A	Lincoln	20.46	Unnamed	
021(24024)(03932)	Lincoln	20.31	Tapp Creek	Identified in MCD 2010
125 1707W14A		19.93	Unnamed	
125 1505W11A	Lincoln	19.04	Unnamed	
021(24034)(02386)	Lincoln	18.47	Van Ornum Creek	Identified in MCD 2010
021(94006)(01315)	Newaukum	18.47	Allen Creek	Identified in MCD 2010
021(28001)(05816)	Lincoln	18.16	Unknown	Identified in MCD 2010
125 1301W23D	Newaukum	18.00	MF Newaukum River	Identified in MCD 2010
125 1403W32B	Lincoln	17.99	Van Ornum Creek	
125 1301E34A	Newaukum	17.60	Lost Creek	Identified in MCD 2010
125 1302W12E	Newaukum	17.53	Berwick Creek	
1302W12E	Newaukum	17.53	Berwick Creek	
125 1505W11B	Lincoln	17.14	Unnamed	
125 1503W12A	Lincoln	16.95	Unnamed	
1404W17A	Lincoln	16.81	Bunker Creek	
125 1304W03A	Boisfort	16.80	Nicholson Creek	
1304W03A	Boisfort	16.80	Nicholson Creek	
125 1503W17A	Lincoln	16.80	Unnamed	
125 1403W32A	Lincoln	16.56	Unnamed	
1504W21A	Lincoln	16.45		
021(40077)(00103)	Newaukum	16.22	Berwick Creek	Identified in MCD 2010
021(10019)(13700)	Lincoln	15.87	Wildcat Creek	Identified in MCD 2010
021(10000)(00271)	Lincoln	15.69	Unnamed	Identified in MCD 2010
125 1703W17A	Black	15.47	Unnamed	
125 1303W07A	Lincoln	15.41	Unnamed	
1303W07A	Lincoln	15.41	Unnamed	
125 1403W32C	Lincoln	15.38	Van Ornum Creek	

Culvert Identifier	Management Unit	Priority Index	Stream Name	Comments
021(45011)(07070)	Newaukum	15.00	MF Newaukum River	Identified in MCD 2010
021(23000)(00460)	Lincoln	14.87	Unnamed	
125 1504W15A	Lincoln	14.84	Unnamed	
125 1403W30A	Lincoln	14.64	Van Ornum Creek	
125 1503W07A	Lincoln	14.63	Unnamed	
125 1503W31C	Lincoln	14.48	Sponenbergh Creek	
125 1304W12A	Lincoln	14.32	Unnamed	
125 1503W31A	Lincoln	14.07	Sponenbergh Creek	
021(10004)(01019)	Lincoln	13.74	Unnamed	Identified in MCD 2010
125 1504W28A	Lincoln	13.65	Unnamed	
125 1304W01A	Lincoln	13.47	Unnamed	
1304W01A	Lincoln	13.47	Unnamed	
125 1302W28B	Lincoln	13.40	Ripple Creek	
1302W28B	Lincoln	13.40	Ripple Creek	
125 1503W31B	Lincoln	13.12	Unnamed	
021(24038)(07422)	Lincoln	13.04	Stearns Creek	Identified in MCD 2010
125 1301E23A	Newaukum	13.00	Unnamed	
125 1402W01A	Skookumchuck	13.00	Unnamed	
341973	Lincoln	12.96	Unnamed	
021(24034)(08899)	Lincoln	12.89	Bunker Creek	Identified in MCD 2010
021(24019)(04778)	Boisfort	12.87	Halfway Creek	Identified in MCD 2010
341513	Black	12.24	Salmon Creek	
125 1304W35A	Boisfort	12.11	Beaver Creek	
021(94001)(15790)	Newaukum	12.00	MF Newaukum River	Identified in MCD 2010
021(25510)(00106)	Boisfort	11.68	Lost Creek	Identified in MCD 2010
125 1303W04C	Lincoln	11.56	Unnamed	
1303W04C	Lincoln	11.56	Unnamed	
1302W31A	Lincoln	11.48	Unnamed	

Culvert Identifier	Management Unit	Priority Index	Stream Name	Comments
021(91019)(05513)	Skookumchuck	11.43	Packwood Creek	Identified in MCD 2010
021(10004)(00716)	Lincoln	10.97	Unnamed	Identified in MCD 2010
021(27000)(02426)	Boisfort	10.67	Taylor Creek	Identified in MCD 2010
125 1403W29B	Lincoln	10.67	Unnamed	
125 1503W17B	Lincoln	10.63	Unnamed	
125 1303W04D	Lincoln	10.57	Unnamed	
1303W04D	Lincoln	10.57	Unnamed	
125 1303W04A	Lincoln	10.51	Unnamed	
1303W04A	Lincoln	10.51	Unnamed	
125 1707W13A		10.27	Unnamed	
021(25401)(03773)	Boisfort	10.19	Lost Creek	Identified in MCD 2010
021(27501)(02750)	Boisfort	10.18	Marcuson Creek	Identified in MCD 2010
125 1301E10B	Newaukum	10.00	MF Newaukum River	
021(10004)(01168)	Lincoln	9.92	Unnamed	Identified in MCD 2010
1203W31B	Boisfort	8.76	Root House Creek	Identified in MCD 2010
1203W30A	Boisfort	8.54	Root House Creek	
125 1203W30A	Boisfort	8.54	Root House Creek	
021(24034)(00730)	Lincoln	8.48	Unknown	Identified in MCD 2010
125 1301E23B	Newaukum	8.26	Lost Creek	
125 1703W17G	Black	7.71	Unnamed	
021(24019)(04032)	Boisfort	7.42	Halfway Creek	
1402W24A	Newaukum	7.18		
125 1405W24A	Lincoln	7.10	Unnamed	
125 1402W24B	Newaukum	7.09	Unnamed	
021(10004)(01536)	Lincoln	6.59	Unnamed	Identified in MCD 2010
125 1703W17H	Black	6.35	Unnamed	
021(15080)(01316)	Newaukum	6.19	Unnamed	Identified in MCD 2010

Culvert Identifier	Management Unit	Priority Index	Stream Name	Comments
125 1305W25B	Boisfort	3.68	Katula Creek	
021(24019)(02040)	Boisfort	3.64	Jones Creek	Identified in MCD 2010
1305W23D	Boisfort	3.26	Unnamed	Identified in MCD 2010

5 ENHANCEMENT BENEFITS

The number of fish barriers fixed, linear feet of floodplain (off-channel) habitat enhanced, riparian acreage restored, and LWD pieces added from all the enhancement projects identified in Section 3 is summarized by MU in Table 8. Floodplain projects were only identified in MUs where floodplain condition was a Tier 1 limiting factor. Therefore, the Black and Boisfort MUs have zero linear feet of floodplain enhanced. The Lincoln MU is a Tier 1 for floodplain conditions but specific areas of floodplain enhancement were not identified. Linear feet of enhancement could not be calculated for the Lincoln MU.

Table 8
Quantity of Enhancement

Management Unit	Number of Fish Barriers Fixed	Linear Feet of Floodplain Enhanced	Acres Riparian Preservation/Restoration	LWD Pieces Added
Black	15	0	200	0
Boisfort	73	0	404	0
Lincoln	114	0	0	0
Newaukum	54	3,100	620	560
Skookumchuck	44	9,597	32	800
Chehalis Mainstem	0	118,790	859	2,336
Total	300	131,487	2,115	3,696

Estimating watershed-scale increases in fish due to a suite of restoration techniques and estimating the amount of restoration needed to measurably increase fish production continue to be pressing research needs. This is because scientists cannot estimate the effectiveness of certain restoration techniques and it is not known which habitats or other factors actually "limit" fish abundance and the size of most salmon populations (Roni et al. 2010). Regional and watershed level monitoring programs are being developed to measure increases in salmonid production at a watershed scale but these programs will not be able to evaluate restoration success for many years because of the high inter-annual variation in fish abundance among both years and sites (Roni et al. 2010).

Although the SHIRAZ fish population model was used for the Chehalis River Flood Storage Dam Fish Population Study (Anchor QEA 2012) to determine potential habitat impacts from

a dam on the mainstem Chehalis River, the SHIRAZ model only addressed impacts to the mainstem Chehalis River and did not cover tributaries. The data needed to prepare a SHIRAZ model that includes tributaries is not available and could not be developed in the timeframe and budget allowed for this study. Thus, another simpler but adaptive approach was used to estimate the enhancement benefits throughout WRIA 23. However, the approach used was informed by the results of the SHIRAZ modeling.

The approach used was developed by the Remand Habitat Workgroup (RHW) in the Columbia River (personal communication with Tracy Hillman, Bioanalysts Inc., Boise, Idaho). The RHW approach estimates overall habitat quality and freshwater (egg-to-smolt) survival benefits for salmonid from restoration actions.

With information from existing literature on limiting factors, current and potential status of habitat variables, habitat actions, and weightings, it is possible to estimate existing and potential local habitat conditions for each management unit using the RHW approach. The estimates of habitat benefits performed in this section assume that all of the enhancement projects listed will be implemented. The combination of all the projects is synergistic and will provide improved habitat for multiple salmonid life stages. Benefits from the proposed projects include more and improved rearing area in the floodplain, access to tributaries for spawning and rearing, and increased riparian functions (i.e., reduced water temperatures, increased LWD recruitment, and increased terrestrial food supply for fish).

Table 9 presents calculations of habitat quality under current conditions and with the habitat enhancements described in this study.

The inputs and assumptions made for each column (A to M) in Table 9 are described below.

- **Management Unit (Column A):** Each MU of WRIA 23 was included in the analysis: Black, Boisfort, Chehalis Mainstem, Lincoln, Neuwakum, and Skookumchuck.
- **MU Weight (proportion of population area, Column B):** Each MU was given an equal weight. The Chehalis mainstem would be underweighted if area was used as a weighting factor. Weighting by area would not reflect the importance of the Chehalis mainstem as a migratory, spawning, and rearing area. Therefore, it was weighted the same as the other MUs.

- **Limiting Factor (Column C):** Limiting factors included the ones selected for the Phase 1 report. These included fish passage, floodplain conditions, riparian conditions, and LWD. Fish passage was not used for the Chehalis mainstem because there are no man-made fish barriers in the MU.
- **Relative Weight of Habitat Variable (Limiting Factor) on Survival (Column D):** Equal weight was given to each limiting factor. This is the common method used by other Washington State entities for the RHW approach. This weight can be adjusted if necessary. For instance different weights can be given to reflect the tiers (Tier 1, 2, or 3) for each limiting factor in a given MU.
- **Current Status of Habitat Variable (percent of optimum, Column E):** The "status" of limiting factors (habitat variables) was described as a percent of optimal condition. As a guide, the definition of properly functioning condition (PFC) developed by the National Oceanic and Atmospheric Administration (NOAA) Fisheries to estimate the status of habitat variables was used (NOAA Fisheries 1996). Tier 1 limiting factors were assumed to have less optimal conditions than Tier 2 and 3 limiting factors within a given MU. Therefore, within a given MU, Tier 1 limiting factors were assumed to be not properly functioning (10 to 50 percent of optimal), Tier 2 limiting factors were functioning at risk (50 to 60 percent of optimal), and Tier 3 limiting factors were properly functioning (70 to 90 percent of optimal). The percentages of optimal are subjective and the ranges listed were used in a sensitivity analysis of habitat quality improvements. The percentages of optimal can be varied as additional information is obtained on existing habitat or the extent of improvement to habitat with enhancement projects.
- **Current Weighted Status of Habitat Variable (Column F):** This column weights each limiting factor based on its effects on fish survival and its current percent of optimal status. It is the weighted status of the limiting factor or Column D times E.
- **Current Local Habitat Condition (Column G):** This column is the sum of the current weighted status of each limiting factor (Column F).
- **Current Overall Habitat Quality Score (Column H):** This column takes the weighted status of each limiting factor (Column G) and multiplies it by the MU weight (Column B). This provides the current overall habitat quality score for WRIA 23 as a percent of optimal.

- **Proposed Habitat Actions (Column I):** These are the proposed enhancement actions to address the limiting factors in Column C.
- **Potential Status of Habitat Variable (% of optimum, Column J):** The improvement in the current condition (Column E) of a limiting factor (Column C) from the proposed enhancement actions (Column I) was estimated using the totals of habitat enhancement in Table 8 for each MU. If the project benefits summarized in Table 8 are realized (i.e., projects built), then it is assumed that, in a given MU, a specific limiting factor could be improved from a Tier 1 to a Tier 2, or a Tier 2 to a Tier 3. The exception to this rule is the mainstem Chehalis MU, which has such a large amount of floodplain enhancement and LWD placement that these limiting factors were improved from Tier 1 to Tier 3. The percentages of optimum for each tier are described in the explanation for Column E.
- **Potential Weighted Status of Habitat Variable (Column K):** This column reflects the weight of the limiting factor (Column C) and the potential percent of optimum after enhancement projects are implemented.
- **Potential Local Habitat Condition (Column L):** Column K is summed to get a MU habitat condition for all the limiting factors combined.
- **Potential Overall Habitat Quality Score (Column M):** Column L is then weighted by the MU weight in Column B to get an overall habitat quality score that represents a percentage of optimum habitat.

Table 9 provides calculations for a low estimate of improvement in habitat quality. This estimate assumed a small difference (10 percent) between percentage of optimum for the 3 tiers (e.g., Tier 1 equals 50 percent, Tier 2 equals 60 percent and Tier 3 equals 70 percent). The habitat quality scores estimated using this approach were 57 percent of optimum for current conditions (Table 9, Column H) and 65 percent of optimum for future conditions (Table 9, Column M) with all of the habitat enhancement projects summarized in Table 8 implemented.

Table 9

Calculation of Habitat Quality Under Existing Conditions and With Enhancement Projects – Low Estimate

				Current Conditions				Resulting Potential Conditions				
[A]	[B]	[C]	[D]	[E]	[F]	[G]	[H]	[I]	[J]	[K]	[L]	[M]
Management Unit	MU Weight (proportion of population area)	Limiting Factor	Relative Weight of Variable on Survival	Current Status of Habitat Variable (% of optimum)	Current Weighted Status of Habitat Variable (D x E)	Current Local Habitat Condition (sum of F)	Current Overall Habitat Quality Score (sum of G x B)	Proposed Habitat Actions	Potential Status of Habitat Variable (% of optimum)	Potential Weighted Status of Habitat Variable (J x D)	Potential Local Habitat Condition (sum of K)	Potential Overall Habitat Quality Score (sum of L x B)
Black	0.166	Fish Passage	0.25	60	15	60.00	57	Culvert replacement	70	17.50	65.00	65
		Floodplain Conditions	0.25	70	17.5			Off channel Reconnection and side channel enhancements	70	17.50		
		Riparian Conditions	0.25	50	12.5			Riparian Restoration	60	15.00		
		Large Woody Debris	0.25	60	15			Woody Debris Treatments	60	15.00		
Boisfort	0.166	Fish Passage	0.25	50	12.5	57.50		Culvert replacement	60	15.00	62.50	
		Floodplain Conditions	0.25	70	17.5			Off channel Reconnection and side channel enhancements	70	17.50		
		Riparian Conditions	0.25	50	12.5			Riparian Restoration	60	15.00		
		Large Woody Debris	0.25	60	15			Woody Debris Treatments	60	15.00		
Chehalis mainstem	0.166	Floodplain Conditions	0.33	50	16.5	52.80		Off channel Reconnection and side channel enhancements	70	23.10	66.00	
		Riparian Conditions	0.33	50	16.5			Riparian Restoration	60	19.80		
		Large Woody Debris	0.33	60	19.8			Woody Debris Treatments	70	23.10		
Lincoln	0.166	Fish Passage	0.25	50	12.5	60.00		Culvert replacement	70	17.50	65.00	
		Floodplain Conditions	0.25	70	17.5			Off channel Reconnection and side channel enhancements	70	17.50		
		Riparian Conditions	0.25	50	12.5			Riparian Restoration	50	12.50		
		Large Woody Debris	0.25	70	17.5			Woody Debris Treatments	70	17.50		
Newaukum	0.166	Fish Passage	0.25	50	12.5	60.00		Culvert replacement	60	15.00	70.00	
		Floodplain Conditions	0.25	70	17.5			Off channel Reconnection and side channel enhancements	80	20.00		
		Riparian Conditions	0.25	50	12.5			Riparian Restoration	60	15.00		
		Large Woody Debris	0.25	70	17.5			Woody Debris Treatments	80	20.00		
Skookumchuck	0.166	Fish Passage	0.25	50	12.5	55.00		Culvert replacement	60	15.00	65.00	
		Floodplain Conditions	0.25	60	15			Off channel Reconnection and side channel enhancements	70	17.50		
		Riparian Conditions	0.25	50	12.5			Riparian Restoration	60	15.00		
		Large Woody Debris	0.25	60	15			Woody Debris Treatments	70	17.50		

Notes:

Numbers in black were provided from existing literature and professional judgment; numbers in red are derived values.

Tier 1 = 50% of Optimum, Tier 2 = 60 %, Tier 3 = 70%

In order to translate this habitat quality improvement to freshwater survival increases, the RHW approach uses a simple linear relationship between habitat quality and egg-to-smolt survival. For Chinook and steelhead, survival was scaled from 0 to the maximum egg-to-smolt survival using relationships developed for the SHIRAZ modeling (Anchor QEA 2012). Habitat quality was scaled from 0 to 100 percent of optimal condition as described above. The resulting egg-to-smolt survival relationship is:

- Chinook salmon egg-to-smolt survival = 0.0045 x (habitat quality score)
- Steelhead egg-to-smolt survival = 0.0045 x (habitat quality score)
- Coho egg-to-smolt survival = 0.0463 x (habitat quality score)

There are several assumptions associated with this approach.

1. Egg-to-smolt survival is the lowest when habitat quality is the lowest and survival is the highest when habitat quality is the highest.
2. Egg-to-smolt survival is directly proportional to habitat quality.
3. Density dependence is not considered.[1]
4. Any effect of hatchery programs on egg-to-smolt survival of naturally produced fish is not considered.

Although some of these assumptions are extremely generalized considering natural biological variability, the overall approach is useful in describing potential changes in survival associated with habitat quality improvements.

The changes in survival associated with habitat quality improvements were estimated using the habitat quality scores from Table 9 and the egg-to-smolt relationships described above. Table 10 provides survival estimates for Chinook and steelhead and Table 11 provides estimates for coho.

The inputs for columns A, B, C, D, and H in Tables 10 and 11 are obtained from Table 9. The above linear relationship between habitat quality and egg-to-smolt survival is then used to determine current and potential survival estimates.

[1] This means that survival is not regulated by mechanisms controlled by the size of the population.

Table 10

Calculation of Egg-to-Smolt Survival for Chinook and Steelhead for Current Conditions and Future with Enhancement Projects – Low Estimate

			Current Condition				Resulting Potential Condition			
[A]	[B]	[C]	[D]	[E]	[F]	[G]	[H]	[I]	[J]	[K]
Assessment Unit	AU Weight (proportion of population area)	Limiting Habitat Variables	Current Local Habitat Condition (from column G in Table 1)	Current Weighted Local Habitat Condition (D x B)	Current Survival Estimate for each AU (E x 0.0045)	Current Survival Estimate for Entire Population (sum of F)	Potential Local Habitat Condition (from column L in Table 1)	Potential Weighted Local Habitat Condition (H x B)	Potential Survival Estimate for each AU (I x 0.0045)	Potential Survival Estimate for Entire Population (sum of J)
Black	0.166	Fish Passage Floodplain Conditions Riparian Conditions Large Woody Debris	60.00	9.96	0.04482		65.00	10.79	0.04856	
Boisfort	0.166	Fish Passage Floodplain Conditions Riparian Conditions Large Woody Debris	57.50	9.545	0.04295		62.50	10.375	0.04669	
Chehalis mainstem	0.166	Floodplain Conditions Riparian Conditions Large Woody Debris	52.80	8.7648	0.03944		66.00	10.956	0.04930	
Lincoln	0.166	Fish Passage Floodplain Conditions Riparian Conditions Large Woody Debris	60.00	9.96	0.04482	0.2579	65.00	10.79	0.04856	0.2939
Newaukum	0.166	Fish Passage Floodplain Conditions Riparian Conditions Large Woody Debris	60.00	9.96	0.04482		70.00	11.62	0.05229	
Skookumchuck	0.166	Fish Passage Floodplain Conditions Riparian Conditions Large Woody Debris	55.00	9.13	0.04109		65.00	10.79	0.04856	

Notes:

Numbers in black were provided from existing literature and professional judgment; numbers in red are derived values.

Tier 1 = 50% of Optimum, Tier 2 = 60 %, Tier 3 = 70%

Table 11

Calculation of Egg-to-Smolt Survival for Coho for Current Conditions and Future with Enhancement Projects – Low Estimate

			Current Condition				Resulting Potential Condition			
[A]	[B]	[C]	[D]	[E]	[F]	[G]	[H]	[I]	[J]	[K]
Assessment Unit	AU Weight (proportion of population area)	Limiting Habitat Variables	Current Local Habitat Condition (from column G in Table 1)	Current Weighted Local Habitat Condition (D x B)	Current Survival Estimate for each AU (E x 0.0463)	Current Survival Estimate for Entire Population (sum of F)	Potential Local Habitat Condition (from column L in Table 1)	Potential Weighted Local Habitat Condition (H x B)	Potential Survival Estimate for each AU (I x 0.00463)	Potential Survival Estimate for Entire Population (sum of J)
Black	0.166	Fish Passage Floodplain Conditions Riparian Conditions Large Woody Debris	60	9.96	0.46115		65.00	10.79	0.49958	
Boisfort	0.166	Fish Passage Floodplain Conditions Riparian Conditions Large Woody Debris	58	9.628	0.44578		62.50	10.375	0.48036	
Chehalis mainstem	0.166	Floodplain Conditions Riparian Conditions Large Woody Debris	53	8.798	0.40735		66.00	10.956	0.50726	
Lincoln	0.166	Fish Passage Floodplain Conditions Riparian Conditions Large Woody Debris	60	9.96	0.46115	2.6593	65.00	10.79	0.49958	3.0244
Newaukum	0.166	Fish Passage Floodplain Conditions Riparian Conditions Large Woody Debris	60	9.96	0.46115		70.00	11.62	0.53801	
Skookumchuck	0.166	Fish Passage Floodplain Conditions Riparian Conditions Large Woody Debris	55	9.13	0.42272		65.00	10.79	0.49958	

Notes:

Numbers in black were provided from existing literature and professional judgment; numbers in red are derived values.

Tier 1 = 50% of Optimum, Tier 2 = 60 %, Tier 3 = 70%

The percentage increase in estimated egg-to-smolt survival with habitat enhancements is the most significant result and less emphasis should be placed on the estimated percentage of egg-to-smolt survival. That is, it is more appropriate to report that a percent increase in salmonid survival is expected from increasing habitat quality than it is to report absolute survivals for the respective habitat quality scores. The absolute survival values are not precise estimates, even though they appear precise.

Using low estimates of improvements to percent of optimum, it is estimated that a 14 percent increase (Column K divided by Column G in Tables 10 and 11) in juvenile steelhead, Chinook, and coho survival is expected from increasing habitat quality from 57 percent to 65 percent (Tables 10 and 11). The inputs in Table 9 reflect a low estimate of improvement from implementing the enhancement projects discussed in Section 3.

Two other scenarios were generated to illustrate how changes in assumptions made in Table 9 can result in different potential survival estimates. In Tables 12 to 14, the beginning percent value of the optimal condition for each Tier 1, 2, and 3 project was changed (Tier 1 = 25 percent of optimal condition, Tier 2 = 50 percent, Tier 3 = 75 percent). This scenario assumes a larger increase in habitat quality would result if the enhancement projects are implemented. This estimate represents a medium estimate of improvements in habitat quality.

Table 12

Calculation of Habitat Quality Under Existing Conditions and With Enhancement Projects – Medium Estimate

				Current Conditions				Resulting Potential Conditions				
[A]	[B]	[C]	[D]	[E]	[F]	[G]	[H]	[I]	[J]	[K]	[L]	[M]
Management Unit	MU Weight (proportion of population area)	Limiting Factor	Relative Weight of Variable on Survival	Current Status of Habitat Variable (% of optimum)	Current Weighted Status of Habitat Variable (D x E)	Current Local Habitat Condition (sum of F)	Current Overall Habitat Quality Score (sum of G x B)	Proposed Habitat Actions	Potential Status of Habitat Variable (% of optimum)	Potential Weighted Status of Habitat Variable (J x D)	Potential Local Habitat Condition (sum of K)	Potential Overall Habitat Quality Score (sum of L x B)
Black	0.166	Fish Passage	0.25	50	12.5	50.00	44	Culvert replacement	75	18.75	62.50	63
		Floodplain Conditions	0.25	75	18.75			Off channel Reconnection and side channel enhancements	75	18.75		
		Riparian Conditions	0.25	25	6.25			Riparian Restoration	50	12.50		
		Large Woody Debris	0.25	50	12.5			Woody Debris Treatments	50	12.50		
Boisfort	0.166	Fish Passage	0.25	25	6.25	43.75		Culvert replacement	50	12.50	56.25	
		Floodplain Conditions	0.25	75	18.75			Off channel Reconnection and side channel enhancements	75	18.75		
		Riparian Conditions	0.25	25	6.25			Riparian Restoration	50	12.50		
		Large Woody Debris	0.25	50	12.5			Woody Debris Treatments	50	12.50		
Chehalis mainstem	0.166	Floodplain Conditions	0.33	25	8.25	33.00		Off channel Reconnection and side channel enhancements	75	24.75	74.25	
		Riparian Conditions	0.33	25	8.25			Riparian Restoration	75	24.75		
		Large Woody Debris	0.33	50	16.5			Woody Debris Treatments	75	24.75		
Lincoln	0.166	Fish Passage	0.25	25	6.25	50.00		Culvert replacement	50	12.50	56.25	
		Floodplain Conditions	0.25	75	18.75			Off channel Reconnection and side channel enhancements	75	18.75		
		Riparian Conditions	0.25	25	6.25			Riparian Restoration	25	6.25		
		Large Woody Debris	0.25	75	18.75			Woody Debris Treatments	75	18.75		
Newaukum	0.166	Fish Passage	0.25	25	6.25	50.00		Culvert replacement	50	12.50	70.00	
		Floodplain Conditions	0.25	75	18.75			Off channel Reconnection and side channel enhancements	90	22.50		
		Riparian Conditions	0.25	25	6.25			Riparian Restoration	50	12.50		
		Large Woody Debris	0.25	75	18.75			Woody Debris Treatments	90	22.50		
Skookumchuck	0.166	Fish Passage	0.25	25	6.25	37.50		Culvert replacement	50	12.50	62.50	
		Floodplain Conditions	0.25	50	12.5			Off channel Reconnection and side channel enhancements	75	18.75		
		Riparian Conditions	0.25	25	6.25			Riparian Restoration	50	12.50		
		Large Woody Debris	0.25	50	12.5			Woody Debris Treatments	75	18.75		

Notes:

Numbers in black were provided by local biologists; numbers in red are derived values.

Tier 1 = 25% of Optimum, Tier 2 = 50%, Tier 3 = 75%

Table 13

Calculation of Egg-to-Smolt Survival for Steelhead and Chinook for Current Conditions and Future with Enhancement Projects – Medium Estimate

			Current Condition				Resulting Potential Condition			
[A]	[B]	[C]	[D]	[E]	[F]	[G]	[H]	[I]	[J]	[K]
Assessment Unit	AU Weight (proportion of population area)	Limiting Habitat Variables	Current Local Habitat Condition (from column G in Table 1)	Current Weighted Local Habitat Condition (D x B)	Current Survival Estimate for each AU (E x 0.0045)	Current Survival Estimate for Entire Population (sum of F)	Potential Local Habitat Condition (from column L in Table 1)	Potential Weighted Local Habitat Condition (H x B)	Potential Survival Estimate for each AU (I x 0.0045)	Potential Survival Estimate for Entire Population (sum of J)
Black	0.166	Fish Passage Floodplain Conditions Riparian Conditions Large Woody Debris	50.00	8.3	0.03735		62.50	10.375	0.04669	
Boisfort	0.166	Fish Passage Floodplain Conditions Riparian Conditions Large Woody Debris	43.75	7.2625	0.03268		56.25	9.3375	0.04202	
Chehalis mainstem	0.166	Floodplain Conditions Riparian Conditions Large Woody Debris	33.00	5.478	0.02465		74.25	12.3255	0.05546	
Lincoln	0.166	Fish Passage Floodplain Conditions Riparian Conditions Large Woody Debris	50.00	8.3	0.03735	0.1974	56.25	9.3375	0.04202	0.2852
Newaukum	0.166	Fish Passage Floodplain Conditions Riparian Conditions Large Woody Debris	50.00	8.3	0.03735		70.00	11.62	0.05229	
Skookumchuck	0.166	Fish Passage Floodplain Conditions Riparian Conditions Large Woody Debris	37.50	6.225	0.02801		62.50	10.375	0.04669	

Notes:

Numbers in black were provided from existing literature and professional judgment; numbers in red are derived values.

Tier 1 = 25% of Optimum, Tier 2 = 50%, Tier 3 = 75%

Table 14

Calculation of Egg-to-Smolt Survival for Coho for Current Conditions and Future with Enhancement Projects – Medium Estimate

			Current Condition				Resulting Potential Condition			
[A]	[B]	[C]	[D]	[E]	[F]	[G]	[H]	[I]	[J]	[K]
Assessment Unit	AU Weight (proportion of population area)	Limiting Habitat Variables	Current Local Habitat Condition (from column G in Table 1)	Current Weighted Local Habitat Condition (D x B)	Current Survival Estimate for each AU (E x 0.0463)	Current Survival Estimate for Entire Population (sum of F)	Potential Local Habitat Condition (from column L in Table 1)	Potential Weighted Local Habitat Condition (H x B)	Potential Survival Estimate for each AU (I x 0.0463)	Potential Survival Estimate for Entire Population (sum of J)
Black	0.166	Fish Passage Floodplain Conditions Riparian Conditions Large Woody Debris	50.00	8.3	0.38429		62.50	10.375	0.48036	
Boisfort	0.166	Fish Passage Floodplain Conditions Riparian Conditions Large Woody Debris	43.75	7.2625	0.33625		56.25	9.3375	0.43233	
Chehalis mainstem	0.166	Floodplain Conditions Riparian Conditions Large Woody Debris	33.00	5.478	0.25363		74.25	12.3255	0.57067	
Lincoln	0.166	Fish Passage Floodplain Conditions Riparian Conditions Large Woody Debris	50.00	8.3	0.38429	2.0310	56.25	9.3375	0.43233	2.9341
Newaukum	0.166	Fish Passage Floodplain Conditions Riparian Conditions Large Woody Debris	50.00	8.3	0.38429		70.00	11.62	0.53801	
Skookumchuck	0.166	Fish Passage Floodplain Conditions Riparian Conditions Large Woody Debris	37.50	6.225	0.28822		62.50	10.375	0.48036	

Notes:

Numbers in black were provided from existing literature and professional judgment; numbers in red are derived values.

Tier 1 = 25% of Optimum, Tier 2 = 50%, Tier 3 = 75%

Using the medium estimate approach to populating Table 12, it is estimated that habitat quality would increase from 44 percent to 63 percent of optimum (Columns H and M in Table 12). This would result in a 44 percent increase (Column K divided by Column G in Tables 13 and 14) in juvenile steelhead, Chinook, and coho survival.

In Tables 15 to 17, the beginning percent value of the optimal condition for each Tier 1, 2, and 3 project was changed (Tier 1 = 10 percent of optimal condition, Tier 2 = 50 percent, Tier 3 = 90 percent). This scenario assumes worse existing conditions and larger improvement in habitat conditions if the proposed projects are implemented.

Using the high estimate approach to populating Table 15, it is estimated that habitat quality would increase from 40 percent to 70 percent of optimum (Columns H and M in Table 15). This would result in a 73 percent increase (Column K divided by Column G in Tables 16 and 17) in juvenile steelhead, Chinook, and coho survival. The inputs in Table 15 reflect a high estimate of improvement from implementing the enhancement projects discussed in Section 3.

Using the three scenarios of low, medium, and high improvements in habitat quality, it is estimated that egg-to-smolt survival could be increased from 14 to 73 percent if the projects identified in Section 3 are implemented. This approach is adaptive and basin biologists and stakeholders can easily modify the input assumptions to incorporate new information or to estimate benefits for a partial list of projects. The calculations are provided in spreadsheets that have been transmitted to the Flood Authority for future use.

Table 15

Calculation of Habitat Quality Under Existing Conditions and With Enhancement Projects – High Estimate

				Current Conditions				Resulting Potential Conditions				
[A]	[B]	[C]	[D]	[E]	[F]	[G]	[H]	[I]	[J]	[K]	[L]	[M]
Management Unit	MU Weight (proportion of population area)	Limiting Factor	Relative Weight of Variable on Survival	Current Status of Habitat Variable (% of optimum)	Current Weighted Status of Habitat Variable (D x E)	Current Local Habitat Condition (sum of F)	Current Overall Habitat Quality Score (sum of G x B)	Proposed Habitat Actions	Potential Status of Habitat Variable (% of optimum)	Potential Weighted Status of Habitat Variable (J x D)	Potential Local Habitat Condition (sum of K)	Potential Overall Habitat Quality Score (sum of L x B)
Black	0.166	Fish Passage	0.25	50	12.5	50.00		Culvert replacement	90	22.50	70.00	
		Floodplain Conditions	0.25	90	22.5			Off channel Reconnection and side channel enhancements	90	22.50		
		Riparian Conditions	0.25	10	2.5			Riparian Restoration	50	12.50		
		Large Woody Debris	0.25	50	12.5			Woody Debris Treatments	50	12.50		
Boisfort	0.166	Fish Passage	0.25	10	2.5	40.00		Culvert replacement	50	12.50	60.00	
		Floodplain Conditions	0.25	90	22.5			Off channel Reconnection and side channel enhancements	90	22.50		
		Riparian Conditions	0.25	10	2.5			Riparian Restoration	50	12.50		
		Large Woody Debris	0.25	50	12.5			Woody Debris Treatments	50	12.50		
Chehalis mainstem	0.166	Floodplain Conditions	0.33	10	3.3	23.10		Off channel Reconnection and side channel enhancements	90	29.70	89.10	
		Riparian Conditions	0.33	10	3.3			Riparian Restoration	90	29.70		
		Large Woody Debris	0.33	50	16.5			Woody Debris Treatments	90	29.70		
Lincoln	0.166	Fish Passage	0.25	10	2.5	50.00	40	Culvert replacement	50	12.50	60.00	70
		Floodplain Conditions	0.25	90	22.5			Off channel Reconnection and side channel enhancements	90	22.50		
		Riparian Conditions	0.25	10	2.5			Riparian Restoration	10	2.50		
		Large Woody Debris	0.25	90	22.5			Woody Debris Treatments	90	22.50		
Newaukum	0.166	Fish Passage	0.25	10	2.5	50.00		Culvert replacement	50	12.50	72.50	
		Floodplain Conditions	0.25	90	22.5			Off channel Reconnection and side channel enhancements	95	23.75		
		Riparian Conditions	0.25	10	2.5			Riparian Restoration	50	12.50		
		Large Woody Debris	0.25	90	22.5			Woody Debris Treatments	95	23.75		
Skookumchuck	0.166	Fish Passage	0.25	10	2.5	30.00		Culvert replacement	50	12.50	70.00	
		Floodplain Conditions	0.25	50	12.5			Off channel Reconnection and side channel enhancements	90	22.50		
		Riparian Conditions	0.25	10	2.5			Riparian Restoration	50	12.50		
		Large Woody Debris	0.25	50	12.5			Woody Debris Treatments	90	22.50		

Notes:

Numbers in black were provided by local biologists; numbers in red are derived values.

Tier 1 = 10% of Optimum, Tier 2 = 50%, Tier 3 = 90%

Table 16

Calculation of Egg-to-Smolt Survival for Steelhead and Chinook for Current Conditions and Future with Enhancement Projects – High Estimate

			Current Condition				Resulting Potential Condition			
[A]	[B]	[C]	[D]	[E]	[F]	[G]	[H]	[I]	[J]	[K]
Assessment Unit	AU Weight (proportion of population area)	Limiting Habitat Variables	Current Local Habitat Condition (from column G in Table 1)	Current Weighted Local Habitat Condition (D x B)	Current Survival Estimate for each AU (E x 0.0045)	Current Survival Estimate for Entire Population (sum of F)	Potential Local Habitat Condition (from column L in Table 1)	Potential Weighted Local Habitat Condition (H x B)	Potential Survival Estimate for each AU (I x 0.0045)	Potential Survival Estimate for Entire Population (sum of J)
Black	0.166	Fish Passage Floodplain Conditions Riparian Conditions Large Woody Debris	50.00	8.3	0.03735		70.00	11.62	0.05229	
Boisfort	0.166	Fish Passage Floodplain Conditions Riparian Conditions Large Woody Debris	40.00	6.64	0.02988		60.00	9.96	0.04482	
Chehalis mainstem	0.166	Floodplain Conditions Riparian Conditions Large Woody Debris	23.10	3.8346	0.01726		89.10	14.7906	0.06656	
Lincoln	0.166	Fish Passage Floodplain Conditions Riparian Conditions Large Woody Debris	50.00	8.3	0.03735	0.1816	60.00	9.96	0.04482	0.3149
Newaukum	0.166	Fish Passage Floodplain Conditions Riparian Conditions Large Woody Debris	50.00	8.3	0.03735		72.50	12.035	0.05416	
Skookumchuck	0.166	Fish Passage Floodplain Conditions Riparian Conditions Large Woody Debris	30.00	4.98	0.02241		70.00	11.62	0.05229	

Notes:

Numbers in black were provided from existing literature and professional judgment; numbers in red are derived values.

Tier 1 = 10% of Optimum, Tier 2 = 50%, Tier 3 = 90%

Table 17

Calculation of Egg-to-Smolt Survival for Coho for Current Conditions and Future with Enhancement Projects – High Estimate

			Current Condition				Resulting Potential Condition			
[A]	[B]	[C]	[D]	[E]	[F]	[G]	[H]	[I]	[J]	[K]
Assessment Unit	AU Weight (proportion of population area)	Limiting Habitat Variables	Current Local Habitat Condition (from column G in Table 1)	Current Weighted Local Habitat condition (D x B)	Current Survival Estimate for each AU (E x 0.0463)	Current Survival Estimate for Entire Population (sum of F)	Potential Local Habitat Condition (from column L in Table 1)	Potential Weighted Local Habitat Condition (H x B)	Potential Survival Estimate for each AU (I x 0.0463)	Potential Survival Estimate for Entire Population (sum of J)
Black	0.166	Fish Passage Floodplain Conditions Riparian Conditions Large Woody Debris	50.00	8.3	0.38429		70.00	11.62	0.53801	
Boisfort	0.166	Fish Passage Floodplain Conditions Riparian Conditions Large Woody Debris	40.00	6.64	0.30743		60.00	9.96	0.46115	
Chehalis mainstem	0.166	Floodplain Conditions Riparian Conditions Large Woody Debris	23.10	3.8346	0.17754		89.10	14.7906	0.68480	
Lincoln	0.166	Fish Passage Floodplain Conditions Riparian Conditions Large Woody Debris	50.00	8.3	0.38429	1.8684	60.00	9.96	0.46115	3.2403
Newaukum	0.166	Fish Passage Floodplain Conditions Riparian Conditions Large Woody Debris	50.00	8.3	0.38429		72.50	12.035	0.55722	
Skookumchuck	0.166	Fish Passage Floodplain Conditions Riparian Conditions Large Woody Debris	30.00	4.98	0.23057		70.00	11.62	0.53801	

Notes:

Numbers in black were provided from existing literature and professional judgment; numbers in red are derived values.

Tier 1 = 10% of Optimum, Tier 2 = 50%, Tier 3 = 90%

6 PRELIMINARY COST ESTIMATES

6.1 Floodplain and Riparian Projects

Preliminary cost estimates were prepared for the floodplain and riparian restoration projects listed in Table 6. A conceptual design with enough detail to prepare estimates of required quantities was prepared for each project that incorporated the following elements:

- For side channel restoration areas, it was assumed that a riparian buffer would extend 50 feet on both sides of a side channel for a total riparian restoration width of 100 feet, except on U.S. Army Corps of Engineers (USACE)-identified projects that already had estimates for that area.
- For mainstem channel restoration areas, it was assumed that a riparian buffer would extend 100 feet on each side of the channel, for a total riparian restoration width of 200 feet, except on USACE-identified projects that already had estimates for that area.
- In riparian restoration areas, it was assumed invasive species would be removed and controlled while plantings matured. It was assumed that one-half of the riparian area would need invasive species removal and control, except on USACE-identified projects that already had estimates for that area.
- The depth of channel constructed to connect the mainstem to a side channel was assumed to be 2 feet lower than the elevation of the mainstem water surface interpolated from the LiDAR data. This will allow inflow to and outflow from the side channel area.
- Two engineered log jams would be constructed for each side channel project in the mainstem river, one at the inlet and one at the outlet of the side channel.
- Within the side channel, one LWD structure per 200 feet of side channel would be placed.

Unit costs used to estimate costs for floodplain and riparian restoration projects were based upon experience with similar and previous projects as well as engineering judgment. The unit costs used are summarized in Table 18. The costs include allowance for tax, engineering/permitting/administration, and a contingency of 30 percent to cover items not identified at this preliminary level of design and cost estimating.

Table 18

Unit Costs Used in Estimates for Floodplain and Riparian Projects

Item	Unit Used	Unit Cost	Comments
Earthwork – Excavation and disposal or haul	Cubic Yard	$8	Assume excess material disposed of off-site
Earthwork – Place and compact material	Cubic Yard	$20	Assume material imported
Engineered Log Jams	Each	$40,000	
Large Woody Debris	Each	$1,000	
Riparian Revegetation	Acre	$21,000	Assume plantings at 15 feet on-center
Invasive Species Removal	Acre	$9,000	Also provides allowance for maintenance
Land Acquisition/Easement	Acre	$10,000	Assume easement is purchased
Land Acquisition/Purchase	Acre	$20,000	Assume land is purchased
Temporary Erosion & Sediment Control, Care and diversion of water	Lump Sum	1% of subtotal of construction items	
Mobilization, including demobilization (8%)	Lump Sum	8% of subtotal of construction items	
Lewis County sales tax	Lump Sum	7.8% of total of construction items	
Engineering, Permitting, Administration	Lump Sum	20% of total of construction items	
Contingencies	Lump Sum	30% of total of construction items	

The estimated costs of the floodplain and riparian projects listed in Table 18 are provided in Table 19. Additional detail, including estimated quantities, is provided in Appendix C.

Table 19

Estimated Costs of Floodplain and Riparian Projects

Project Identifier*	Location	Total Estimated Project Cost
BL-6	Black River Preservation	$315,600
BF-4	South Fork Chehalis	$11,728,000

Project Identifier*	Location	Total Estimated Project Cost
BF-5	South Fork Chehalis Confluence	$323,000
BF-6	Elk Creek Preservation	$315,600
CH-6	State Route 6 oxbow	$4,372,000
CH-1	River Miles 66 to 81	$30,168,000
CH-7	Oxbow Lake Reconnection	$949,000
CH-8	WDFW Pheasant Farm	$699,000
CH-9	Scheuber Ditch	$5,785,000
CH-10	Near Gaddis Creek Confluence RM 34	$3,178,000
CH-11	Near RM 36	$1,966,000
CH-12	Near RM 42	$5,575,000
CH-13	Near RM 43	$4,151,000
CH-14	Near Garrard Creek Confluence Chehalis RM 46	$1,414,000
CH-15	Near RM 50	$2,122,000
CH-16	Near Chehalis Village Chehalis RM 54	$2,084,000
CH-17	Near RM 56-58	$2,380,000
CH-17a	Near RM 58	$774,000
CH-18	Dry Creek confluence Chehalis RM 60	$625,000
CH-20	Near RM 68	$1,412,000
CH-21	Near RM 78	$761,000
CH-22	Near RM 79	$346,000
Ch-23	Near RM 82	$424,000
CH-24	Near RM 83	$1,268,000
CH-25	Near RM 85	$2,384,000
CH-26	Near RM 88	$1,723,000
NE-8	Dillenbaugh Creek	$1,329,000
NE-9	Newaukum River	$21,082,000
NE-10a	Salzer Creek Lower Mile Oxbow Reconnection and Riparian Restoration	$2,130,000
NE-10b	Salzer Creek I-5 to BNRR Riparian and In-Channel Restoration	$658,000
NE-10c	Salzer-Coal Creek Fairgrounds Floodplain and Channel Restoration	$4,634,000
NE-10d	Salzer Creek at Centralia Alpha Road Floodplain Storage and Riparian	$1,082,000

Project Identifier*	Location	Total Estimated Project Cost
	Restoration	
NE-10e	Salzer Creek at Proffitt Road Riparian Restoration	$870,000
NE-15	Newaukum Confluence	$396,000
NE-16	Stan Hedwall Park Floodplain Reconnection	$3,597,000
NE-17	Rice Road Floodplain/Side Channel Restoration	$1,075,000
NE-18	North Fork/South Fork Newaukum Confluence Riparian Restoration	$1,646,000
NE-19	North Fork Newaukum River at Tauscher Road	$545,000
NE-20	Middle Fork Newaukum	$1,098,000
NE-21	Middle Fork Preservation	$315,600
SK-8a	Near RM 7	$242,000
SK-8b	Near RM 7.5	$429,000
SK-9	Near RM 8	$303,000
SK-11	Near RM 10	$344,000
SK-12	Near RM 11	$544,000
SK-13	Near RM 12	$668,000
SK-14	Near RM 13	$347,000
SK-15	Near RM 14	$313,000

Note:
Cost estimates were not generated for LI-12, LI-13, LI-14, NE-13, and SK-5 because specific areas of enhancement were not identified. However, they were included in Section 4 prioritization because they were a Tier 1 concern for the floodplain condition limiting factor or a specific project (i.e., SK-5).

6.2 Culverts

Preliminary cost estimates were prepared for the culvert projects listed in Appendix A, Tables 4 and 5. Topographic data for the culvert locations was not available so more assumptions were needed to estimate costs. Those assumptions are described below.

- All excavations would be made with side slopes equal to 2H:1V. Fill slopes would have the same slope.
- It was assumed the depth of fill above each culvert is 5 feet.
- The length of each culvert was assumed to be 42 feet.

- Road surfaces were unpaved with a gravel-surfacing depth of 6 inches and a road width of 22 feet.
- The bottom 30 percent of the new culvert would be filled with streambed gravel.
- For large culverts, bridges would be more cost effective. When culvert sizes exceeded 12-foot diameter, a 50-foot long bridge was used.

To develop costs for various sizes of culverts and a bridge, estimates of quantities were developed for culverts ranging from 3-foot diameter to 12-foot diameter. Construction cost estimates were prepared by applying unit costs to those quantities. The unit costs were based upon experience with previous projects as well as engineering judgment. The unit costs used are summarized in Table 20. The costs include allowance for tax, engineering/permitting/ administration, and a contingency of 30 percent to cover items not identified at this preliminary level of design and cost estimating.

Table 20
Unit Costs used in Estimates for Culvert Projects

Item	Unit Used	Unit Cost	Comments
Excavation and backfill	Cubic Yard	$4	
Off-site disposal of material	Cubic Yard	$25	
Gravel road surfacing	Cubic Yard	$30	Assume material imported
Streambed gravel	Cubic Yard	$32	Assume material imported
Culverts	Lineal Foot	$4/inch-diameter/lineal foot	
Temporary Erosion & Sediment Control, Care and diversion of water	Lump Sum	$5,000	
Revegetation	Lump Sum	$2,000	
Bridge	Lineal Foot	$1,800	Assume 50-foot long bridge
Mobilization, including demobilization (8%)	Lump Sum	8% of subtotal of construction items	
Lewis County sales tax	Lump Sum	7.8% of total of construction items	
Engineering, Permitting, Administration	Lump Sum	20% of total of construction items	
Contingencies	Lump Sum	30% of total of construction items	

The total estimated costs for standard diameters of culvert and a bridge are listed in Table 21. These costs were applied to each potential culvert replacement project in the Chehalis River Basin listed in Appendix A, Tables 4 and 5.

Table 21
Estimated Costs for Culverts and Bridge

Culvert Diameter, feet	Estimated Culvert Cost
3	$31,000
4	$36,000
5	$41,000
6	$47,000
7	$53,000
8	$59,000
9	$65,000
10	$72,000
11	$80,000
12	$87,000
Bridge	$90,000

There are 300 culvert replacement projects identified in Section 4. The estimated cost for each project is provided in Appendix C. Those costs are summarized by Management Unit in Table 22.

Table 22
Total Estimated Costs for Culverts and Bridges

Management Area	Number of Projects	Estimated Culvert Replacement Cost
Black River	15	$1,205,000
Boisfort	73	$5,049,000
Lincoln	116	$8,271,000
Newaukum	54	$3,777,000
Skookumchuck	44	$3,125,000

7 SUMMARY

The Chehalis River Basin Comprehensive Salmonid Habitat Enhancement Plan identified potential opportunities to improve salmonid habitat conditions in WRIA 23. Those opportunities include floodplain and riparian restoration projects, preservation, and culvert fish barrier removal. The plan contains cost estimates, as well as estimated benefits to fisheries. The plan also provides an approach to prioritizing projects to identify which projects will provide the greatest ecological lift within potential constraints such as funding, landowner permission, permitting, and other implementation issues. As many of the implementation issues are not known at this time, those criteria were not included in the prioritization process. Only benefits to fisheries were considered in the prioritization.

The prioritization process was designed to be a flexible and adaptive approach that is easily adjusted as desired by basin stakeholders to place more or less emphasis on certain criteria. In addition, the prioritization of identified projects will provide the Flood Authority with a hierarchical path to select mitigation for future flood hazard mitigation projects. The prioritization approach and scoring was provided in a spreadsheet format to the Flood Authority for its future use. The total number and cost of the projects identified in Section 4 are summarized in Table 23.

Table 23
Number of Enhancement Projects and Estimated Costs by Management Unit

Management Unit	Number of Floodplain and Riparian Projects*	Estimated Cost of Floodplain and Riparian Projects	Number of Culvert Projects	Estimated Cost of Culvert Projects	Total Cost per Management Unit
Black	1	$315,600	15	$1,205,000	$1,520,600
Boisfort	3	$12,366,600	73	$5,049,000	17,415,600
Chehalis Mainstem	22	$75,574,200	0	0	$75,574,200
Lincoln	0	$315,600	114	$8,271,000	$8,271,000
Newaukum	14	$40,457,600	54	$3,777,000	$44,234,600
Skookumchuck	8	$2,175,000	44	$3,125,000	$3,125,000
Total	48	$130,891,000	300	$21,427,000	$152,316,000

Note:
Cost estimates were not generated for LI-12, LI-13, LI-14, NE-13, and SK-5 because specific areas of enhancement were not identified.

The total estimated cost of the floodplain and riparian restoration projects is approximately $130.9 million, while the cost of replacing the top 300 culverts to improve fish passage is approximately $21.4 million. The overall cost is estimated to be $152.3 million.

An approach to estimating fisheries benefits for the enhancement projects was presented, in which it was assumed that all projects listed in the table above will be implemented. The approach estimates a habitat value that is a percentage of optimal habitat condition for current conditions and future conditions with all the enhancement projects implemented. The habitat value was multiplied by an egg-to-smolt survival relationship for juvenile Chinook, steelhead, and coho salmon to estimate the potential difference in egg-to-smolt survival. Three scenarios of improvement in habitat conditions were analyzed to estimate a range of potential improvements in juvenile salmon survival. The low scenario estimates an improvement of 14 percent in juvenile survival. The middle scenario estimates an improvement of 44 percent in juvenile survival. The high scenario estimates an improvement of 73 percent survival for juvenile Chinook, steelhead, and coho salmon. The potential improvements in juvenile salmon survival from implementation of the enhancement projects described in this report range from 14 to 73 percent.

The approach to estimating fisheries benefits is also adaptive and basin stakeholders can easily modify the input assumptions to incorporate new information or to estimate benefits for a partial list of projects. The calculations are provided in spreadsheets that have been transmitted to the Flood Authority for future use.

All GIS maps, metadata, and calculations have been provided to the Flood Authority for its use and dissemination to Chehalis River Basin stakeholders.

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APPENDIX A
PHASE 1 REPORT

PHASE 1 REPORT
CHEHALIS RIVER BASIN ENHANCEMENT OPPORTUNITIES

Prepared for

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May 2012

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LIST OF ACRONYMS AND ABBREVIATIONS

DNR	Department of Natural Resources
GIS	geographic information system
LCCD	Lewis County Conservation District
LiDAR	Light Detection and Ranging
MCD	Mason Conservation District
RM	river mile
USDA	U.S. Department of Agriculture
WAU	Watershed Administrative Unit
WRIA	Water Resource Inventory Area

1 INTRODUCTION

As the second largest river system in the State of Washington outside the Columbia River basin, the Chehalis River supports numerous species and runs of salmonids. Current conditions in the watershed limit fisheries production. Limiting factors for salmonids include fish passage blockages (e.g., impassable culverts), floodplain conditions (e.g., incised channels or drainage and filling of wetlands), streambed substrate (e.g., mass wasting or low large woody debris levels), riparian conditions (e.g., tree canopy loss), water quality (e.g., high water temperature or low dissolved oxygen), and water quantity (e.g., low summer base flows) in the Chehalis River basin (Smith and Wegner 2001).

In order to support salmonid enhancement planning in the Chehalis River basin, the Chehalis River Basin Flood Authority (Flood Authority) contracted with Anchor QEA, LLC, to develop a Comprehensive Salmonid Habitat Enhancement Plan that identifies potential opportunities to improve habitat conditions. This work is being completed in two steps:

1. Development of a comprehensive list of opportunities based on compilation from other sources and the identification of additional opportunities, particularly side channels.
2. Prioritization of identified opportunities to help inform which opportunities provide the greatest benefits to meet the habitat needs of the watershed.

This report describes the Step 1 identification of enhancement opportunities. The objective of this report is to list and summarize enhancement opportunities, including existing and potential off-channel habitat along the upper mainstem Chehalis River (river miles [RMs] 33 to 118) and associated tributaries (Water Resource Inventory Area [WRIA] 23).

1.1 Study Area

The Chehalis River basin encompasses 2,520 square miles and drains 2,660 square miles flowing through the Cascade, Puget Lowland, and Coast Range ecoregions and emptying into Grays Harbor near Aberdeen (Omernik 1987). It is divided into the Lower Chehalis Basin (WRIA 22) and the Upper Chehalis Basin (WRIA 23); this assessment is focused on

WRIA 23. Within WRIA 23, the watershed was divided into six management units (sub-basins) representing the major watersheds (Figure 1):

- Black (BL) Management Unit (includes Black River and Porter Creek subbasins)
- Boistfort (BF) Management Unit (Upper Chehalis, South Fork Chehalis, Stillman Creek, Lake Creek, and other smaller creeks)
- Chehalis Mainstem (CH) Management Unit
- Lincoln (LI) Management Unit (Lincoln Creek, Independence Creek, Garrard Creek, Gaddis Creek, Rock/Williams Creek, Bunker Creek, Scammon Creek, Mill Creek, Stearns Creek, and other smaller creeks)
- Newaukum (NE) Management Unit (Newaukum mainstem, North Fork Newaukum, Middle Fork Newaukum, Salzer Creek, Coal Creek, Dillenbaugh Creek, Berwick Creek, China Creek, and other smaller creeks)
- Skookumchuck (SK) Management Unit (Skookumchuck River, Scatter Creek, and other smaller creeks)

Management units were delineated based on Watershed Administrative Units (WAUs) from the Washington Department of Natural Resources (DNR). These WAUs did not match exactly with the watershed boundaries in the Work Plan; however, they looked more accurate, so these more recent WAUs were used in this analysis. With this decision, the DNR WAUs were grouped into management units that closely approximate those described in the Work Plan.

2 DATA SOURCES AND EVALUATION

Three methods were used to identify salmonid habitat enhancement opportunities in the Chehalis River watershed:

1. Review existing reports and databases
2. Conduct interviews and workshops
3. Analyze Light Detection and Ranging (LiDAR) data and aerial photography

Reports and websites were reviewed and included:

- *Salmon and Steelhead Habitat Limiting Factors; Chehalis Basin and Nearby Drainages WRIAs 22 and 23* (Smith and Wegner 2001)
- *Chehalis Basin Salmon Habitat Restoration and Preservation Work Plan for WRIA 22 and 23* (Work Plan; Grays Harbor Lead Entity Habitat Work Group 2011)
- Lewis County Conservation District (LCCD) Culvert Survey Reports (LCCD 2006, 2007, and 2009)
- *Chehalis Basin Fish Passage Barrier Ranking and Project Development* (Mason Conservation District 2010)
- *Chehalis Basin Watershed Assessment* (Washington Department of Ecology, Stanley et al. 2010)
- *Flood Protection and Ecosystem Services in the Chehalis River Basin* (Earth Economics 2010)
- *Chehalis River Basin Comprehensive Flood Hazard Management Plan* (Flood Authority 2010)
- Washington Recreation and Conservation Office PRISM database
- Habitat Work Schedule

Phone interviews and meetings also were conducted with local planners and biologists to obtain the most recent list of potential projects throughout WRIA 23. A workshop was convened on October 19, 2011, to bring together Chehalis River Basin biologists and planners to discuss potential enhancement projects and prioritization methods. Approximately 20 people representing various entities within the watershed participated and offered insight into potential projects and identified projects already completed or in progress (Attachment A). The projects listed in this report reflect the input from this workshop.

LiDAR and aerial photography were used to identify areas with potential for restoration in the mainstem Chehalis, South Fork Chehalis River, and Skookumchuck River. No LiDAR data are available for the Newaukum River.

Existing geographic information system (GIS) layers of fish habitat and limiting factors, including existing culverts, were used to make maps of project locations. Data sources for the layers included:

- LiDAR – Puget Sound LiDAR Consortium, 2002
- Aerial – U.S. Department of Agriculture (USDA), National Agriculture Imagery Program, 2009
- WAUs – Washington Department of Natural Resources, 2006

2.1 Identification of Potential Projects

Potential projects were identified based on an assessment of the common limiting factors within WRIA 23. Seven limiting factors have been identified that have impacts on both physical processes within the watershed and salmonids (Grays Harbor County Lead Entity 2011):

- **Fish Passage Conditions**: Poor fish passage conditions typically result from improperly sized water crossing structures and result in loss of access to spawning and rearing habitat.
- **Floodplain Conditions**: Degraded floodplain conditions typically result from floodplain filling, dike and levee construction, and streambank armoring and result in loss of backwater and side channels used for spawning, rearing, and refugia during high flows.
- **Riparian Conditions**: Poor riparian conditions typically result from intentional removal of vegetation, usually associated with land use conversion or timber harvest, and results in limiting shade, nutrients, and large woody debris availability.
- **Large Woody Debris**: Lack of large woody debris usually results from poor riparian conditions and removal of woody debris from the channel.
- **Water Quality**: Poor water quality typically is associated with water temperature, suspended solids, and chemical composition usually resulting from poor riparian conditions and stormwater runoff problems.

- **Water Quantity**: Low summer flows typically result from altered hydrology (landscape changes that allows rapid surface runoff).
- **Streambed Sediment**: High contributions of sediment typically are associated with land use management practices including logging roads, landscapes without vegetation, and areas of excessive streambank erosion resulting in filling in of pools and spawning gravels.

Consideration was given for enhancement projects that would be the most beneficial in terms of response time, probability of success, and duration of the action. Preservation and then reconnection of isolated habitats have been suggested as a first and second priority (Roni et al. 2002). In addition, replacing culverts to improve fish passage and access to additional habitat, and restoring floodplain functions are a priority (Grays Harbor County Lead Entity 2011). However, riparian conditions and large woody debris also are of concern within WRIA 23, and projects necessary to enhance these factors were identified as well. The other three limiting factors also may be addressed as part of enhancements in any of the first four. For example, improvement in riparian conditions will also reduce the amount of sediment that can be deposited into streams within the watershed and will provide additional vegetative cover, thereby improving water quality by reducing stream temperatures. Based on this, the primary focus for assessment was on four limiting factors: floodplain conditions, riparian conditions, large woody debris, and fish passage conditions. An existing prioritization strategy based on the general features of each subbasin, type and status of anadromous fish stocks, land use activities, and limiting factor analysis has been developed for the Chehalis River (Grays Harbor County Lead Entity 2011). This strategy prioritized the degree of impact created by each limiting factor on the fitness and survival of targeted stocks by assigning a ranking into three tiers. Tier 1 concerns represent the most pressing limiting factors impacting the targeted stocks and projects targeting these areas will likely provide the greatest benefit to fish. The subbasins with a Tier 1 concern for any of these limiting factors were identified to develop a master list of potential projects. Projects that also addressed other limiting factors were included in the assessment if information was readily available.

A summary of the tiered concerns for each limiting factor separated by management unit was compiled to begin development of the potential project list (Table 1). Tier 1 concerns for floodplain conditions, riparian conditions, and fish passage conditions were used to

identify subbasins for targeted projects. In addition, fish use within each subbasin was summarized for integration into the prioritization process (Table 2).

A master list of potential projects was developed for WRIA 23 (Table 3). Projects are listed by management unit and the major tributary identified. The type of enhancement and limiting factor addressed are provided, with multiple limiting factors addressed for some projects. In addition, a general description of the project and potential area of upstream habitat available are provided. Eighty-eight potential programs or specific projects have been identified within WRIA 23 with 6 identified to enhance floodplain conditions, 27 for fish passage conditions, 7 for riparian conditions, and 49 addressing multiple limiting factors (Table 3).

Fish passage barriers within the basin were identified based on the inventory data available to date; no additional field surveys were conducted for this report. The Mason Conservation District (MCD) identified 2,677 barriers within the Chehalis basin (MCD 2010; yellow, orange, and red dots on Figures 2 through 6). As part of that effort, the sites were ranked according to the number of species that may utilize upstream habitat, the amount of habitat upstream of the barrier, and the percent passability of the barrier. The rankings were then converted to percentiles to assign barriers to three tiers, the top 25 percent of sites were included in Tier 1 (top priority), sites in the 50th to 74th percentile were included in Tier 2, and the remaining sites (0 to 49th percentile) were assigned to Tier 3. The sites in Tier 1 represent sites with the most available upstream habitat and species utilization. Table 4 provides a complete list of barriers that were ranked as Tier 1 in WRIA 23 and are still in need of funding for removal. LCCD has updated the MCD barrier database with numerous additional barriers where habitat data were physically collected from each barrier (LCCD 2006, 2007, and 2009; included on Figures 2 through 6 as purple circles). The top 99 culverts identified by LCCD are included in Table 5 (30 of these are also found in the MCD data table).

Specific floodplain and riparian project locations are located on Figures 5 and 6 and relative elevation maps (Figures 7 through 12). Several of these projects came from the Draft Twin Cities Flood Reduction Project, Mitigation Site Evaluations Appendix A (U.S. Army Corps of Engineers 2011). These projects have conceptual plans prepared for them.

Anchor QEA prepared an analysis of mainstem floodplain conditions using LiDAR mapping. Maps show floodplain elevations relative to mainstem river thalweg and potential areas of floodplain, off channel, and side channel habitat restoration in the mainstem Chehalis, Skookumchuck, and South Fork Chehalis Rivers. Additional information is needed to understand current land uses and ownership within these areas to determine if restoration of these habitats is feasible.

3 DISCUSSION

This assessment identified potential restoration projects within WRIA 23 that would provide additional habitat for the various salmonid species found within the watershed. Projects primarily focused on those that addressed four of seven limiting factors identified as limiting salmonid production; fish passage conditions, floodplain conditions, riparian conditions, and large woody debris. Salmonids rely on habitats, many located above barriers that may be passable, partially passable, or impassable, as well as areas of refuge typically located within the floodplain (Henning et al. 2007). Based on the Tier 1 ranked culverts, approximately 2,400 miles of habitat is inaccessible or has limited accessibility for salmonids due to barriers (MCD 2010). The majority of projects identified focused on fish passage due to the intensive culvert surveys that have been conducted by both the LCCD and MCD and several projects were identified that related to other limiting factors as indicated on Table 3; future projects may need to consider other limiting factors, as well as those that are the focus of this report.

During the workshop, several attendees identified the need for preservation of areas that already contain suitable habitat and support the various salmonid species. This is an important consideration since preserving existing habitats may be more cost effective than restoring degraded areas. The documents reviewed during this assessment did not explicitly identify areas in need of preservation, but following a similar methodology of assessing the limiting factors and identifying areas most likely to contain these features would be a first step to identify areas to protect. One example discussed during the workshop was the coldwater areas within the Black River that currently provide summer refuge for salmonids. It was suggested that these, and similar areas, be preserved. Additional areas may be identified by evaluating areas of groundwater upwelling based on the *Chehalis Basin Watershed Assessment* focused on hydrology (Stanley et al. 2010).

The integration of limiting factors, fish use, and habitat availability is important for assessing subbasins or reaches within the watershed that would provide the greatest gain for cost. Since funding availability will limit the number and timing of projects that can be completed, it is important to identify and then rank projects properly. A recent study was conducted to help the Flood Authority evaluate future flood protection investments (Earth Economics 2010). As part of that study, the annual value of ecosystem services

within the basin was estimated between $1.3 and $11.6 billion. Recommendations in the study identified a combination of natural capital (e.g., floodplains), selective built capital (e.g., dams and levees), and social capital (e.g., early warning systems and training) as the best investments to achieve flood protection (Earth Economics 2010).

Development of a strategy for conservation, restoration, and development can be accomplished following the framework of the *Chehalis Basin Watershed Assessment* (Stanley et al. 2010). Utilizing information in that document also may help in developing the prioritization of projects identified in this report. Both impairments and level of importance for several water processes (groundwater recharge, groundwater discharge, and surface water delivery) were identified within subbasins in the Chehalis basin. The incorporation of the assessments was used to establish an overall management framework of areas that would benefit most from protection or restoration. Evaluation of these areas may allow for identification of areas most important for preservation.

The focus of Phase 2 of this effort is to prioritize the projects identified in this report. This prioritization will allow the Flood Authority to select the projects with the greatest ecological lift when continued feasibility and design work proceeds for future flood hazard mitigation projects. The Phase 2 report will also provide determine potential benefits to salmon from habitat enhancements and estimate costs of floodplain, riparian, and fish passage projects.

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TABLES

Table 1
Overview of Limiting Factor Concerns in Upper Chehalis River Watershed (RM 33 to 118)

Management Unit*	Major Tributary	River Mile	Tier 1, 2, 3 Concerns							Comments on Floodplain	Comments on Fish Passage Problems
			Floodplain Conditions	Fish Passage Conditions	Riparian Conditions	LWD	Water Quality	Water Quantity	Streambed Sediment		
Chehalis Mainstem	Not applicable	SF downstream to RM 33	1	3	1	2	1	2	3	RM 57 to 79 (Grand Mound – Stearns Creek) the mainstem appears to be incised and disconnected from floodplain and off-channel habitat. More data needed on channel incision from RM 57 to 79 (Smith and Wenger 2001).	
Black	Black River	47	3	2	1	2	1	1	3	Cold water refuge in lower 10 miles.	
	Porter Creek	38.5	2	1	1	1	3	3	2		Numerous road crossings are undersized (Grays Harbor County Lead Entity 2011)
Lincoln	Lincoln Creek	61.9	2	1	1	3	2	3	1		Numerous road crossings are undersized (Grays Harbor County Lead Entity 2011)
	Independence Creek	51.5	3	1	1	2	2	3	1		Numerous road crossings are undersized (Grays Harbor County Lead Entity 2011)
	Black River River Miles 0-10	45.5	3	1	1	3	2	2	1		fish passage barrier status not fully known (Grays Harbor County Lead Entity 2011)
	Gaddis Creek		1	1	2	2	3	3	1	Rock, Williams, and Gaddis creeks have incised channels (L. Crumley, LWC Consulting, personal communication). These streams are rated "poor" for floodplain conditions; further assessment of this impact is necessary (Smith and Wenger 2001).	Fish passage barrier status is unknown (Grays Harbor County Lead Entity 2011)
	Rock/Williams Creek	39.3	1	1	2	2	3	3	1	Rock, Williams, and Gaddis creeks have incised channels (L. Crumley, LWC Consulting, personal communication). These streams are rated "poor" for floodplain conditions; further assessment of this impact is necessary (Smith and Wenger 2001).	Fish passage barrier status is unknown; current awareness of at least two existing blockages (Grays Harbor County Lead Entity 2011)
	Bunker Creek		1	1	2	2	3	3	1	Floodplain conditions in the Bunker Creek subbasin are in fair condition with most of the floodplain connectivity impacts occurring in Deep Creek and lower Bunker Creek.	Numerous road crossings are undersized (Grays Harbor County Lead Entity 2011)
	Scammon, Mill, and Stearns Creeks	65.9, 77.85, 78.1	3	1	2	3	1	2	1		Numerous road crossings are undersized (Grays Harbor County Lead Entity 2011)
Skookumchuck	South Fork Chehalis	Riparian Restoration	1	1	1	3	2	2	3	Loss of floodplain function (74 of 185 miles) in Skookumchuck subbasin.	Skookumchuck Dam blocks 3.6 miles of chinook and 8 miles of coho habitat; small barriers, such as culverts, exist throughout system (Grays Harbor County Lead Entity 2011)
	Scatter Creek	55.2	3	2	1	1	1	3	2		
Newaukum	Newaukum River Mainstem	45.5	3	2	1	3	1	1	3		
	North Fork	10.8	3	1	1	3	2	2	1		Many culverts at road crossings on tributaries are undersized (Grays Harbor County Lead Entity 2011)
	River Miles 66 to 81	Riparian Restoration	3	1	1	3	2	2	1	Unaltered riparian areas.	Many culverts at road crossings on tributaries are undersized (Grays Harbor County Lead Entity 2011)
	Salzer Creek	69.4	2	1	1	3	2	3	1		High percentage forestland and logging roads with undersized culverts and road crossings (Grays Harbor County Lead Entity 2011)
	Coal Creek	Tributary of Salzer	3	2	1	3	2	1	1		
	Dillenbaugh Creek	Tributary of Newaukum	3	1	1	2	2	3	1		Undersized stream crossing structures restricts fish passage and natural processes (Grays Harbor County Lead Entity 2011)
	Berwick Creek	Tributary of Dillenbaugh	3	1	1	2	1	2	3		Undersized stream crossing structures restricts fish passage and natural processes (Grays Harbor County Lead Entity 2011)

Table 1
Overview of Limiting Factor Concerns in Upper Chehalis River Watershed (RM 33 to 118)

Management Unit*	Major Tributary	River Mile	Tier 1, 2, 3 Concerns							Comments on Floodplain	Comments on Fish Passage Problems
			Floodplain Conditions	Fish Passage Conditions	Riparian Conditions	LWD	Water Quality	Water Quantity	Streambed Sediment		
	State Route 6 oxbow	Oxbow reconnection, Riparian restoration, Install LWD	3	2	1	3	1	1	2		

Table 1
Overview of Limiting Factor Concerns in Upper Chehalis River Watershed (RM 33 to 118)

Management Unit*	Major Tributary	River Mile	Tier 1, 2, 3 Concerns							Comments on Floodplain	Comments on Fish Passage Problems
			Floodplain Conditions	Fish Passage Conditions	Riparian Conditions	LWD	Water Quality	Water Quantity	Streambed Sediment		
Boistfort	Oxbow Lake Reconnection	Oxbow reconnection, Riparian restoration, Install LWD	3	1	1	2	2	3	1		43 of 72 assessed culverts had barriers (Grays Harbor County Lead Entity 2011)
	WDFW Pheasant Farm	High flow side channel restoration, Wetland restoration, Riparian restoration	3	1	1	2	2	3	1		21 of 42 assessed culverts on tributaries were barriers (Grays Harbor County Lead Entity 2011)
	Scheuber Ditch	Floodplain, Riparian restoration, Install LWD	3	3	1	2	1	2	1		
	r Gaddis Creek Confluence RM	Side channel/flood plain enhancement	3	1	2	2	1	3	1		17 of 40 assessed culverts on tributaries were barriers (Grays Harbor County Lead Entity 2011)

Table 2
Salmonid Use in the Upper Chehalis Watershed

Management Unit*	Major Tributary	River Mile	Spring Chinook	Summer Chinook	Fall Chinook	Coho	Chum	Winter Steelhead	Summer Steelhead	Cutthroat	Bull Trout
Black Management Unit (includes Black	Not Applicable	SF downstream to RM 33	X		X	X	X	X		X	
Black	Black River	47			X	X	X	X		X	
	Porter Creek	38.5	X		X	X		X		X	
Lincoln	Lincoln Creek	61.9				X		X		X	
	Independence Creek	51.5				X				X	
	Garrard Creek	45.5				X		X		X	
	Black River River Miles 0-10					X				X	
	Rock/Williams Creek	39.3	X		X	X		X		X	
	Bunker Creek					X		X		X	
	Scammon, Mill, and Stearns Creeks	65.9, 77.85, 78.1				X		X		X	
Skookumchuck	Skookumchuck River	67.3	X		X	X		X		X	
	South Fork Chehalis	Riparian Restoration			X	X		X		X	
Newaukum	Newaukum River Mainstem	75.2	X		X	X		X		X	
	North Fork		X		X						
	Middle Fork	Tributary of NF			X						
	River Miles 66 to 81	Riparian Restoration				X				X	
	Coal Creek	Tributary of Salzer				X				X	
	Dillenbaugh Creek					X				X	
	Berwick Creek	Tributary of Dillenbaugh				X				X	
	China Creek	67.3				X				X	
Boistfort	State Route 6 oxbow	Oxbow reconnection, Riparian restoration, Install LWD	X		X	X		X		X	
	Oxbow Lake Reconnection	Oxbow reconnection, Riparian restoration, Install LWD	X		X	X		X		X	
	WDFW Pheasant Farm	High flow side channel restoration, Wetland restoration, Riparian restoration				X		X		X	
	Scheuber Ditch	Floodplain, Riparian restoration, Install LWD	X		X	X		X		X	

Notes: Near Gaddis Creek Confluence Side channel/floodplain enhancement

Table 3
Description of Potential Enhancement Projects in Upper Chehalis Watershed

Project Identifier	Location	Enhancement	Limiting Factor Addressed	Description of Project	Potential Available Habitat Upstream of Project	Comments
Black Management Unit (includes Black River, Porter Creek subbasins)						
BL-1	Management Unit-Wide	Correct barrier culverts	Fish Passage Conditions	Use guidelines in Section 4 of Strategy (Source: Grays Harbor County Lead Entity 2011). There are 65 barrier culverts in this management unit . Five culverts in this management unit have a Priority Index and are discussed in more detail below (Lewis County Conservation District (LCCD; 2006, 2007, and 2009).	Porter Creek	General Actions in Strategy
BL-2	Albert-Dempsey Creek Tributary R7	Correct barrier culvert	Fish Passage Conditions	The Albert fish barrier is on a tributary to Dempsey Creek; Black River; Chehalis River. There are no known barriers up or downstream.	Correction of this barrier would open about 0.15 miles of habitat for coho, cutthroat and possibly steelhead.	PRISM - proposed projects
BL-3	Baker-Goliath Creek R9	Correct barrier culvert	Fish Passage Conditions	This 33% passable culvert is on a tributary to Mima Creek which flows into the Black River in Thurston County. There is one private total barrier on an upstream tributary and two partial barriers and one total barrier upstream on DNR land.	Correction of this fish barrier would improve access to 3.91 miles of fish habitat. No downstream barriers.	PRISM - proposed projects
BL-4	Tilley Road	Culvert replacement	Fish Passage Conditions	No other information provided		Chehalis River Basin Comprehensive Flood Hazard Management Plan. June 2010.
BL-5	Dunnagan Creek	Correct barrier culverts, enhance habitat	Fish Passage Conditions, Floodplain Conditions, Riparian Conditions	This project will restore fish passage, improve habitat and reconnect the stream with its natural floodplain by replacing the existing culvert with a larger one and by creating approximately 300 feet of new meandering stream channel that will be enhanced with spawning gravels and riparian plantings.		Conceptual project hws database
BL-6	Black River River Miles 0-10	Preservation	Floodplain Conditions, Riparian Conditions, LWD	Preserve lower reach habitat buy acquisition of riparian, off-channel, and wetland habitats.		Comment by local planner/biologist from October 2011 Chehalis Salmon Enhancement Plan Workshop.
Boistfort Management Unit (Upper Chehalis, South Fork Chehalis, Stillman Creek, Lake Creek)						
BF-1	Upper Chehalis River	Correct barrier culverts; improve fish passage	Fish Passage Conditions	Use guidelines in Section 4 of Strategy (Grays Harbor County Lead Entity 2011); improve passage at fishways, add fishways where needed		General Actions in Strategy
BF-2	South Fork Chehalis	Correct barrier culverts	Fish Passage Conditions	Use guidelines in Section 4 of Strategy (Grays Harbor County Lead Entity 2011)		General Actions in Strategy
BF-3	Stillman Creek	Correct barrier culverts	Fish Passage Conditions	Use guidelines in Section 4 of Strategy (Grays Harbor County Lead Entity 2011)		General Actions in Strategy
BF-4	South Fork Chehalis	Riparian Restoration	Riparian Conditions, Floodplain Conditions	Includes revegetating and regrading banks to 2:1 slopes with a bench or 3:1 slope and removing invasive/planting a native understory.		Draft Twin Cities Flood Reduction Project, Mitigation Site Evaluations. Appendix A. Dated March 2011.
BF-5	South Fork Chehalis Confluence	Floodplain, Riparian Restoration, Install LWD	Floodplain Conditions, Riparian Conditions, LWD	Includes revegetating and regrading banks to 2:1 slopes with a bench or 3:1 slope and removing invasive/planting a native understory. Also includes excavation along South Fork to create wetland bench and install LWD clusters on bank.		Draft Twin Cities Flood Reduction Project, Mitigation Site Evaluations. Appendix A. Dated March 2011.
BF-6	Elk Creek Preservation	Preservation	Floodplain Conditions, Riparian Conditions, LWD	Preserve habitat buy acquisition of intact riparian, off-channel, and wetland habitats.		Assume purchase of 200 acres.
Chehalis Mainstem Management Unit						
CH-1	River Miles 66 to 81	Riparian Restoration	Riparian Conditions, Floodplain Conditions	Includes revegetating and regrading banks to 2:1 slopes with a bench or 3:1 slope and removing invasives/planting a native understory.		Draft Twin Cities Flood Reduction Project, Mitigation Site Evaluations. Appendix A. Dated March 2011.
CH-2	Galvin Road area; downstream Grand Mound	Oxbow reconnection	Floodplain Conditions	Many oxbows downstream of Grand Mound		Personal communication with Merri Martz of TetraTech Inc. Authors of Draft Twin Cities Flood Reduction Project.
CH-3	Oakville backwater	Oxbow reconnection	Floodplain Conditions	Chehalis Tribe project there and may be opportunity to add to it		Personal communication with Merri Martz of TetraTech Inc. Authors of Draft Twin Cities Flood Reduction Project.
CH-4	Porter area	Oxbow reconnection	Floodplain Conditions	Just upstream are the black hills tributaries and old oxbows; also oxbows at Porter Creek		Personal communication with Merri Martz of TetraTech Inc. Authors of Draft Twin Cities Flood Reduction Project.

Table 3
Description of Potential Enhancement Projects in Upper Chehalis Watershed

Project Identifier	Location	Enhancement	Limiting Factor Addressed	Description of Project	Potential Available Habitat Upstream of Project	Comments
CH-5	River Miles 20 to 79	Reconnect and restore off-channel habitat	Floodplain Conditions	Reconnect and restore off-channel habitat identified in (USACE 2001) and Ralph and Peterson (1994)		General Actions in Strategy
CH-6	State Route 6 oxbow	Oxbow reconnection, Riparian restoration, Install LWD	Floodplain Conditions, Riparian Conditions, LWD	City of Chehalis owns two-thirds of the property (130 acres). City of Chehalis owns Poplar farm on the north side of SR-6 that may be available for restoration. Landowner in the SR-6 Oxbow site may be interested in conservation. This oxbow is currently connected to the Chehalis at approximately a 1.2-year flow.		Draft Twin Cities Flood Reduction Project, Mitigation Site Evaluations. Appendix A. Dated March 2011.
CH-7	Oxbow Lake Reconnection	Oxbow reconnection, Riparian restoration, Install LWD	Floodplain Conditions, Riparian Conditions, LWD	Approximately 75 acres; 2 landowners. Improve connection to main channel—not currently a connection but when floodwaters exceed the bank elevation (something above a 2-year flow, maybe 5-year flow), then it may briefly connect. Will require about 12 feet of excavation to create a channel connection to Chehalis River for winter rearing (i.e., November to May).		Draft Twin Cities Flood Reduction Project, Mitigation Site Evaluations. Appendix A. Dated March 2011.
CH-8	WDFW Pheasant Farm	High flow side channel restoration, Wetland restoration, Riparian restoration	Floodplain Conditions, Riparian Conditions, Water Quality, Water Quantity	200 acres (combined Washington Department of Fish and Wildlife [WDFW] and private landowner just downstream). WDFW owns a pheasant farm and may be open to conservation. Good floodplain area with potential excavation and enhancement. The area closest to the river already has a number of higher flow side channels and good riparian cover; existing good quality. There are a few fields that are hayed that could be excavated for wetlands and side channels and also revegetated.		Draft Twin Cities Flood Reduction Project, Mitigation Site Evaluations. Appendix A. Dated March 2011.
CH-9	Scheuber Ditch	Floodplain, Riparian restoration, Install LWD	Floodplain Conditions, Riparian Conditions, LWD, Water Quality, Water Quantity	Connect Scheuber Ditch to State Route 6 Oxbow at upstream end and excavate new meandering stream with benches on the inside. Also create and enhance emergent wetlands along newly excavated stream. Install engineered log jam at confluence of newly excavated stream and Chehalis River. Landowners to the north along Scheuber Ditch are less amenable to restoration.		Draft Twin Cities Flood Reduction Project, Mitigation Site Evaluations. Appendix A. Dated March 2011.
CH-10	Near Gaddis Creek Confluence RM 34	Side channel/floodplain enhancement	Floodplain Conditions, LWD, Riparian Conditions	Enhance low elevation areas, side channels, and floodplain habitat with vegetated benches and LWD.		Geomorphic analysis from aerial photos and elevation maps.
CH-11	Near RM 36	Oxbow Reconnection, Side channel/floodplain enhancement	Floodplain Conditions, LWD, Riparian Conditions	Reconnect oxbow with mainstem Chehalis. Enhance low elevation areas, side channels, and floodplain habitat with vegetated benches and LWD.		Geomorphic analysis from aerial photos and elevation maps.
CH-12	Near RM 42	Floodplain Enhancement	Floodplain Conditions, LWD, Riparian Conditions	Enhance low elevation areas, side channels, and floodplain habitat with vegetated benches and LWD.		Geomorphic analysis from aerial photos and elevation maps.
CH-13	Near RM 43	Oxbow Reconnection, Side channel/floodplain	Floodplain Conditions, LWD, Riparian	Reconnect oxbow with mainstem Chehalis. Enhance low elevation areas, side channels, and floodplain habitat with vegetated benches and LWD.		Geomorphic analysis from aerial photos and elevation maps.
CH-14	Near Garrard Creek Confluence Chehalis RM 46	Side channel/floodplain enhancement	Floodplain Conditions, LWD, Riparian Conditions	Enhance low elevation areas, side channels, and floodplain habitat with vegetated benches and LWD.		Geomorphic analysis from aerial photos and elevation maps.
CH-15	Near RM 50	Side channel/floodplain enhancement	Floodplain Conditions, LWD, Riparian Conditions	Enhance low elevation areas, side channels, and floodplain habitat with vegetated benches and LWD.		Geomorphic analysis from aerial photos and elevation maps.
CH-16	Near Chehalis Village Chehalis RM 54	Side channel/floodplain enhancement	Floodplain Conditions, LWD, Riparian Conditions	Enhance low elevation areas, side channels, and floodplain habitat with vegetated benches and LWD.		Geomorphic analysis from aerial photos and elevation maps.
CH-17	Near RM 56-58	Side channel/floodplain enhancement	Floodplain Conditions, LWD, Riparian Conditions	Enhance low elevation areas, side channels, and floodplain habitat with vegetated benches and LWD.		Geomorphic analysis from aerial photos and elevation maps.

Table 3
Description of Potential Enhancement Projects in Upper Chehalis Watershed

Project Identifier	Location	Enhancement	Limiting Factor Addressed	Description of Project	Potential Available Habitat Upstream of Project	Comments
CH-17a	Near RM 58	Side channel/floodplain enhancement	Floodplain Conditions, LWD, Riparian Conditions	Enhance low elevation areas, side channels, and floodplain habitat with vegetated benches and LWD.		Geomorphic analysis from aerial photos and elevation maps.
CH-18	Dry Creek confluence Chehalis RM 60	Floodplain enhancement	Floodplain Conditions, LWD, Riparian	Enhance low elevation areas and floodplain habitat with vegetated benches and LWD.		Geomorphic analysis from aerial photos and elevation maps.
CH-19	Near RM 62	Floodplain enhancement	Floodplain Conditions, LWD, Riparian Conditions	Enhance low elevation areas and floodplain habitat with vegetated benches and LWD.		Geomorphic analysis from aerial photos and elevation maps.
CH-20	Near RM 68	Oxbow Reconnection, Side channel/floodplain enhancement	Floodplain Conditions, LWD, Riparian Conditions	Reconnect oxbow with mainstem Chehalis. Enhance low elevation areas, side channels, and floodplain habitat with vegetated benches and LWD.		Geomorphic analysis from aerial photos and elevation maps.
CH-21	Near RM 78	Oxbow Reconnection, Side channel/floodplain	Floodplain Conditions, LWD, Riparian	Reconnect oxbow with mainstem Chehalis. Enhance low elevation areas, side channels, and floodplain habitat with vegetated benches and LWD.		Geomorphic analysis from aerial photos and elevation maps.
CH-22	Near RM 79	Floodplain enhancement	Floodplain Conditions, LWD, Riparian Conditions	Enhance low elevation areas and floodplain habitat with vegetated benches and LWD.		Geomorphic analysis from aerial photos and elevation maps.
Ch-23	Near RM 82	Side channel/floodplain enhancement	Floodplain Conditions, LWD, Riparian Conditions	Enhance low elevation areas and floodplain habitat with vegetated benches and LWD.		Geomorphic analysis from aerial photos and elevation maps.
CH-24	Near RM 83	Floodplain enhancement	Floodplain Conditions, LWD, Riparian Conditions	Enhance low elevation areas and floodplain habitat with vegetated benches and LWD.		Geomorphic analysis from aerial photos and elevation maps.
CH-25	Near RM 85	Floodplain enhancement	Floodplain Conditions, LWD, Riparian Conditions	Enhance low elevation areas and floodplain habitat with vegetated benches and LWD.		Geomorphic analysis from aerial photos and elevation maps.
CH-26	Near RM 88	Floodplain enhancement	Floodplain Conditions, LWD, Riparian Conditions	Enhance low elevation areas and floodplain habitat with vegetated benches and LWD.		Geomorphic analysis from aerial photos and elevation maps.
Lincoln Management Unit (Lincoln Creek, Independence Creek, Garrard Creek, Gaddis Creek, Rock/Williams Creek, Bunker Creek, Scammon Creek, Mill Creek, Stearns Creek)						
LI-1	Lincoln Creek	Correct barrier culverts	Fish Passage Conditions	Use guidelines in Section 4 of Strategy (Grays Harbor County Lead Entity 2011)		General Actions in Strategy
LI-2	Independence Creek	Correct barrier culverts	Fish Passage Conditions	Use guidelines in Section 4 of Strategy (Grays Harbor County Lead Entity 2011)		General Actions in Strategy
LI-3	Harris Creek	Correct Barrier culverts	Fish Passage Conditions	Sickman-Ford Bridge culvert		Chehalis River Basin Comprehensive Flood Hazard Management Plan. June 2010.
LI-4	Garrard Creek (county and private properties)	Correct barrier culverts	Fish Passage Conditions	Use guidelines in Section 4 of Strategy (Grays Harbor County Lead Entity 2011)		General Actions in Strategy
LI-5	Gaddis Creek	Correct barrier culverts	Fish Passage Conditions	Use guidelines in Section 4 of Strategy (Grays Harbor County Lead Entity 2011)		General Actions in Strategy
LI-6	Rock/Williams Creek	Correct barrier culverts	Fish Passage Conditions	Use guidelines in Section 4 of Strategy (Grays Harbor County Lead Entity 2011)		General Actions in Strategy
LI-7	Bunker Creek	Correct barrier culverts	Fish Passage Conditions	Use guidelines in Section 4 of Strategy (Grays Harbor County Lead Entity 2011)		General Actions in Strategy
LI-8	Scammon, Mill, and Stearns Creeks	Correct barrier culverts	Fish Passage Conditions	Use guidelines in Section 4 of Strategy (Grays Harbor County Lead Entity 2011)		General Actions in Strategy
LI-9	Wolf-Davis Creek R6	Correct barrier culverts	Fish Passage Conditions	This culvert is on Davis Creek, a tributary to the Chehalis River. The downstream third of the culvert slopes upward severely which likely caused the invert to rust out. The road partially washed out 5 or 6 yrs ago. At higher flows some flow goes through culvert, and some flow goes over road. At low flow, all flow goes through severely undersized culvert.	over 11 miles of fish habitat upstream for chum, coho, steelhead and cutthroat trout	PRISM
LI-10	Independence Road bank protection	Bank protection	Riparian Conditions	No other information provided		Chehalis River Basin Comprehensive Flood Hazard Management Plan. June 2010.

Table 3
Description of Potential Enhancement Projects in Upper Chehalis Watershed

Project Identifier	Location	Enhancement	Limiting Factor Addressed	Description of Project	Potential Available Habitat Upstream of Project	Comments
LI-11	Harris Creek Fish Enhancement			No other information provided		Chehalis River Basin Comprehensive Flood Hazard Management Plan. June 2010.
LI-12	Gaddis Creek floodplain Near Chehalis RM 34	Floodplain enhancement	Floodplain Conditions, LWD, Riparian Conditions	Enhance low elevation areas and floodplain habitat with vegetated benches and LWD.		Geomorphic analysis from aerial photos and elevation maps.
LI-13	Rock/Williams Creek floodplain Near Chehalis RM 40	Floodplain enhancement	Floodplain Conditions, LWD, Riparian Conditions	Enhance low elevation areas and floodplain habitat with vegetated benches and LWD.		Geomorphic analysis from aerial photos and elevation maps.
LI-14	Bunker Creek floodplain Near Chehalis RM 85	Floodplain enhancement	Floodplain Conditions, LWD, Riparian Conditions	Enhance low elevation areas and floodplain habitat with vegetated benches and LWD.		Geomorphic analysis from aerial photos and elevation maps.
Newaukum Management Unit (Newaukum Mainstem, North Fork, Middle Fork, Salzer Creek, Coal Creek, Dillenbaugh Creek, Berwick Creek, China Creek)						
NE-1	North Fork Newaukum	Correct barrier culverts; improve fish passage	Fish Passage Conditions	Use guidelines in Section 4 of Strategy (Grays Harbor County Lead Entity 2011); improve passage at fishways, add fishways where needed		General Actions in Strategy
NE-2	Middle Fork Newaukum	Correct barrier culverts	Fish Passage Conditions	Use guidelines in Section 4 of Strategy (Grays Harbor County Lead Entity 2011)		General Actions in Strategy
NE-3	Salzer Creek	Correct barrier culverts	Fish Passage Conditions	Use guidelines in Section 4 of Strategy (Grays Harbor County Lead Entity 2011)		General Actions in Strategy
NE-4	Dillenbaugh Creek	Correct barrier culverts	Fish Passage	Use guidelines in Section 4 of Strategy (Grays Harbor County Lead Entity 2011)		General Actions in Strategy
NE-5	Berwick Creek	Correct barrier culverts	Fish Passage Conditions	Use guidelines in Section 4 of Strategy (Grays Harbor County Lead Entity 2011)		General Actions in Strategy
NE-6	Lucas Creek	Replace culvert	Fish Passage Conditions	Conceptual project on Habitat Work Schedule	access will be restored to 1.73 miles of healthy spawning and rearing habitat	Conceptual project hws database - Lucas Creek MP 4.3 Barrier Removal Project
NE-7	Lucas Creek	Replace culvert	Fish Passage Conditions	Conceptual project on Habitat Work Schedule	annual access to 2588 sq meters spawning habitat; 1299 sq meters rearing habitat	Conceptual project hws database - Lucas Creek MP 4.2 Barrier Removal Project
NE-8	Dillenbaugh Creek	Oxbow reconnection	Fish Passage Conditions, Floodplain Conditions	Near Dillenbaugh Creek; demolish old sewage treatment plant. Look at route of Dillenbaugh Creek (lower 2 miles or so) that traverses the Chehalis River floodplain. Could either reroute Dillenbaugh Creek into the Newaukum at Stan Hedwall Park, or could improve its existing course and send towards old sewage treatment plant. Bob Burkle has been a fan of rerouting it into Newaukum.		Draft Twin Cities Flood Reduction Project, Mitigation Site Evaluations. Appendix A. Dated March 2011.
NE-9	Newaukum River	Riparian Restoration	Riparian Conditions, Floodplain Conditions	Includes revegetating and regrading banks to 2:1 slopes with a bench or 3:1 slope and removing invasives/planting a native understory.		Draft Twin Cities Flood Reduction Project, Mitigation Site Evaluations. Appendix A. Dated March 2011.
NE-10a	Salzer Creek Lower Mile Oxbow Reconnection and Riparian Restoration	Oxbow Reconnection, Riparian Restoration, Install LWD, Wetland Creation and Restoration	Floodplain Conditions, Riparian Conditions, LWD, Water Quality, Water Quantity	Connect Salzer Creek to old Chehalis River oxbow. Includes revegetating and regrading banks of Salzer Creek to 2:1 slopes with a bench or 3:1 slopes and removing invasives/planting a native understory. Also includes wetland creation, enhancement, and installation of LWD.		Draft Twin Cities Flood Reduction Project, Mitigation Site Evaluations. Appendix A. Dated March 2011.
NE-10b	Salzer Creek I-5 to BNRR Riparian and In-Channel Restoration	Stream and Riparian Restoration	Floodplain Conditions, Riparian Conditions, LWD	Realign stream and install LWD between I-5 and the BNRR railroad. Revegetate with native trees and shrubs.		Draft Twin Cities Flood Reduction Project, Mitigation Site Evaluations. Appendix A. Dated March 2011.

Table 3
Description of Potential Enhancement Projects in Upper Chehalis Watershed

Project Identifier	Location	Enhancement	Limiting Factor Addressed	Description of Project	Potential Available Habitat Upstream of Project	Comments
NE-10c	Salzer-Coal Creek Fairgrounds Floodplain and Channel Restoration	Relocate Levee, Stream and Riparian Restoration, Wetland Creation and Restoration	Floodplain Conditions, Riparian Conditions, Water Quality, Water Quantity	Remove existing levee and realign Salzer and Coal Creeks to create sinuosity and improved instream habitat. Also includes wetland creation, enhancement, and riparian revegetation.		Chehalis River Basin Comprehensive Flood Hazard Management Plan. June 2010.
NE-10d	Salzer Creek at Centralia Alpha Road Floodplain Storage and Riparian Restoration	Stream and Riparian Restoration, Install LWD, Wetland Creation and Restoration	Floodplain Conditions, LWD, Riparian Conditions, Water Quality, Water Quantity	Create approximately 2,000 feet of sinuous stream and install LWD log clusters. Revegetate with native trees and shrubs. Excavate emergent wetland and revegetate with wetland plants.		Chehalis River Basin Comprehensive Flood Hazard Management Plan. June 2010.
NE-10e	Salzer Creek at Proffitt Road Riparian Restoration	Riparian Restoration, Install LWD	Riparian Conditions, LWD	Includes revegetating and regrading banks to 2:1 slopes with a bench or 3:1 and removing invasives/planting a native understory. Also includes installation of LWD.		Chehalis River Basin Comprehensive Flood Hazard Management Plan. June 2010.
NE-13	Newaukum River/Newaukum Valley Golf Course	In-channel Enhancements	Riparian and Floodplain	Golf course landowner is interested in enhancements. Potential for riparian and in-channel enhancements – area of channel migration.		Personal communication with Merri Martz of TetraTech Inc. Authors of Draft Twin Cities Flood Reduction Project.
NE-14	North Fork Newaukum		Riparian and Floodplain	From Tauscher Road downstream to confluence is potential for riparian and floodplain restoration. A couple of interested landowners (e.g., owner of a trout pond). Would then connect to Washington State Department of Transportation's mitigation bank at lower end of Middle Fork Newaukum.		Draft Twin Cities Flood Reduction Project, Mitigation Site Evaluations. Appendix A. Dated March 2011.
NE-15	Newaukum Confluence	Riparian Restoration, Install LWD	Riparian Conditions, LWD	Includes revegetating and regrading banks to 2:1 slopes with a bench and removing invasives/planting a native understory. Also includes installation of LWD.		Draft Twin Cities Flood Reduction Project, Mitigation Site Evaluations. Appendix A. Dated March 2011.
NE-16	Stan Hedwall Park Floodplain Reconnection	Floodplain, Riparian Restoration, Install LWD	Floodplain Conditions, Riparian Conditions, LWD	Includes reconnecting existing side-channels, four engineered log jams, and riparian revegetation over 40 acres.		Draft Twin Cities Flood Reduction Project, Mitigation Site Evaluations. Appendix A. Dated March 2011.
NE-17	Rice Road Floodplain/Side Channel Restoration	Floodplain, Riparian Restoration, Install LWD	Floodplain Conditions, Riparian Conditions, LWD	Includes reconnecting existing side-channels, one engineered log jam, and riparian revegetation over 14 acres.		Draft Twin Cities Flood Reduction Project, Mitigation Site Evaluations. Appendix A. Dated March 2011.
NE-18	North Fork/South Fork Newaukum Confluence Riparian Restoration	Riparian Restoration	Riparian Conditions, LWD	Includes revegetating and regrading banks to 2:1 slopes with a bench and removing invasives/planting a native understory. Also includes installation of LWD.		Draft Twin Cities Flood Reduction Project, Mitigation Site Evaluations. Appendix A. Dated March 2011.
NE-19	North Fork Newaukum River at Tauscher Road	Riparian Restoration, Install LWD	Riparian Conditions, LWD	Includes revegetating and regrading banks to 2:1 slopes with a bench and removing invasives/planting a native understory. Also includes installation of LWD.		Draft Twin Cities Flood Reduction Project, Mitigation Site Evaluations. Appendix A. Dated March 2011.
NE-20	Middle Fork Newaukum	Riparian Preservation and Restoration	Riparian Conditions	Preserve 4 acres of riparian forest along Middle Fork Newaukum River and restore 16 acres.		Draft Twin Cities Flood Reduction Project, Mitigation Site Evaluations. Appendix A. Dated March 2011.
NE-21	Middle Fork Newaukum Preservation			Preserve habitat buy acquisition of intact riparian, off-channel, and wetland habitats.		Personal communication with Bob Amrine of Lewis County Conservation District.
Skookumchuck Management Unit (Skookumchuck River, Scatter Creek)						
SK-1	Skookumchuck River	Correct barrier culverts, improve fish passage	Fish Passage Conditions	Use guidelines in Section 4 of Strategy (Grays Harbor County Lead Entity 2011); improve passage at fishways, add fishways where needed		General Actions in Strategy
SK-2	Skookumchuck River	Twin culverts under Main St. at 11th	Fish Passage Conditions	No additional description provided		Chehalis River Basin Comprehensive Flood Hazard Management Plan. June 2010.
SK-3	Upstream of River Mile 10	Potential floodplain enhancement	Floodplain Conditions	River is against one wall of the valley with the rest of the valley open for potential enhancement. River has been rerouted to edge of floodplain (hillslopes) and there are remnant wetlands and side channels and large floodplain area.		Draft Twin Cities Flood Reduction Project, Mitigation Site Evaluations. Appendix A. Dated March 2011.
SK-4	Lower watershed	Reconnect, enhance, restore off-channel, floodplain, wetlands	Floodplain Conditions	36 miles in lower watershed (Skookumchuck, Coffee Creek, Salmon Creek, Johnson Creek)		General Actions in Strategy
SK-5	Scatter Creek	Sampson Wetland Enhancement Ph. 1	Floodplain Conditions, Riparian Conditions, LWD, Water Quality	30% design project; part of larger conceptual plan to develop wetland complex/refugia; larger project approx. 10+ acres submerged wetland		Conceptual Project HWS database

Table 3
Description of Potential Enhancement Projects in Upper Chehalis Watershed

Project Identifier	Location	Enhancement	Limiting Factor Addressed	Description of Project	Potential Available Habitat Upstream of Project	Comments
SK-6	Skookumchuck River	Streambank stabilization	Riparian Conditions	Streambank stabilization in Bucoda		Chehalis River Basin Comprehensive Flood Hazard Management Plan. June 2010.
SK-8a	Near RM 7	Riparian Restoration	Riparian Conditions	Off-Channel Area (old meander), Open Space with some riparian cover, Excavate perennial off-channel connection, railroad present.		Geomorphic analysis from aerial photos and elevation maps.
SK-8b	Near RM 7.5	Side channel/floodplain enhancement	Floodplain Conditions, LWD, Riparian Conditions	Off-Channel Area (old meander), Open Space with some riparian cover, Excavate perennial off-channel connection, railroad present.		Geomorphic analysis from aerial photos and elevation maps.
SK-9	Near RM 8	Side channel/floodplain enhancement	Floodplain Conditions, LWD, Riparian Conditions	Off-Channel Area (old meander), Open Space with some riparian cover, Excavate perennial off-channel connection, Limited to no infrastructure (houses) present		Geomorphic analysis from aerial photos and elevation maps.
SK-11	Near RM 10	Floodplain enhancement	Floodplain Conditions, LWD, Riparian Conditions	Off-Channel Area (old meander), Confined along left bank by RR, Excavate off-channel connection, Infrastructure present (houses, road, structures)		Geomorphic analysis from aerial photos and elevation maps.
SK-12	Near RM 11	Side channel/floodplain enhancement	Floodplain Conditions, LWD, Riparian Conditions	Right Bank Side Channel, Right Bank Low Lying Area (potential floodplain), Left Bank and Right Bank: Low lying floodplain areas Adjacent, Improve Riparian Cover (as necessary), Excavate Off-Channel/Floodplain, Connect to Off-channel Floodplain areas Habitat Area		Geomorphic analysis from aerial photos and elevation maps.
SK-13	Near RM 12	Side channel/floodplain enhancement	Floodplain Conditions, LWD, Riparian Conditions	Left Bank Side Channel (verify), Left Bank Low Lying Area (potential floodplain)(open field area), Improve Side Channel Connection As Necessary, Excavation, Little Riparian Vegetation Present-improve riparian cover		Geomorphic analysis from aerial photos and elevation maps.
SK-14	Near RM 13	Side channel/floodplain enhancement	Floodplain Conditions, LWD, Riparian Conditions	Includes removing invasives/planting native forest trees and understory.		Draft Twin Cities Flood Reduction Project, Mitigation Site Evaluations. Appendix A. Dated March 2011.
SK-15	Near RM 14	Side channel/floodplain enhancement	Floodplain Conditions, LWD, Riparian Conditions	Right Bank Side Channel, Left Bank Side Channel, Floodplain areas right and left bank, Off-channel habitat potential (right bank), Riparian vegetation present, Infrastructure present outside of boundaries.		Geomorphic analysis from aerial photos and elevation maps.

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Table 4
Tier 1 Ranked Barrier Sites within WRIA 23

Site ID	Latitude	Longitude	Salmon Species Present	Percent Passable	Upstream Habitat (miles)	Raw Score	RANK	PERCENT	WAU-Name	Salmonid Presence				
										Coho Salmon	Chinook Salmon	Chum Salmon	Steelhead Trout	Cutthroat Trout
Black River Management Unit														
1703W25A	46.93439	-122.99788	2	0.00	12.34	125.4	13	99.50%	Black River	+				+
1703W22E	46.95286	-123.03912	2	0.00	3.78	39.8	143	94.60%	Black River	+				+
341513	46.94588	-122.96075	2	0.67	9.89	33.3	179	93.30%	Black River	+				+
1602W09A	46.88775	-122.93589	2	0.67	7.70	26.1	249	90.60%	Black River	+				+
990040	46.92623	-122.94542	3	0.67	7.35	25.2	270	89.90%	Black River	+			+	+
343629	46.88348	-122.93690	2	0.67	7.39	25.0	272	89.80%	Black River	+				+
990365	46.93969	-122.94150	2	0.67	7.09	24.1	285	89.30%	Black River	+				+
1703W15A	46.96618	-123.04752	2	0.00	2.21	24.1	285	89.30%	Black River	+				+
1604W33C	46.82332	-123.19172	3	0.33	3.17	23.2	293	89.00%	Black River	+	+			+
1604W33A	46.83216	-123.18271	2	0.00	2.00	22.0	314	88.20%	Black River	+				+
1703W10A	46.97475	-123.02595	2	0.00	1.98	21.8	316	88.10%	Black River	+				+
1703W22B	46.94440	-123.03941	2	0.00	1.96	21.6	319	88.00%	Black River	+				+
23.0691 0.53	46.96599	-123.04732	1	0.00	2.02	21.2	329	87.60%	Black River					+
341711	46.85074	-123.04435	3	0.33	2.76	20.5	346	87.10%	Black River	+	+			+
990962	46.92044	-122.90794	3	0.67	5.37	18.7	380	85.80%	Black River	+			+	+
343206	46.96459	-123.03942	2	0.33	2.55	18.4	386	85.50%	Black River	+				+
1601W07C	46.89251	-122.85807	2	0.67	5.21	17.9	404	84.70%	Black River	+				+
1603W38A	46.84621	-123.11689	2	0.67	4.94	17.0	427	83.80%	Black River	+				+
990963	46.93643	-122.90787	2	0.67	4.02	13.9	515	80.60%	Black River	+				+
1703W15C	46.95825	-123.03985	2	0.33	1.64	12.3	601	77.30%	Black River	+				+
1603W14A	46.86992	-123.02349	2	0.00	0.98	11.8	623	76.50%	Black River	+				+
1703W22A	46.94304	-123.04484	2	0.33	1.48	11.3	650	75.40%	Black River	+				+
23.0543 A 0.10	46.96238	-123.27895	2	0.67	4.90	16.8	433	83.70%	Porter Creek				+	+
991536	46.90922	-123.29531	3	0.00	1.25	15.5	460	82.60%	Porter Creek	+			+	+
1603W40A	46.86964	-123.07948	2	0.67	9.92	33.4	177	93.30%	Waddel Creek	+				+
340958	46.86207	-123.08919	2	0.33	4.49	31.4	196	92.60%	Waddel Creek	+				+
1703W17A	46.95821	-123.08300	3	0.33	3.96	28.5	227	91.50%	Waddel Creek	+			+	+
342722	46.95390	-123.07627	3	0.33	2.91	21.5	322	87.80%	Waddel Creek	+			+	+
Boistfort Management Unit														
021(92004)(08538)	46.48839	-123.10246	3	0.00	7.31	76.1	44	98.30%	Chehalis, SF	+			+	+
021(92004)(05661)	46.45210	-123.08353	2	0.67	17.77	59.3	69	97.40%	Chehalis, SF				+	+
021(92004)(03836)	46.42566	-123.08350	1	0.67	12.48	41.5	128	95.20%	Chehalis, SF					+
021(92004)(03525)	46.42111	-123.08345	2	0.67	12.09	40.6	136	94.80%	Chehalis, SF	+				+
021(92004)(02984)	46.41326	-123.08328	2	0.67	10.30	34.7	162	93.90%	Chehalis, SF	+				+
1203W31B	46.48662	-123.11517	4	0.33	2.41	18.8	378	85.80%	Chehalis, SF	+	+		+	+
1104W34A	46.39508	-123.15273	3	0.67	4.71	16.5	438	83.50%	Chehalis, SF	+			+	+
021(92004)(07238)	46.47070	-123.09876	3	0.67	4.63	16.3	447	83.20%	Chehalis, SF	+			+	+

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Site ID	Latitude	Longitude	Salmon Species Present	Percent Passable	Upstream Habitat (miles)	Raw Score	RANK	PERCENT	WAU-Name	Salmonid Presence				
										Coho Salmon	Chinook Salmon	Chum Salmon	Steelhead Trout	Cutthroat Trout
021(92004)(07883)	46.47993	-123.09673	3	0.33	2.04	15.7	456	82.90%	Chehalis, SF	+			+	+
1203W30A	46.48895	-123.11102	4	0.67	4.02	14.6	482	81.90%	Chehalis, SF	+	+		+	+
1204W36A	46.48604	-123.12346	2	0.33	1.92	14.2	501	81.10%	Chehalis, SF				+	+
021(92004)(07013)	46.46745	-123.09771	4	0.67	3.21	11.9	618	76.70%	Chehalis, SF	+	+		+	+
021(24017)(08876)	46.53741	-123.07027	2	0.33	11.42	77.9	41	98.40%	Curtis	+				+
021(27000)(02426)	46.64588	-123.28514	3	0.00	6.60	69.0	52	98.00%	Curtis	+			+	+
021(27501)(02750)	46.63439	-123.23717	3	0.67	15.71	52.8	86	96.80%	Curtis	+			+	+
021(27651)(00273)	46.63846	-123.24675	2	0.67	12.24	41.1	130	95.10%	Curtis	+				+
021(27820)(02631)	46.63773	-123.17453	3	0.67	12.04	40.7	134	94.90%	Curtis	+	+			+
021(24017)(11680)	46.56999	-123.09639	2	0.00	3.17	33.7	174	93.40%	Curtis	+				+
1204W03B	46.55559	-123.10154	3	0.33	3.88	28.0	229	91.40%	Curtis	+			+	+
1203W05B	46.55653	-123.08617	2	0.33	3.95	27.8	232	91.30%	Curtis	+				+
021(24017)(12280)	46.57455	-123.10426	2	0.67	7.65	25.9	255	90.20%	Curtis	+				+
1203W10A	46.53999	-123.05498	3	0.00	2.23	25.3	267	89.90%	Curtis	+			+	+
1304W35A	46.57398	-123.15390	3	0.67	6.07	21.0	333	87.40%	Curtis	+			+	+
1304W13C	46.61288	-123.13216	3	0.00	1.76	20.6	343	87.10%	Curtis	+			+	+
021(27000)(02202)	46.64591	-123.28044	2	0.67	5.71	19.5	358	86.40%	Curtis	+				+
021(24036)(00519)	46.58377	-123.10220	2	0.67	5.34	18.3	388	85.50%	Curtis	+				+
1304W03A	46.63507	-123.16772	3	0.67	5.13	17.9	404	84.70%	Curtis	+			+	+
990764	46.60041	-123.12880	4	0.67	4.92	17.6	413	84.40%	Curtis	+	+		+	+
1304W13B	46.61032	-123.13338	3	0.33	2.26	17.2	424	84.10%	Curtis	+			+	+
021(27820)(02365)	46.63648	-123.16571	2	0.67	4.17	14.4	491	81.40%	Curtis	+				+
1203W05A	46.55600	-123.08875	2	0.67	4.00	13.9	515	80.60%	Curtis	+				+
990760	46.59588	-123.15223	4	0.67	3.78	13.8	519	80.40%	Curtis	+	+		+	+
991221	46.61274	-123.11216	4	0.00	0.96	13.6	529	80.10%	Curtis	+	+		+	+
1304W23A	46.59648	-123.15163	3	0.67	3.75	13.4	538	79.70%	Curtis	+			+	+
125 1303W05A	46.55635	-123.08741	2	0.67	3.87	13.4	538	79.70%	Curtis	+				+
021(28051)(00450)	46.59663	-123.15199	3	0.67	3.76	13.4	538	79.70%	Curtis	+			+	+
990423	46.63197	-123.19923	3	0.00	1.01	13.1	554	79.00%	Curtis	+			+	+
1304W36B	46.56755	-123.12621	3	0.33	1.65	13.1	554	79.00%	Curtis	+	+			+
991542	46.63028	-123.23126	3	0.33	1.57	12.5	583	77.90%	Curtis	+			+	+
021(24017)(10900)	46.56020	-123.08954	2	0.67	3.55	12.4	591	77.60%	Curtis	+				+
1304W17A	46.61419	-123.20596	3	0.33	1.44	11.7	629	76.30%	Curtis	+			+	+
021(23650)(02800)	46.59310	-123.10513	2	0.67	3.36	11.7	629	76.30%	Curtis	+				+
021(24017)(09046)	46.54250	-123.07817	2	0.67	3.22	11.3	650	75.40%	Curtis	+				+
990758	46.63041	-123.21776	2	0.00	0.92	11.2	659	75.10%	Curtis				+	+
1305W17A	46.61320	-123.34313	3	0.00	1.69	19.9	352	86.80%	Elk Creek	+			+	+
1305W18B	46.61696	-123.35686	3	0.33	2.31	17.5	418	84.40%	Elk Creek	+			+	+

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										Coho Salmon	Chinook Salmon	Chum Salmon	Steelhead Trout	Cutthroat Trout
1305W18C	46.61531	-123.35740	2	0.33	1.72	12.9	566	78.80%	Elk Creek				+	+
1305W17B	46.61236	-123.34859	3	0.33	1.44	11.7	629	76.30%	Elk Creek	+			+	+
1205W05A	46.56051	-123.33348	4	0.00	22.22	226.2	1	100.00%	Rock-Jones	+	+		+	+
021(26661)(00060)	46.59524	-123.27837	3	0.67	24.42	81.6	38	98.60%	Rock-Jones	+			+	+
1080120	46.55730	-123.36099	2	0.67	22.07	73.5	46	98.30%	Rock-Jones				+	+
1305W25B	46.59049	-123.26218	1	0.33	9.54	64.6	59	97.80%	Rock-Jones					+
1305W25A	46.58081	-123.24256	1	0.00	4.79	48.9	98	96.30%	Rock-Jones					+
021(26390)(00612)	46.57760	-123.30452	3	0.67	12.11	41.0	132	95.00%	Rock-Jones	+			+	+
990473	46.56365	-123.31011	3	0.67	12.01	40.6	136	94.80%	Rock-Jones	+			+	+
1305W23A	46.60443	-123.27932	3	0.00	3.07	33.7	174	93.40%	Rock-Jones	+			+	+
1305W23D	46.59253	-123.26402	1	0.67	9.69	32.3	187	93.00%	Rock-Jones					+
021(24019)(02040)	46.56868	-123.25687	3	0.67	9.17	31.3	198	92.60%	Rock-Jones	+			+	+
1303W31A	46.56857	-123.34934	3	0.33	4.01	28.9	221	91.70%	Rock-Jones	+				+
021(24019)(02402)	46.56547	-123.25096	3	0.67	6.28	21.7	318	88.10%	Rock-Jones	+			+	+
1205W05B	46.54946	-123.33145	3	0.00	0.87	11.7	629	76.30%	Rock-Jones					
1205W05C	46.55803	-123.32987	3	0.00	0.84	11.4	646	75.70%	Rock-Jones	+			+	+
021(25510)(00106)	46.56178	-123.18351	3	0.67	17.78	59.7	68	97.40%	Stillman Creek	+			+	+
021(25401)(01657)	46.54929	-123.16430	3	0.00	4.91	52.1	88	96.70%	Stillman Creek	+			+	+
021(25570)(00024)	46.56372	-123.19499	3	0.67	7.55	25.9	255	90.20%	Stillman Creek	+			+	+
021(25401)(03620)	46.56320	-123.19600	3	0.67	7.52	25.8	262	90.20%	Stillman Creek	+			+	+
1204W05C	46.56263	-123.21796	3	0.00	1.79	20.9	337	87.30%	Stillman Creek	+			+	+
021(25510)(00722)	46.57028	-123.18202	1	0.67	5.43	18.2	390	85.30%	Stillman Creek					+
021(24019)(04778)	46.54935	-123.21307	3	0.67	5.04	17.6	413	84.40%	Stillman Creek	+			+	+
021(25401)(03773)	46.56260	-123.19918	3	0.67	4.84	17.0	427	83.80%	Stillman Creek	+			+	+
1204W33A	46.49900	-123.16700	3	0.67	3.36	12.1	609	77.00%	Stillman Creek	+			+	+
021(24019)(04966)	46.54688	-123.21158	2	0.67	3.29	11.5	639	75.90%	Stillman Creek	+				+
Lincoln Management Unit														
1404W15A	46.70090	-123.16716	2	0.67	55.28	183.1	5	99.80%	Bunker Creek	+				+
021(24034)(05678)	46.67026	-123.14844	2	0.33	18.38	124.5	14	99.50%	Bunker Creek	+				+
021(28001)(05816)	46.62637	-123.11168	2	0.00	11.71	119.1	15	99.40%	Bunker Creek	+				+
021(24034)(02386)	46.64661	-123.09566	2	0.00	11.57	117.7	17	99.40%	Bunker Creek	+				+
021(24024)(03932)	46.70309	-123.11952	2	0.67	31.98	106.2	24	99.10%	Bunker Creek	+				+
1403W32B	46.65430	-123.09785	2	0.33	10.27	70.1	51	98.10%	Bunker Creek	+				+
1403W07A	46.69143	-123.11896	2	0.67	20.57	68.5	53	98.00%	Bunker Creek	+				+
1303W06A	46.63712	-123.11925	2	0.67	15.04	50.3	92	96.50%	Bunker Creek	+				+
1303W07A	46.63242	-123.11585	2	0.67	14.71	49.2	96	96.40%	Bunker Creek	+				+
021(24034)(08899)	46.70459	-123.18445	2	0.00	4.56	47.6	104	96.10%	Bunker Creek	+				+
1403W32C	46.64820	-123.09785	2	0.67	11.48	38.5	150	94.30%	Bunker Creek	+				+

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										Coho Salmon	Chinook Salmon	Chum Salmon	Steelhead Trout	Cutthroat Trout
1403W32A	46.65680	-123.09765	2	0.00	3.45	36.5	158	94.10%	Bunker Creek	+				+
1304W12A	46.62323	-123.12555	2	0.67	8.62	29.1	219	91.80%	Bunker Creek	+				+
1403W30A	46.66880	-123.09985	2	0.00	2.05	22.5	303	88.60%	Bunker Creek	+				+
021(24034)(00730)	46.63543	-123.06920	2	0.67	5.77	19.7	355	86.70%	Bunker Creek	+				+
1303W04D	46.64442	-123.07445	2	0.33	2.64	19.0	372	85.90%	Bunker Creek	+				+
1303W04C	46.64570	-123.07425	2	0.00	1.60	18.0	400	84.90%	Bunker Creek	+				+
1404W24A	46.68862	-123.13095	2	0.00	1.56	17.6	413	84.40%	Bunker Creek	+				+
021(24024)(01701)	46.67149	-123.11983	2	0.33	2.40	17.4	419	84.30%	Bunker Creek	+				+
1403W29B	46.66751	-123.08385	2	0.00	1.43	16.3	447	83.20%	Bunker Creek	+				+
1303W04A	46.64700	-123.07514	2	0.00	1.36	15.6	458	82.80%	Bunker Creek	+				+
1404W20B	46.69062	-123.21106	2	0.00	1.27	14.7	479	82.00%	Bunker Creek	+				+
1304W01A	46.63830	-123.13605	2	0.67	4.13	14.3	499	81.30%	Bunker Creek	+				+
L1404W23A	46.69133	-123.15660	2	0.67	3.43	12.0	615	76.90%	Bunker Creek	+				+
1404W23A	46.69133	-123.15660	2	0.67	3.43	12.0	615	76.90%	Bunker Creek	+				+
021(28001)(06343)	46.63263	-123.11676	2	0.33	1.57	11.9	618	76.70%	Bunker Creek	+				+
1504W06A	46.81348	-123.23703	2	0.67	14.04	47.0	109	95.90%	Garrard Creek	+				+
1504W06B	46.81172	-123.23635	2	0.67	13.94	46.7	110	95.80%	Garrard Creek	+				+
1505W04A	46.80952	-123.31327	2	0.00	2.39	25.9	255	90.20%	Garrard Creek	+				+
1505W11B	46.80173	-123.28777	2	0.67	6.55	22.3	308	88.40%	Garrard Creek	+				+
1505W16A	46.78431	-123.31321	2	0.67	4.63	15.9	452	83.00%	Garrard Creek	+				+
1505W08A	46.80048	-123.34740	2	0.00	1.22	14.2	501	81.10%	Garrard Creek	+				+
1505W10A	46.80728	-123.29647	2	0.67	4.07	14.1	507	80.90%	Garrard Creek	+				+
1505W02D	46.81392	-123.28062	2	0.00	1.17	13.7	526	80.30%	Garrard Creek	+				+
1505W02G	46.80998	-123.27668	2	0.67	3.65	12.7	572	78.50%	Garrard Creek	+				+
1505W11C	46.80188	-123.27207	2	0.67	3.56	12.4	591	77.60%	Garrard Creek	+				+
1505W21A	46.77472	-123.31215	2	0.00	0.95	11.5	639	75.90%	Garrard Creek	+				+
021(10026)(02100)	46.73405	-123.19333	3	0.67	45.00	149.5	7	99.70%	Lincoln Creek	+			+	+
1504W15A	46.78969	-123.17566	2	0.00	14.36	145.6	8	99.70%	Lincoln Creek	+				+
021(10019)(13700)	46.71410	-123.24532	3	0.00	10.64	109.4	22	99.20%	Lincoln Creek	+			+	+
021(10000)(00271)	46.79349	-123.17684	2	0.33	13.79	93.7	28	98.90%	Lincoln Creek	+				+
1403W03A	46.72768	-123.05048	2	0.67	19.95	66.5	56	97.90%	Lincoln Creek	+				+
1504W21A	46.77515	-123.18919	2	0.00	6.13	63.3	62	97.70%	Lincoln Creek	+				+
1503W17A	46.79031	-123.09767	2	0.00	5.87	60.7	66	97.50%	Lincoln Creek	+				+
021(10004)(01019)	46.76552	-123.19020	2	0.00	5.73	59.3	69	97.40%	Lincoln Creek	+				+
021(91015)(00761)	46.73938	-123.04228	3	0.67	17.38	58.3	72	97.30%	Lincoln Creek	+			+	+
021(91009)(01364)	46.76302	-123.24799	2	0.67	14.69	49.1	97	96.40%	Lincoln Creek	+				+
1503W31B	46.74895	-123.10987	2	0.67	13.32	44.6	116	95.70%	Lincoln Creek	+				+
1503W31A	46.74663	-123.10732	2	0.67	12.95	43.4	119	95.50%	Lincoln Creek	+				+

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										Coho Salmon	Chinook Salmon	Chum Salmon	Steelhead Trout	Cutthroat Trout
1503W12A	46.80210	-123.12707	2	0.67	11.79	39.6	145	94.50%	Lincoln Creek	+				+
1403W04C	46.72497	-123.06548	2	0.67	10.03	33.8	173	93.50%	Lincoln Creek	+				+
021(10000)(00064)	46.79064	-123.17564	2	0.67	9.74	32.8	183	93.10%	Lincoln Creek	+				+
1504W28A	46.77544	-123.18670	2	0.00	2.91	31.1	200	92.50%	Lincoln Creek	+				+
021(91009)(02925)	46.76254	-123.28009	2	0.00	2.59	27.9	230	91.40%	Lincoln Creek	+				+
1503W07A	46.79370	-123.10979	2	0.67	8.16	27.6	236	91.10%	Lincoln Creek	+				+
1504W29A	46.75388	-123.21622	2	0.00	2.36	25.6	263	90.20%	Lincoln Creek	+				+
1503W31D	46.74949	-123.09991	2	0.67	7.29	24.7	276	89.60%	Lincoln Creek	+				+
021(10000)(01485)	46.79349	-123.19065	2	0.67	7.17	24.3	281	89.40%	Lincoln Creek	+				+
021(10004)(01536)	46.75904	-123.19338	2	0.00	2.15	23.5	290	89.20%	Lincoln Creek	+				+
1503W17B	46.78848	-123.09743	2	0.00	2.05	22.5	303	88.60%	Lincoln Creek	+				+
1503W31C	46.74916	-123.10095	2	0.67	6.55	22.3	308	88.40%	Lincoln Creek	+				+
341972	46.78844	-123.09725	1	0.00	2.05	21.5	322	87.80%	Lincoln Creek					+
021(10004)(00716)	46.76989	-123.19078	2	0.67	6.13	20.9	337	87.30%	Lincoln Creek	+				+
1505W12AA	46.71626	-123.25685	2	0.00	1.74	19.4	365	86.30%	Lincoln Creek	+				+
021(10004)(01168)	46.76341	-123.18986	2	0.67	5.55	19.0	372	85.90%	Lincoln Creek	+				+
1504W26A	46.75360	-123.15009	2	0.67	5.44	18.6	381	85.60%	Lincoln Creek	+				+
021(10024)(00877)	46.77081	-123.21133	2	0.67	5.27	18.1	395	85.10%	Lincoln Creek	+				+
021(91015)(06963)	46.75656	-123.14685	2	0.33	2.34	17.0	427	83.80%	Lincoln Creek	+				+
021(91009)(02604)	46.76243	-123.27343	2	0.00	1.16	13.6	529	80.10%	Lincoln Creek	+				+
1504W21C	46.77079	-123.21121	2	0.33	1.82	13.5	532	79.90%	Lincoln Creek	+				+
021(10004)(00013)	46.77901	-123.18743	2	0.67	3.76	13.1	554	79.00%	Lincoln Creek	+				+
1504W14A	46.78785	-123.14979	2	0.67	3.74	13.0	562	78.90%	Lincoln Creek	+				+
1504W33A	46.74016	-123.19077	3	0.33	1.46	11.8	623	76.50%	Lincoln Creek	+			+	+
021(24002)(01505)	46.66281	-123.05823	2	0.00	18.71	189.1	3	99.90%	Scammon-Stearns	+				+
021(91025)(01010)	46.70634	-122.99589	2	0.33	27.69	186.9	4	99.80%	Scammon-Stearns	+				+
1403W34A	46.64984	-123.04925	2	0.33	26.14	176.5	6	99.80%	Scammon-Stearns	+				+
1403W10C	46.71566	-123.03306	2	0.00	11.38	115.8	20	99.20%	Scammon-Stearns	+				+
021(24005)(01131)	46.63638	-123.03660	2	0.67	32.03	106.4	23	99.10%	Scammon-Stearns	+				+
021(91017)(00973)	46.71379	-122.99442	3	0.67	27.12	90.5	31	98.80%	Scammon-Stearns	+			+	+
1302W29B	46.57872	-122.95824	3	0.33	11.94	82.0	37	98.60%	Scammon-Stearns	+			+	+
021(14001)(01340)	46.70315	-123.00045	2	0.67	21.73	72.4	49	98.20%	Scammon-Stearns	+				+
021(24002)(01242)	46.66134	-123.05397	2	0.67	20.07	66.9	55	97.90%	Scammon-Stearns	+				+
021(14004)(00698)	46.70730	-123.01594	2	0.67	19.28	64.3	61	97.70%	Scammon-Stearns	+				+
021(31013)(02557)	46.57457	-122.96343	3	0.67	15.95	53.6	78	97.00%	Scammon-Stearns	+			+	+
991757	46.62713	-123.06340	3	0.67	15.85	53.3	80	97.00%	Scammon-Stearns	+			+	+
991544	46.62693	-123.06495	3	0.67	15.81	53.2	81	97.00%	Scammon-Stearns	+			+	+
1303W16A	46.60670	-123.06525	3	0.33	6.55	45.9	112	95.80%	Scammon-Stearns	+			+	+

Table 4
Tier 1 Ranked Barrier Sites within WRIA 23

Site ID	Latitude	Longitude	Salmon Species Present	Percent Passable	Upstream Habitat (miles)	Raw Score	RANK	PERCENT	WAU-Name	Salmonid Presence				
										Coho Salmon	Chinook Salmon	Chum Salmon	Steelhead Trout	Cutthroat Trout
021(31013)(02326)	46.57638	-122.96104	3	0.67	12.64	42.7	122	95.40%	Scammon-Stearns	+			+	+
021(24038)(07422)	46.61441	-123.03030	2	0.33	5.33	37.1	157	94.10%	Scammon-Stearns	+			+	+
1303W23A	46.59858	-123.04313	3	0.00	3.16	34.6	164	93.90%	Scammon-Stearns	+			+	+
021(30100)(02179)	46.56178	-122.96480	3	0.00	2.87	31.7	193	92.80%	Scammon-Stearns	+			+	+
021(22850)(02861)	46.57998	-123.03401	1	0.67	9.32	31.1	200	92.50%	Scammon-Stearns					+
1303W10A	46.62117	-123.04515	2	0.33	3.95	27.8	232	91.30%	Scammon-Stearns	+				+
021(22901)(00022)	46.57714	-123.03367	2	0.67	7.68	26.0	253	90.50%	Scammon-Stearns	+				+
021(22850)(03138)	46.57597	-123.03405	2	0.67	7.66	25.9	255	90.20%	Scammon-Stearns	+				+
021(22850)(03024)	46.57762	-123.03403	2	0.67	7.52	25.5	264	90.10%	Scammon-Stearns	+				+
1302W19A	46.59985	-122.99014	3	0.00	2.17	24.7	276	89.60%	Scammon-Stearns	+			+	+
1302W32B	46.56151	-122.96477	3	0.33	2.88	21.3	327	87.70%	Scammon-Stearns	+			+	+
1302W28B	46.58001	-122.94594	3	0.67	6.08	21.1	332	87.60%	Scammon-Stearns	+			+	+
1303W17A	46.61843	-123.08275	3	0.33	2.82	20.9	337	87.30%	Scammon-Stearns	+			+	+
1303W14A	46.61989	-123.02015	3	0.67	5.87	20.4	347	87.00%	Scammon-Stearns	+			+	+
1403W25A	46.67175	-123.00485	2	0.67	5.59	19.1	370	86.10%	Scammon-Stearns	+				+
021(30100)(04686)	46.58959	-122.99100	3	0.67	4.86	17.0	427	83.80%	Scammon-Stearns	+			+	+
021(31013)(00854)	46.57627	-122.93076	3	0.67	4.74	16.6	436	83.70%	Scammon-Stearns	+			+	+
1303W15A	46.61261	-123.04225	2	0.00	1.35	15.5	460	82.60%	Scammon-Stearns	+				+
1303W24C	46.60347	-123.00944	2	0.33	2.05	15.1	472	82.30%	Scammon-Stearns	+				+
021(44002)(00595)	46.62285	-122.99611	3	0.67	4.08	14.5	485	81.70%	Scammon-Stearns	+			+	+
1303W24E	46.60347	-123.00634	2	0.33	1.90	14.1	507	80.90%	Scammon-Stearns	+				+
021(24021)(02297)	46.61972	-123.04509	3	0.67	3.86	13.7	526	80.30%	Scammon-Stearns	+			+	+
021(23000)(02686)	46.59803	-123.06097	3	0.67	3.78	13.5	532	79.90%	Scammon-Stearns	+			+	+
1302W31B	46.56489	-122.97814	3	0.33	1.58	12.6	577	78.20%	Scammon-Stearns	+			+	+
1302W31A	46.57633	-122.98354	3	0.67	3.30	11.9	618	76.70%	Scammon-Stearns	+			+	+
Newaukum Management Unit														
021(94006)(01315)	46.59290	-122.90814	3	0.00	13.65	139.5	9	99.70%	Newaukum, Lower NF	+			+	+
021(15051)(03086)	46.69174	-122.89708	2	0.67	23.06	76.8	43	98.40%	Newaukum, Lower NF	+				+
021(40028)(02366)	46.59983	-122.91280	3	0.67	16.57	55.7	75	97.20%	Newaukum, Lower NF	+			+	+
021(40077)(01126)	46.63028	-122.87500	2	0.33	7.30	50.3	92	96.50%	Newaukum, Lower NF	+				+
021(40051)(01242)	46.64167	-122.89238	2	0.67	14.37	48.1	102	96.20%	Newaukum, Lower NF	+				+
994286	46.61929	-122.92414	2	0.67	13.58	45.5	114	95.70%	Newaukum, Lower NF	+				+
1301W04A	46.64130	-122.81546	3	0.00	3.91	42.1	124	95.40%	Newaukum, Lower NF	+			+	+
021(40046)(00032)	46.61954	-122.91858	2	0.67	12.40	41.6	125	95.20%	Newaukum, Lower NF	+				+
1402W28A	46.66368	-122.93494	2	0.67	12.28	41.2	129	95.20%	Newaukum, Lower NF	+				+
021(40051)(01588)	46.64478	-122.88749	2	0.67	12.01	40.3	140	94.70%	Newaukum, Lower NF	+				+
021(15082)(00259)	46.69555	-122.89247	2	0.67	12.02	40.3	140	94.70%	Newaukum, Lower NF	+				+
021(40077)(00103)	46.62156	-122.89197	2	0.67	11.07	37.2	156	94.20%	Newaukum, Lower NF	+				+

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										Coho Salmon	Chinook Salmon	Chum Salmon	Steelhead Trout	Cutthroat Trout
1302W12E	46.62456	-122.88436	2	0.67	9.85	33.2	180	93.30%	Newaukum, Lower NF	+				+
1302W26A	46.58353	-122.89857	3	0.00	2.67	29.7	213	92.00%	Newaukum, Lower NF	+			+	+
021(15080)(00490)	46.68660	-122.88737	2	0.67	8.18	27.7	234	91.20%	Newaukum, Lower NF	+				+
995539	46.59235	-122.89660	3	0.67	7.57	26.0	253	90.50%	Newaukum, Lower NF	+			+	+
021(17121)(00400)	46.70610	-122.87954	2	0.33	3.67	25.9	255	90.20%	Newaukum, Lower NF	+				+
125 1302W23A	46.59131	-122.89240	3	0.67	7.31	25.1	271	89.90%	Newaukum, Lower NF	+			+	+
021(40017)(02135)	46.59101	-122.87669	3	0.67	6.49	22.4	306	88.50%	Newaukum, Lower NF	+			+	+
021(15051)(04407)	46.70588	-122.88726	2	0.67	5.69	19.4	365	86.30%	Newaukum, Lower NF	+				+
1302W12A	46.63018	-122.87399	2	0.00	1.64	18.4	386	85.50%	Newaukum, Lower NF	+				+
021(15080)(01316)	46.68462	-122.87570	2	0.67	5.33	18.2	390	85.30%	Newaukum, Lower NF	+				+
021(91005)(02938)	46.65570	-122.91839	2	0.00	1.59	17.9	404	84.70%	Newaukum, Lower NF	+				+
021(15051)(04436)	46.70630	-122.88726	2	0.67	5.14	17.6	413	84.40%	Newaukum, Lower NF	+				+
021(40031)(00620)	46.63407	-122.82576	3	0.67	4.69	16.5	438	83.50%	Newaukum, Lower NF	+			+	+
125 1301W04A	46.64130	-122.81546	3	0.67	3.96	14.1	507	80.90%	Newaukum, Lower NF	+			+	+
1302W12C	46.63018	-122.87354	2	0.00	1.08	12.8	568	78.60%	Newaukum, Lower NF	+				+
021(15051)(01999)	46.69631	-122.91766	0	0.00	1.28	12.8	568	78.60%	Newaukum, Lower NF	+				+
1302W12B	46.62996	-122.87020	2	0.33	1.61	12.1	609	77.00%	Newaukum, Lower NF	+				+
125 1402W34B	46.65756	-122.91133	2	0.67	3.47	12.1	609	77.00%	Newaukum, Lower NF	+				+
021(15781)(00325)	46.69876	-122.94856	2	0.33	1.60	12.1	609	77.00%	Newaukum, Lower NF	+				+
1301W23D	46.60000	-122.76470	2	0.33	17.19	116.5	19	99.30%	Newaukum, MF	+				+
125 1301W23D	46.60000	-122.76470	2	0.67	13.96	46.7	110	95.80%	Newaukum, MF	+				+
021(45011)(07070)	46.60172	-122.70787	2	0.67	12.95	43.4	119	95.50%	Newaukum, MF	+				+
1301W22B	46.59308	-122.78631	2	0.33	4.92	34.3	168	93.70%	Newaukum, MF	+				+
1301E18A	46.61002	-122.72991	2	0.33	4.11	28.9	221	91.70%	Newaukum, MF	+				+
1301E18A	46.61002	-122.72991	2	0.33	4.11	28.9	221	91.70%	Newaukum, MF	+				+
1301E34A	46.57267	-122.66224	3	0.67	7.79	26.7	242	90.90%	Newaukum, MF	+			+	+
125 1301E34A	46.57267	-122.66224	3	0.67	7.76	26.6	243	90.90%	Newaukum, MF	+			+	+
021(94001)(15790)	46.61550	-122.67557	2	0.67	7.47	25.3	267	89.90%	Newaukum, MF	+				+
021(40106)(00918)	46.58892	-122.71953	3	0.67	6.21	21.5	322	87.80%	Newaukum, MF	+			+	+
021(40106)(00558)	46.58374	-122.71957	3	0.67	5.93	20.6	343	87.10%	Newaukum, MF	+			+	+
125 1301W22B	46.59710	-122.79313	2	0.67	5.45	18.6	381	85.60%	Newaukum, MF	+				+
1301E15B	46.61480	-122.65919	3	0.33	1.98	15.3	468	82.40%	Newaukum, MF	+			+	+
1301E15C	46.61904	-122.66791	2	0.33	2.01	14.8	478	82.10%	Newaukum, MF	+				+
125 1301E18A	46.61002	-122.72991	2	0.67	4.17	14.4	491	81.40%	Newaukum, MF	+				+
021(96001)(16720)	46.61550	-122.65610	2	0.33	1.95	14.4	491	81.40%	Newaukum, MF	+				+
125 1301W23A	46.59322	-122.77338	2	0.67	3.83	13.3	545	79.40%	Newaukum, MF	+				+
1301E14A	46.61798	-122.64972	2	0.33	1.77	13.2	552	79.30%	Newaukum, MF	+				+
125 1301W26A	46.58277	-122.77139	3	0.00	0.94	12.4	591	77.60%	Newaukum, MF	+			+	+

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										Coho Salmon	Chinook Salmon	Chum Salmon	Steelhead Trout	Cutthroat Trout
1301E10B	46.61926	-122.66210	2	0.67	3.37	11.8	623	76.50%	Newaukum, MF	+				+
021(46005)(05173)	46.64256	-122.69925	4	0.67	14.57	49.4	95	96.40%	Newaukum, Upper NF	+	+		+	+
021(46005)(04386)	46.64951	-122.70440	3	0.33	4.42	31.6	194	92.70%	Newaukum, Upper NF	+			+	+
021(46005)(04239)	46.65110	-122.70418	3	0.33	4.24	30.4	207	92.30%	Newaukum, Upper NF	+			+	+
021(46004)(00077)	46.62712	-122.77160	4	0.00	1.48	18.8	378	85.80%	Newaukum, Upper NF	+	+		+	+
1301W10A	46.62947	-122.78406	4	0.33	2.25	17.8	409	84.60%	Newaukum, Upper NF	+	+		+	+
021(46005)(03006)	46.65290	-122.72800	2	0.67	4.76	16.4	443	83.30%	Newaukum, Upper NF	+				+
021(40031)(01647)	46.61706	-122.82411	4	0.67	3.40	12.5	583	77.90%	Newaukum, Upper NF	+	+		+	+
021(64022)(00529)	46.62334	-122.63240	3	0.00	11.41	117.1	18	99.30%	Newaukum, Upper NF	+			+	+
021(66430)(00541)	46.60354	-122.58374	2	0.67	8.95	30.2	208	92.20%	Newaukum, Upper NF				+	+
1302E18B	46.61178	-122.59940	2	0.33	1.78	13.3	545	79.40%	Newaukum, Upper NF	+				+
Skookumchuck Management Unit														
1501W27D	46.75111	-122.78328	2	0.00	12.54	127.4	12	99.50%	Hanaford	+				+
1501W33A	46.74563	-122.81370	3	0.33	16.57	113.0	21	99.20%	Hanaford	+			+	+
1501W33C	46.73680	-122.73680	3	0.33	14.78	101.0	25	99.10%	Hanaford	+			+	+
1401W03A	46.73218	-122.78056	2	0.33	14.04	95.4	26	99.00%	Hanaford	+				+
021(91019)(05513)	46.75447	-122.83447	2	0.67	22.01	73.3	47	98.20%	Hanaford	+				+
1501W26A	46.75598	-122.77081	2	0.33	9.85	67.3	54	98.00%	Hanaford	+				+
1402W08A	46.71525	-122.96779	2	0.67	18.94	63.2	63	97.60%	Hanaford	+				+
994301	46.71298	-122.97524	2	0.67	18.76	62.6	64	97.60%	Hanaford	+				+
1401W10A	46.73215	-122.83523	3	0.00	5.87	61.7	65	97.60%	Hanaford	+			+	+
1501W27B	46.75643	-122.79426	2	0.67	16.30	54.4	76	97.10%	Hanaford	+				+
1501W33B	46.75762	-122.83120	3	0.67	16.07	54.0	77	97.10%	Hanaford	+			+	+
1401W16A	46.69969	-122.82092	3	0.00	3.55	38.5	150	94.30%	Hanaford	+			+	+
021(16990)(00052)	46.72715	-122.92657	2	0.67	9.51	32.0	189	92.90%	Hanaford	+				+
1402W01A	46.72403	-122.86633	3	0.00	2.89	31.9	190	92.90%	Hanaford	+			+	+
021(17151)(05946)	46.70669	-122.85077	3	0.33	3.49	25.4	265	90.00%	Hanaford	+			+	+
021(17151)(07992)	46.70140	-122.82127	3	0.33	3.35	24.5	279	89.60%	Hanaford	+			+	+
021(16990)(00016)	46.72765	-122.92655	2	0.67	6.65	22.6	302	88.70%	Hanaford	+				+
1401W03B	46.73271	-122.79326	2	0.67	6.50	22.1	312	88.30%	Hanaford	+				+
1502W26A	46.75500	-122.90000	2	0.00	1.62	18.2	390	85.30%	Hanaford	+				+
021(17151)(08005)	46.70157	-122.82115	3	0.67	4.37	15.4	465	82.50%	Hanaford	+			+	+
021(17190)(01308)	46.69594	-122.84384	2	0.33	2.00	14.7	479	82.00%	Hanaford	+				+
021(91019)(06725)	46.76356	-122.81833	2	0.00	1.25	14.5	485	81.70%	Hanaford	+				+
1502W27A	46.75449	-122.92189	2	0.00	1.06	12.6	577	78.20%	Hanaford	+				+
1401W17A	46.69615	-122.84735	2	0.00	1.06	12.6	577	78.20%	Hanaford	+				+
021(17151)(07924)	46.70066	-122.82165	3	0.67	3.50	12.5	583	77.90%	Hanaford	+			+	+
1502W27B	46.75630	-122.92210	3	0.00	0.94	12.4	591	77.60%	Hanaford	+			+	+

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Tier 1 Ranked Barrier Sites within WRIA 23

Site ID	Latitude	Longitude	Salmon Species Present	Percent Passable	Upstream Habitat (miles)	Raw Score	RANK	PERCENT	WAU-Name	Salmonid Presence				
										Coho Salmon	Chinook Salmon	Chum Salmon	Steelhead Trout	Cutthroat Trout
1503W15A	46.79197	-123.03214	3	0.67	25.16	84.0	34	98.70%	Scatter Creek	+	+			+
1503W12B	46.80183	-122.99496	2	0.33	10.33	70.6	50	98.10%	Scatter Creek	+				+
1601W16D	46.87243	-122.81327	2	0.67	13.09	43.9	118	95.60%	Scatter Creek	+				+
1601W38C	46.86380	-122.84612	2	0.33	6.01	41.6	125	95.20%	Scatter Creek	+				+
1601W38B	46.86547	-122.84574	2	0.33	5.94	41.1	130	95.10%	Scatter Creek	+				+
1601W16A	46.86750	-122.80243	2	0.00	2.81	30.1	209	92.10%	Scatter Creek	+				+
23.0720 0.25	46.85726	-122.82613	2	0.00	1.18	13.8	519	80.40%	Scatter Creek	+				+
1601W04A	46.89426	-122.80941	2	0.67	3.97	13.8	519	80.40%	Scatter Creek	+				+
981727	46.84512	-122.99046	2	0.67	3.83	13.3	545	79.40%	Scatter Creek	+				+
1502W08A	46.80553	-122.96345	2	0.67	3.75	13.0	562	78.90%	Scatter Creek	+				+
340868	46.77829	-122.92208	3	0.00	12.57	128.7	11	99.60%	Skookumchuck, Lower	+			+	+
343112	46.77324	-122.92366	3	0.33	13.23	90.7	30	98.90%	Skookumchuck, Lower	+			+	+
021(91011)(00487)	46.73536	-122.96404	3	0.67	25.02	83.6	35	98.70%	Skookumchuck, Lower	+			+	+
1502W21B	46.77367	-122.94614	3	0.67	15.10	50.8	91	96.60%	Skookumchuck, Lower	+			+	+
996468	46.80759	-122.86276	3	0.67	13.96	47.1	108	96.00%	Skookumchuck, Lower	+			+	+
1502W15C	46.78782	-122.91873	4	0.67	11.65	39.8	143	94.60%	Skookumchuck, Lower	+	+		+	+
340733	46.78005	-122.96112	3	0.33	4.70	33.5	176	93.40%	Skookumchuck, Lower	+			+	+
1501W06C	46.81923	-122.86811	3	0.67	6.51	22.5	303	88.60%	Skookumchuck, Lower	+			+	+
1502W02A	46.82049	-122.87696	3	0.67	6.05	21.0	333	87.40%	Skookumchuck, Lower	+			+	+
1502W11B	46.79513	-122.89709	4	0.33	2.45	19.1	370	86.10%	Skookumchuck, Lower	+	+		+	+
343717	46.81968	-122.85196	3	0.67	5.22	18.2	390	85.30%	Skookumchuck, Lower	+			+	+
1502W32B	46.74962	-122.95944	3	0.00	1.41	17.1	426	84.10%	Skookumchuck, Lower	+			+	+
996469	46.81477	-122.86254	3	0.67	4.62	16.2	449	83.20%	Skookumchuck, Lower	+			+	+
991040	46.77357	-122.99814	3	0.67	4.49	15.8	455	83.00%	Skookumchuck, Lower	+			+	+
341468	46.82860	-122.72858	2	0.67	4.57	15.7	456	82.90%	Skookumchuck, Lower	+				+
1501W05B	46.81036	-122.82517	3	0.33	1.65	13.1	554	79.00%	Skookumchuck, Lower	+			+	+

Data from Mason Conservation District (2010)
Latitude and Longitude provided in NAD 83

Table 5
LCCD Culverts Surveyed and Ranked for Replacement

Culvert Identifier	Data Source	Priority Index	Stream Name	Species Present*
Black River Management Unit				
125 1703W25A	WDFW	23.88	Salmon Creek	
125 1703W17A	WDFW	15.47	Unnamed	
341513	WDFW	12.24	Salmon Cr	Coho Salmon
125 1703W17G	WDFW	7.71	Unnamed	
125 1703W17H	WDFW	6.35	Unnamed	
Boistfort Management Unit				
125 1205W05A	WDFW	25.6	McCormick Cr	Steelhead Trout, Coho Salmon
125 1303W31A	WDFW	24.37	Unnamed	
125 1304W03A	WDFW	16.8	Nicholson Cr	Coho Salmon
021(24019)(04778)	WDFW	12.87	Halfway Cr	Coho Salmon
021(27000)(02203)	LCCD	12.84	Absher Creek	Coho Salmon
125 1304W35A	WDFW	12.11	Beaver Cr	Steelhead Trout
021(25510)(00106)	WDFW	11.68	Lost Cr	Steelhead Trout, Coho Salmon
021(27000)(02426)	WDFW	10.67	Taylor Cr	
021(25401)(03773)	WDFW	10.19	Lost Cr	
021(27501)(02750)	WDFW	10.18	Marcuson Creek	Coho Salmon
1203W31B	LCCD	8.76	Root House Creek	Coho Salmon
125 1203W30A	WDFW	8.54	Root House Cr	Coho Salmon
021(24019)(04032)	WDFW	7.42	Halfway Cr	Coho Salmon
1405W34A	LCCD	5.68	Capps Creek	
125 1305W25B	WDFW	3.68	Katula Cr	
021(24019)(02040)	WDFW	3.64	Jones Cr	
1305W23D	LCCD	3.26		
Lincoln Management Unit				
125 1404W15A	WDFW	33.83	Bunker Cr	Coho Salmon
125 1403W34A	WDFW	25.93	Mill Cr	
021(31013)(02557)	WDFW	23.88	Ripple Creek	Steelhead Trout, Coho Salmon
021(24002)(01505)	WDFW	20.74	Mill Cr	
125 1303W06A	WDFW	20.46	Unnamed	Coho Salmon

Table 5
LCCD Culverts Surveyed and Ranked for Replacement

Culvert Identifier	Data Source	Priority Index	Stream Name	Species Present*
021(24024)(03932)	WDFW	20.31	Tapp Cr	Coho Salmon
125 1505W11A	WDFW	19.04		
021(24034)(02386)	WDFW	18.47	Van Ornum Creek	Coho Salmon
021(28001)(05816)	WDFW	18.16	unknown	
125 1403W32B	WDFW	17.99	Van Ornum Cr	
1403W32D	LCCD	17.99	Van Orum Creek	Coho Salmon
1503W27A	LCCD	17.83		
125 1505W11B	WDFW	17.14		
125 1503W12A	WDFW	16.95	Unnamed	
1404W17A	LCCD	16.81	Bunker Creek	Coho Salmon
125 1503W17A	WDFW	16.8	Unnamed	
125 1403W32A	WDFW	16.56	Unnamed	
125 1504W21A	WDFW	16.45		Coho Salmon
021(10019)(13700)	LCCD	15.87	Wildcat Creek	Coho Salmon
021(10000)(00271)	WDFW	15.69	Unnamed	Coho Salmon
1303W06B	LCCD	15.57		
125 1303W07A	WDFW	15.41	Unnamed	Coho Salmon
125 1403W32C	WDFW	15.38	Van Ornum Cr	
1303W07D	LCCD	15.3		
1303W07C	LCCD	15.27		Coho Salmon
021(23000)(00460)	WDFW	14.87		
125 1504W15A	WDFW	14.84	Unnamed	Coho Salmon
125 1403W30A	WDFW	14.64	Van Ornum Cr	
125 1503W07A	WDFW	14.63	Unnamed	
125 1503W31C	WDFW	14.48	Sponenbergh Cr	Coho Salmon
125 1304W12A	WDFW	14.32	Unnamed	
125 1503W31A	WDFW	14.07	Sponenbergh Cr	Coho Salmon
021(10004)(01019)	WDFW	13.74	Unnamed	
125 1504W28A	WDFW	13.65	Unnamed	
125 1304W01A	WDFW	13.47	Unnamed	

Table 5
LCCD Culverts Surveyed and Ranked for Replacement

Culvert Identifier	Data Source	Priority Index	Stream Name	Species Present*
125 1302W28B	WDFW	13.4	Ripple Cr	
125 1503W31B	WDFW	13.12	Unnamed	Coho Salmon
1503W07C	LCCD	13.05		
021(24038)(07422)	WDFW	13.04	Stearns Cr	Coho Salmon
341973	WDFW	12.96		
021(24034)(08899)	WDFW	12.89	Bunker Cr	
1503W18C	LCCD	11.75		
125 1303W04C	WDFW	11.56	Unnamed	
125 1302W31A	WDFW	11.48		Coho Salmon
021(10004)(00716)	WDFW	10.97	Unnamed	Coho Salmon
125 1403W29B	WDFW	10.67	Unnamed	
125 1503W17B	WDFW	10.63	Unnamed	
125 1303W04D	WDFW	10.57	Unnamed	
125 1303W04A	WDFW	10.51	Unnamed	
1503W17F	LCCD	10.26		
021(10004)(01168)	WDFW	9.92	Unnamed	
1504W28C	LCCD	8.73		
021(24034)(00730)	WDFW	8.48	unknown	
1503W07E	LCCD	7.92		
125 1405W24A	WDFW	7.1	Unnamed	
021(10004)(01536)	WDFW	6.59	Unnamed	
1503W07D	LCCD	5.75		
1504W28D	LCCD	5.21		
Newaukum Management Unit				
021(94006)(01315)	WDFW	18.47	Allen Creek	Steelhead Trout, Coho Salmon
125 1301W23D	WDFW	18	MF Newaukum River	Coho Salmon
125 1301E34A	WDFW	17.6	Lost Cr	Steelhead Trout, Coho Salmon
125 1302W12E	WDFW	17.53	Berwick Cr	
021(40077)(00103)	WDFW	16.22	Berwick Cr	Coho Salmon
021(45011)(07070)	WDFW	15	MF Newaukum River	Coho Salmon

Table 5

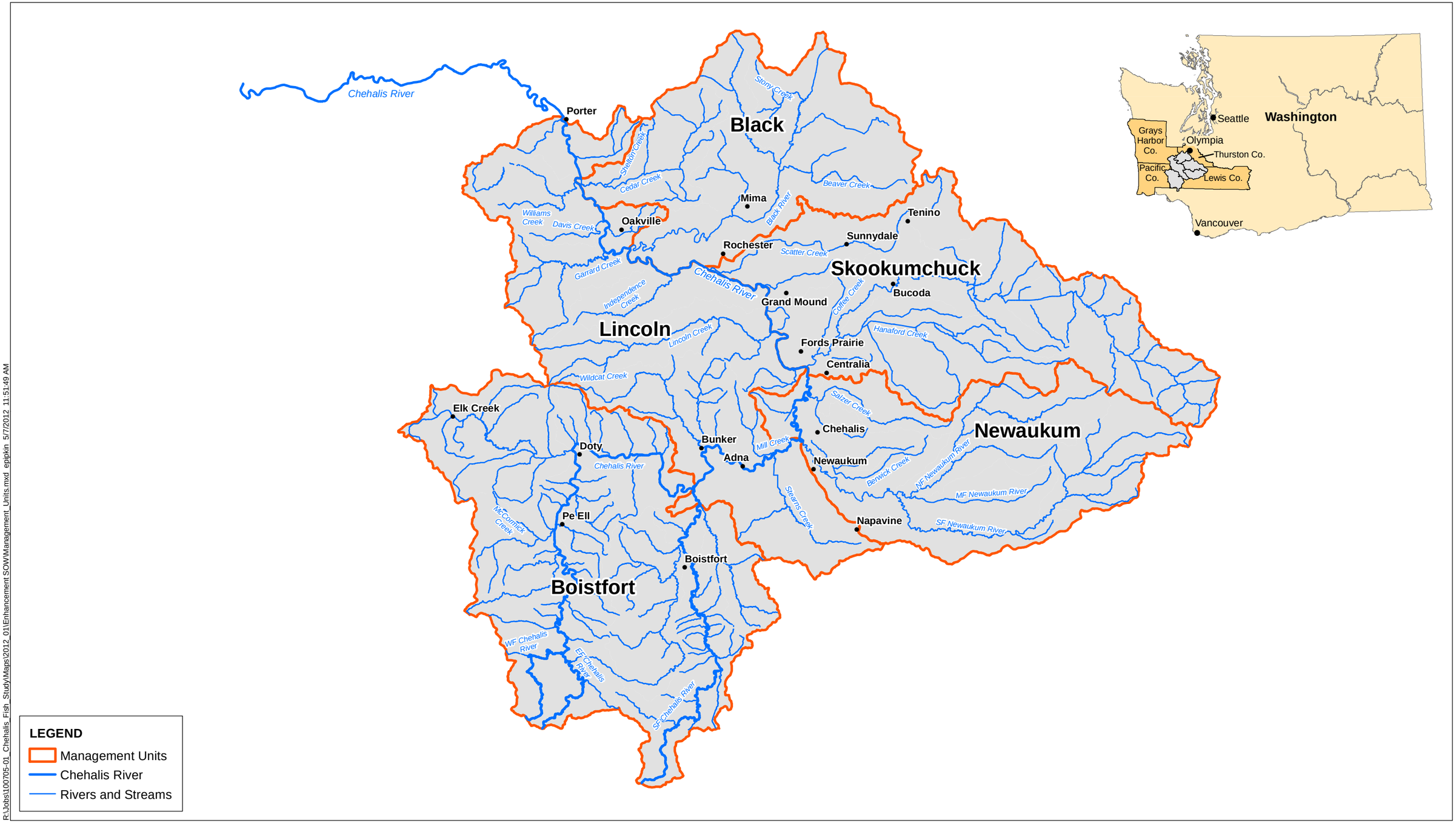
LCCD Culverts Surveyed and Ranked for Replacement

Culvert Identifier	Data Source	Priority Index	Stream Name	Species Present*
125 1301E23A	WDFW	13		Steelhead Trout, Chinook Salmon, Coho Salmon
021(94001)(15790)	WDFW	12	MF Newaukum River	Coho Salmon
125 1301E10B	WDFW	10	MF Newaukum River	
1302W26C	LCCD	9.59		
125 1301E23B	WDFW	8.26	Lost Cr	
125 1402W24A	WDFW	7.18		Coho Salmon
125 1402W24B	WDFW	7.09	Unnamed	Coho Salmon
021(15080)(01316)	WDFW	6.19	Unnamed	Coho Salmon
Skookumchuck Management Unit				
125 1402W01A	WDFW	13	Unnamed	Steelhead Trout, Coho Salmon
021(91019)(05513)	WDFW	11.43	Packwood Cr	Steelhead Trout, Coho Salmon
125 1707W14A	WDFW	19.93	Unnamed	
125 1707W13A	WDFW	10.27	Unnamed	

MF = Middle Fork

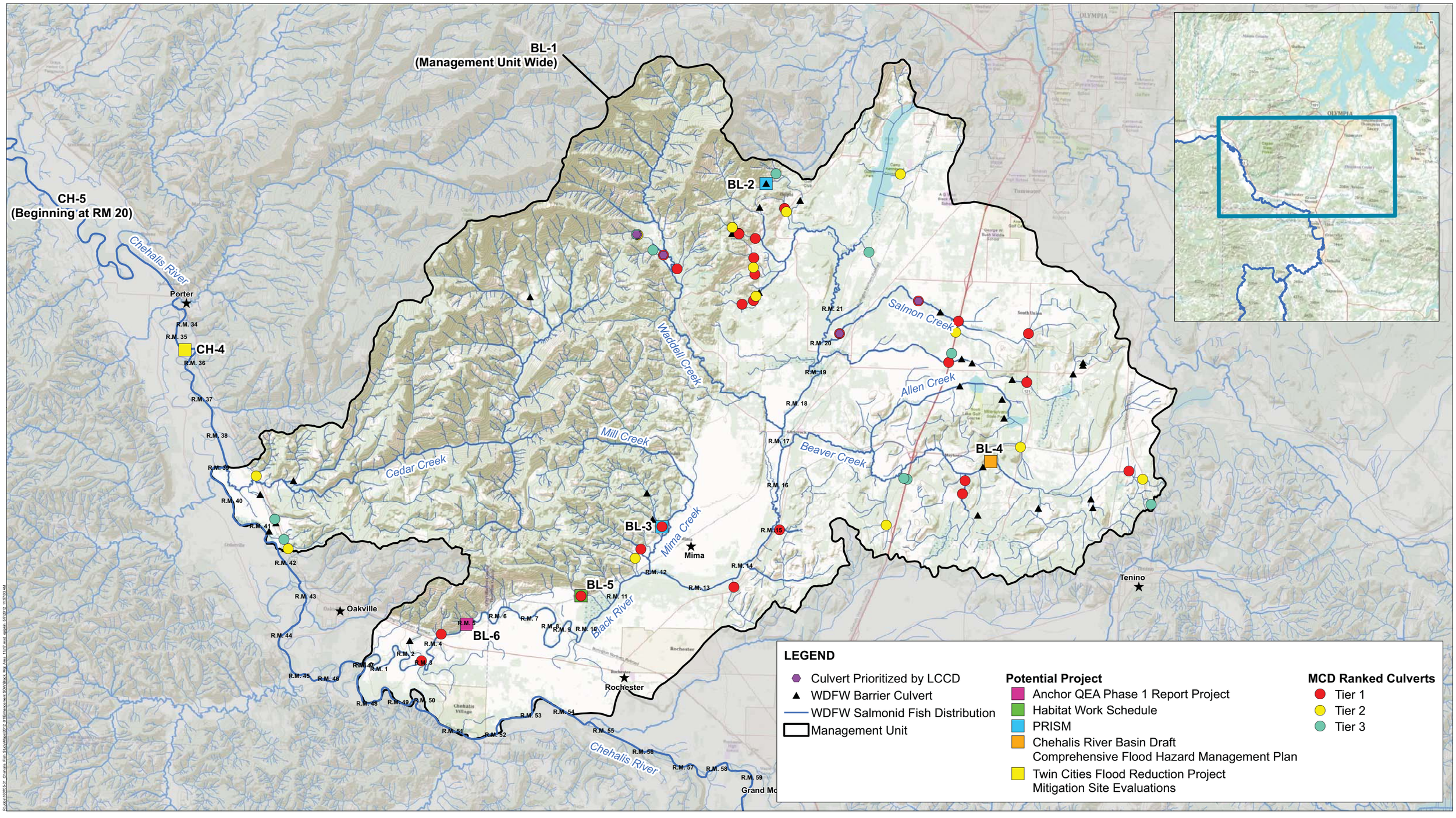
*Fish distribution from WDFW database

FIGURES



R:\Jobs\100705-01_Chehalis_Fish_Study\Maps\2012_01\Enhancement SOW\Management_Units.mxd epipkin 5/7/2012 11:51:49 AM

Figure 1
Chehalis River Basin Study Area - WRIA 23
Chehalis River Basin Comprehensive Salmonid Enhancement Plan
Chehalis River Basin Flood Authority



NOTES:

1. Conceptual project compiled from multiple sources, locations shown are approximate.
2. Prioritized culvert data provided by Lewis County Conservation District.
3. Ranked culverts provided by Mason Conservation District, 2010.
4. Barrier culvert data and fish distribution acquired from WDFW.
5. River miles acquired from USGS.
6. Stream data acquired from WDNR.
7. Base map provided by ESRI.

Miles
0 1 2

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Figure 2
Black Management Unit
Chehalis River Basin Comprehensive Salmonid Enhancement Plan
Chehalis River Basin Flood Authority

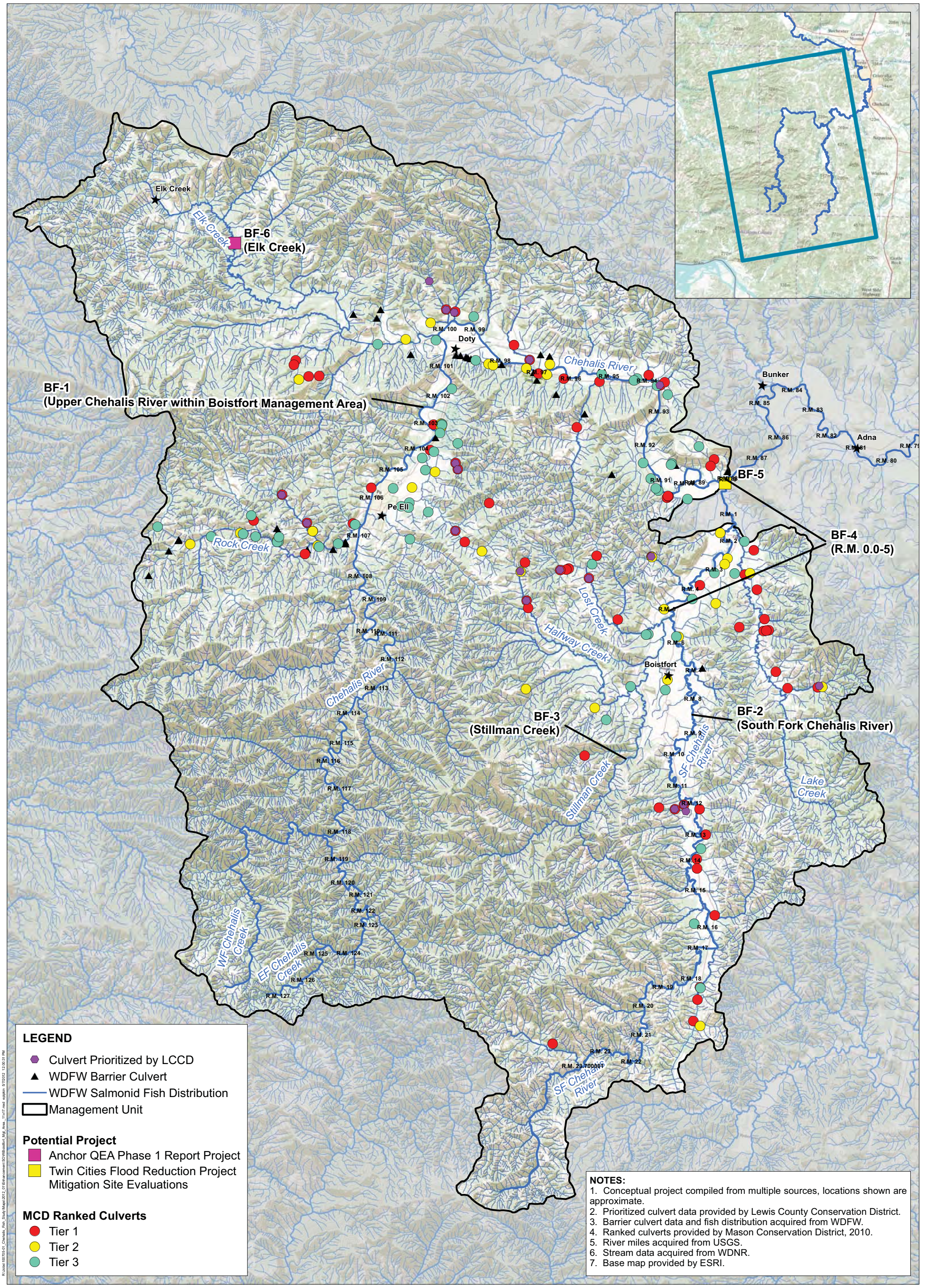


Figure 3
Boistfort Management Unit
Chehalis River Basin Comprehensive Salmonid Enhancement Plan
Chehalis River Basin Flood Authority

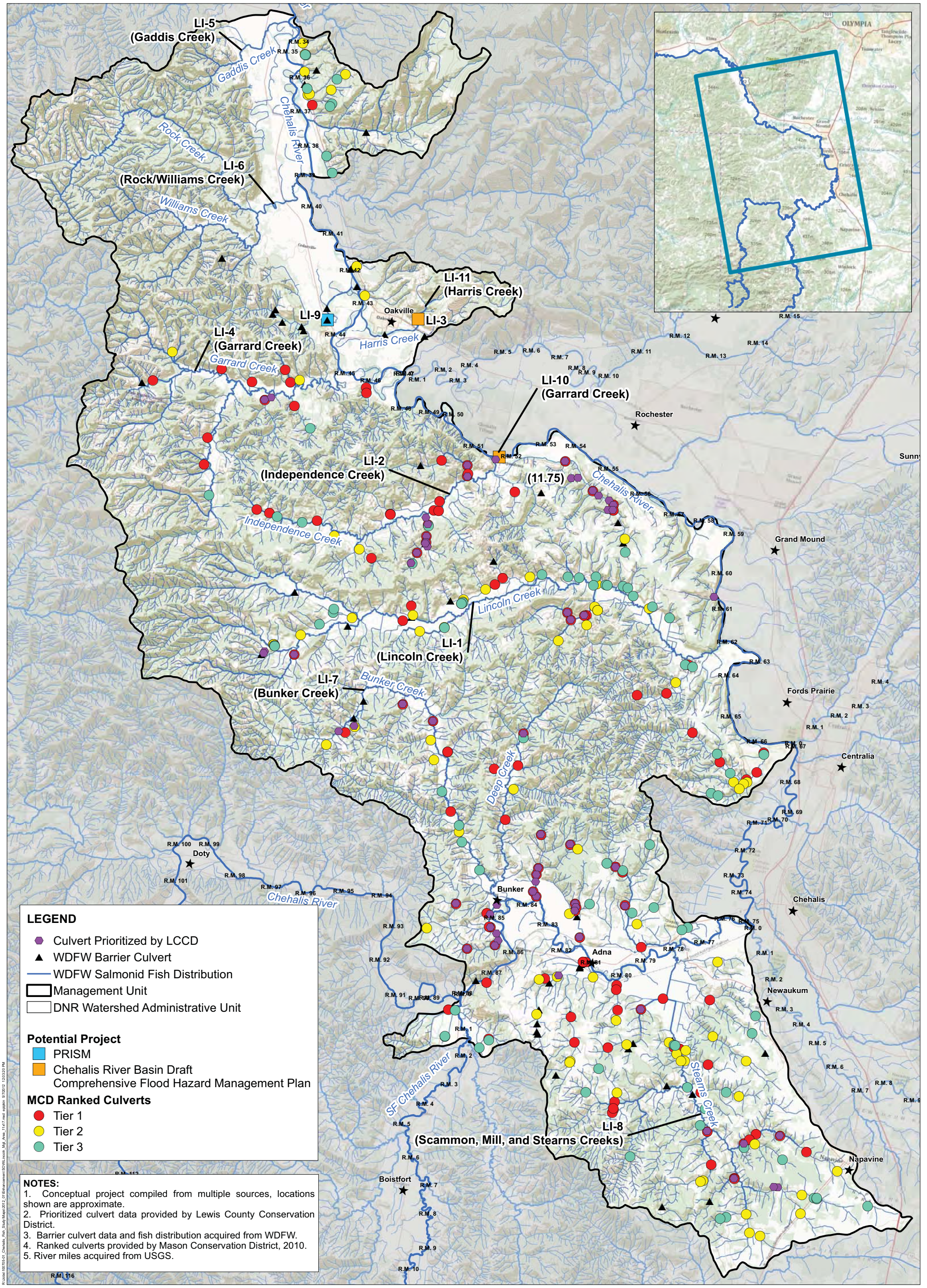
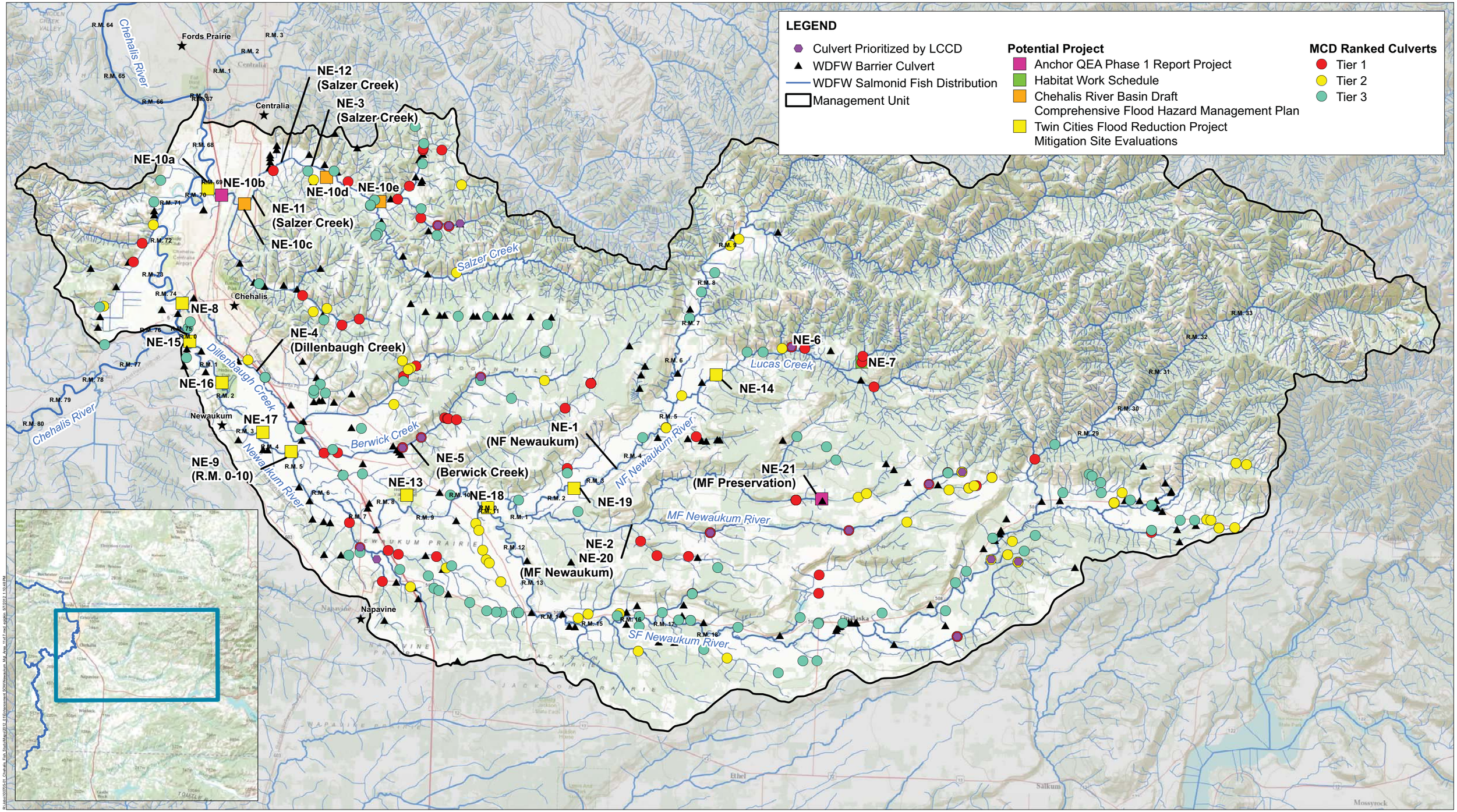


Figure 4
Lincoln Management Unit
Chehalis River Basin Comprehensive Salmonid Enhancement Plan
Chehalis River Basin Flood Authority

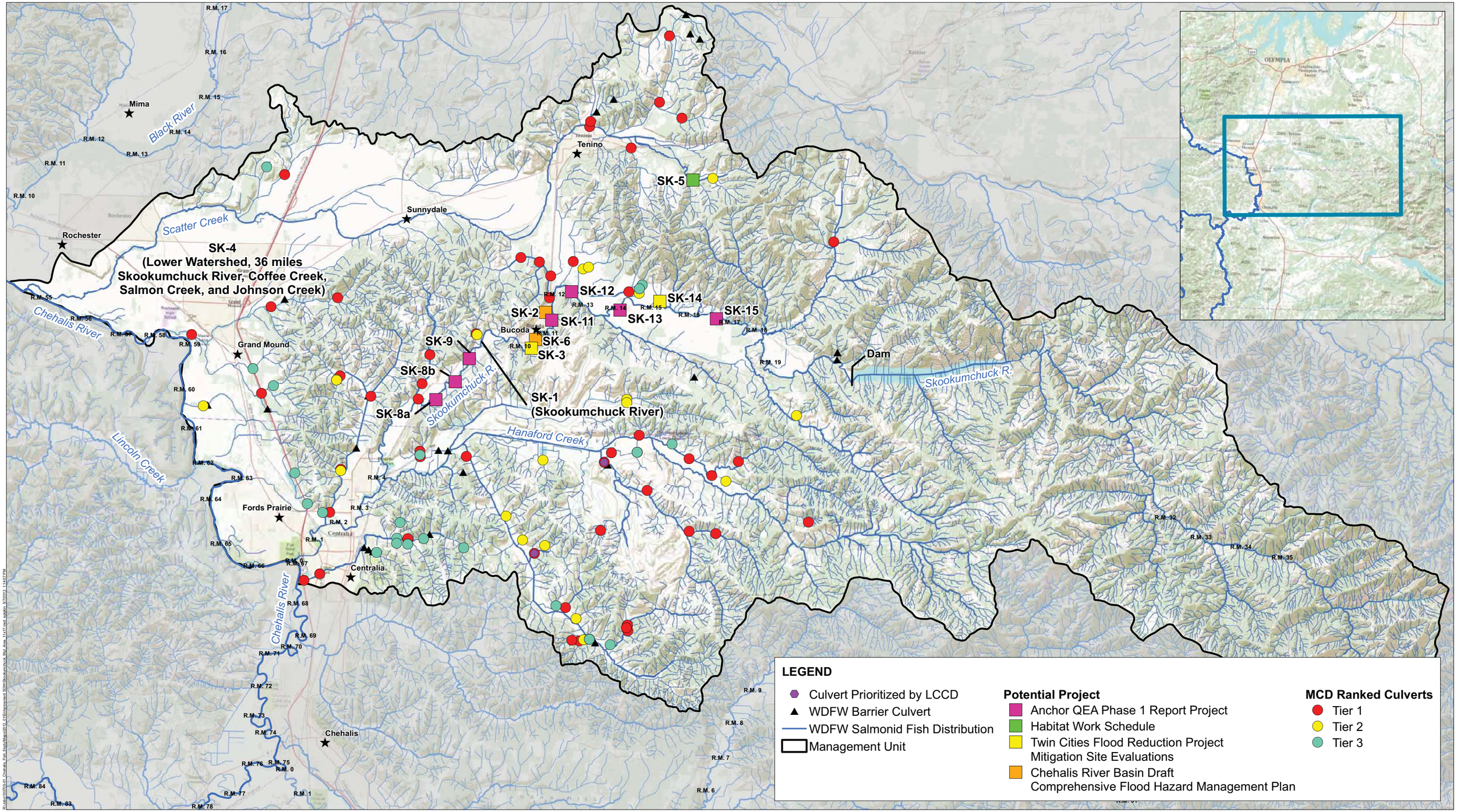


NOTES:

1. Conceptual project compiled from multiple sources, locations shown are approximate.
2. Prioritized culvert data provided by Lewis County Conservation District.
3. Barrier culvert data and fish distribution acquired from WDFW.
4. Ranked culverts provided by Mason Conservation District, 2010.
5. River miles acquired from USGS.
6. Stream data acquired from WDNR.
7. Base map provided by ESRI.

Miles
0 1 2

Figure 5
Newaukum Management Unit
Chehalis River Basin Comprehensive Salmonid Enhancement Plan
Chehalis River Basin Flood Authority



NOTES:

1. Conceptual project compiled from multiple sources, locations shown are approximate.
2. Prioritized culvert data provided by Lewis County Conservation District.
3. Barrier culvert data and fish distribution acquired from WDFW.
4. Ranked culverts provided by Mason Conservation District, 2010.
5. River miles acquired from USGS.
6. Stream data acquired from WDNR.
7. Base map provided by ESRI.

Miles
0 1 2

Figure 6
Skookumchuck Management Unit
Chehalis River Basin Comprehensive Salmonid Enhancement Plan
Chehalis River Basin Flood Authority

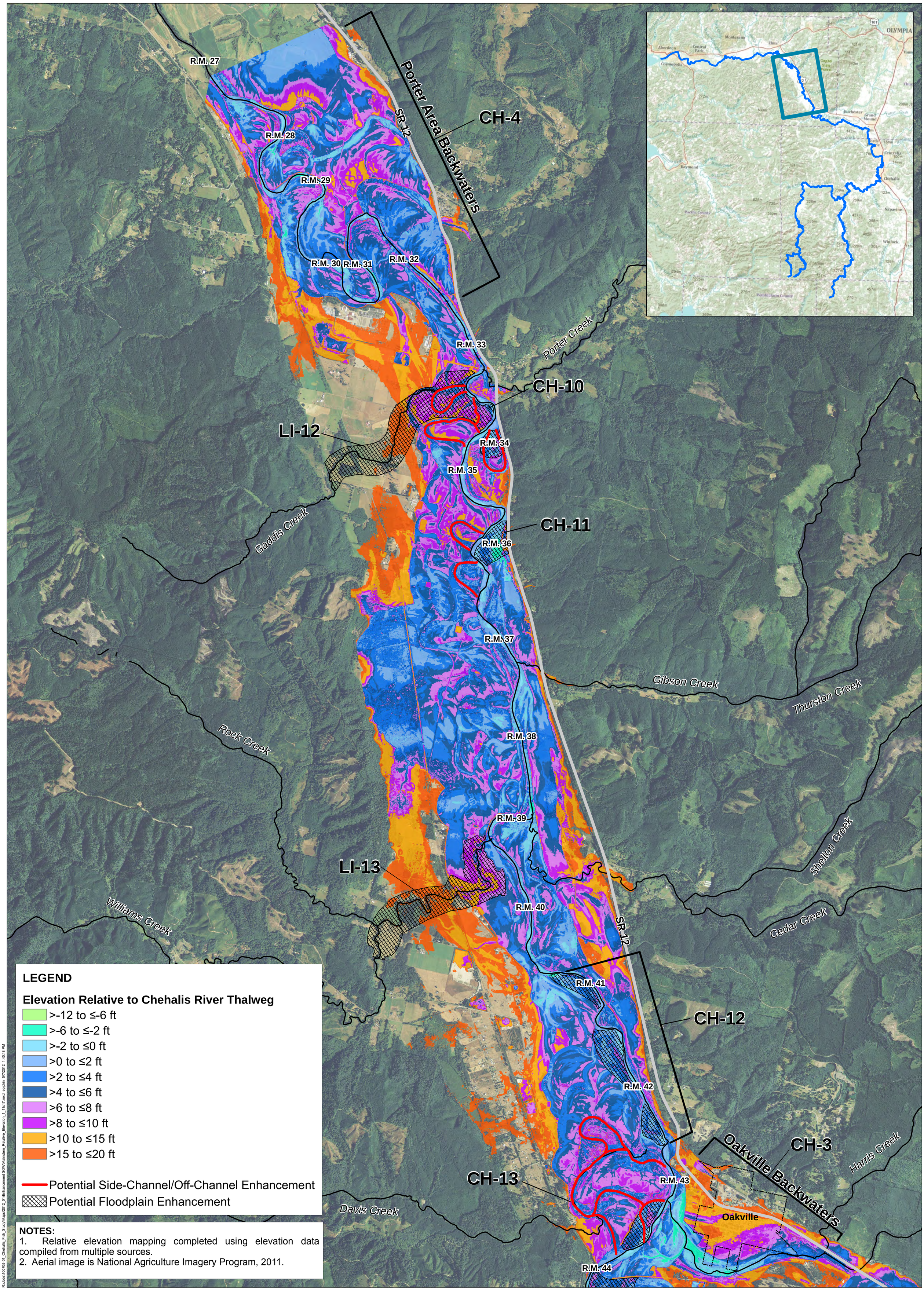
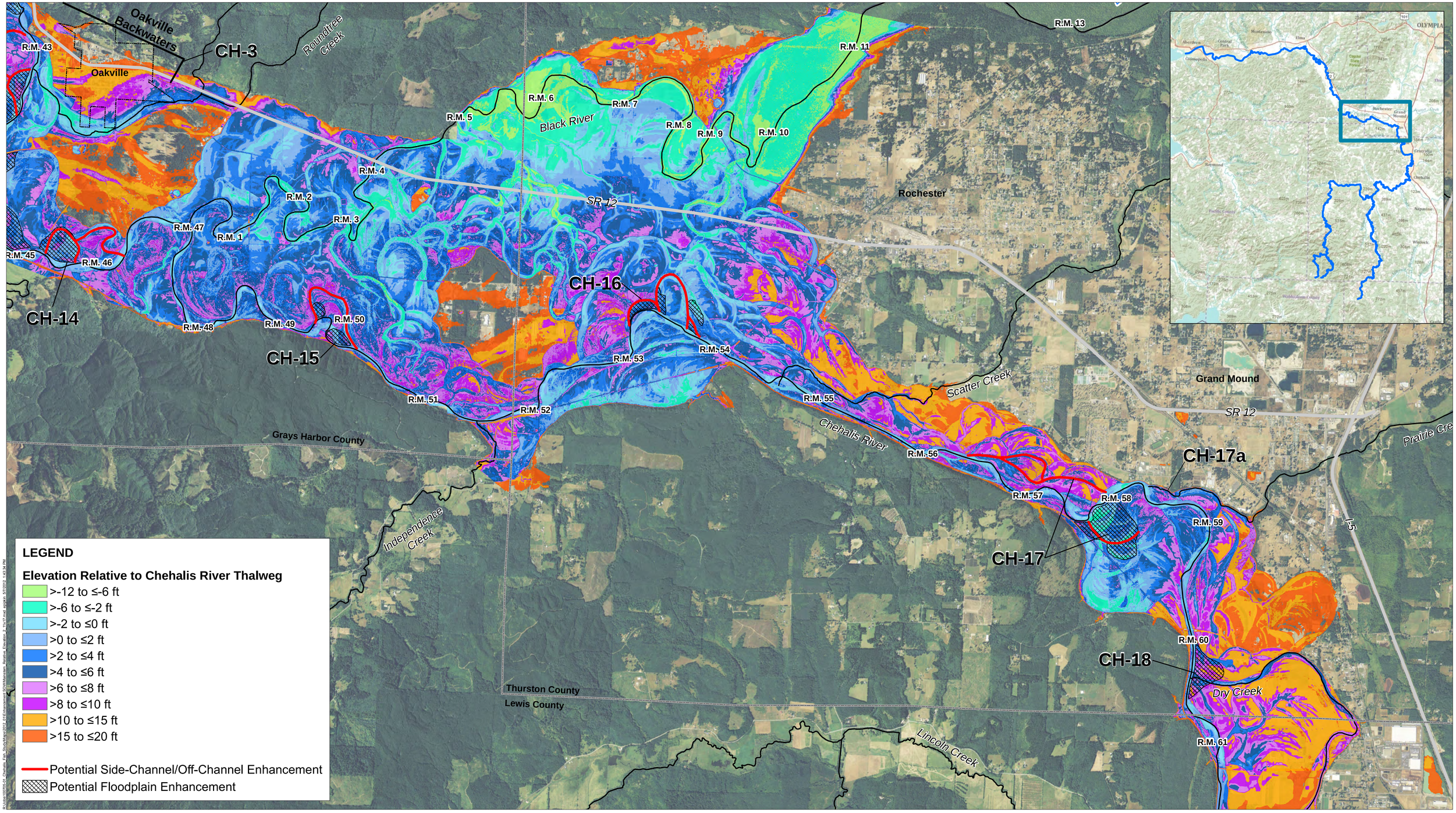


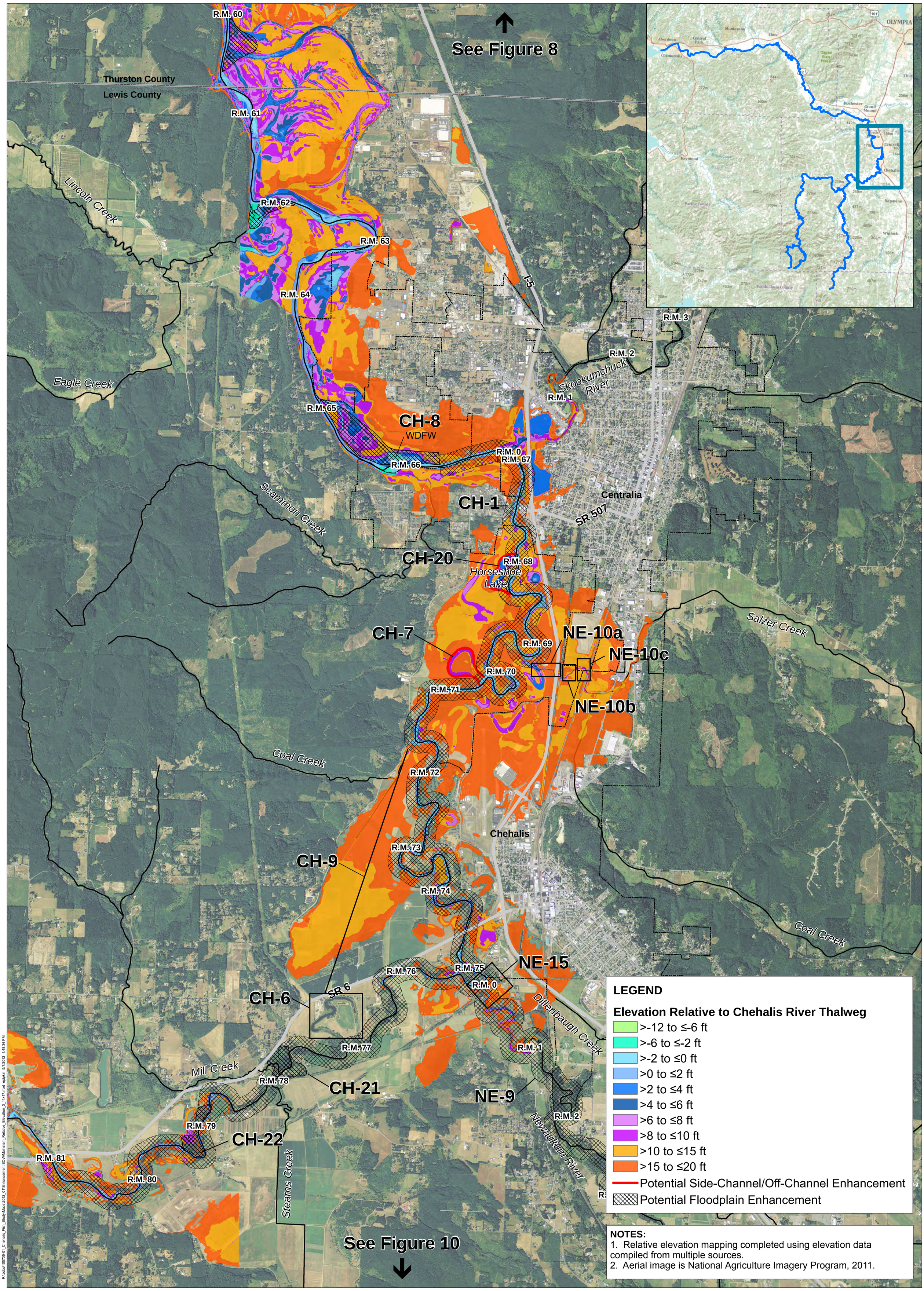
Figure 7
Mainstem Chehalis River Relative Elevation Map 1 of 5
Chehalis River Basin Comprehensive Salmonid Enhancement Plan
Chehalis River Basin Flood Authority



NOTES:
1. Relative elevation mapping completed using elevation data compiled from multiple sources.
2. Aerial image is National Agriculture Imagery Program, 2011.

Miles
0 0.5 1

Figure 8
Mainstem Chehalis River Relative Elevation Map 2 of 5
Chehalis River Basin Comprehensive Salmonid Enhancement Plan
Chehalis River Basin Flood Authority



LEGEND

Elevation Relative to Chehalis River Thalweg

- >-12 to ≤-6 ft
- >-6 to ≤-2 ft
- >-2 to ≤0 ft
- >0 to ≤2 ft
- >2 to ≤4 ft
- >4 to ≤6 ft
- >6 to ≤8 ft
- >8 to ≤10 ft
- >10 to ≤15 ft
- >15 to ≤20 ft
- Potential Side-Channel/Off-Channel Enhancement
- Potential Floodplain Enhancement

NOTES:

1. Relative elevation mapping completed using elevation data compiled from multiple sources.
2. Aerial image is National Agriculture Imagery Program, 2011.

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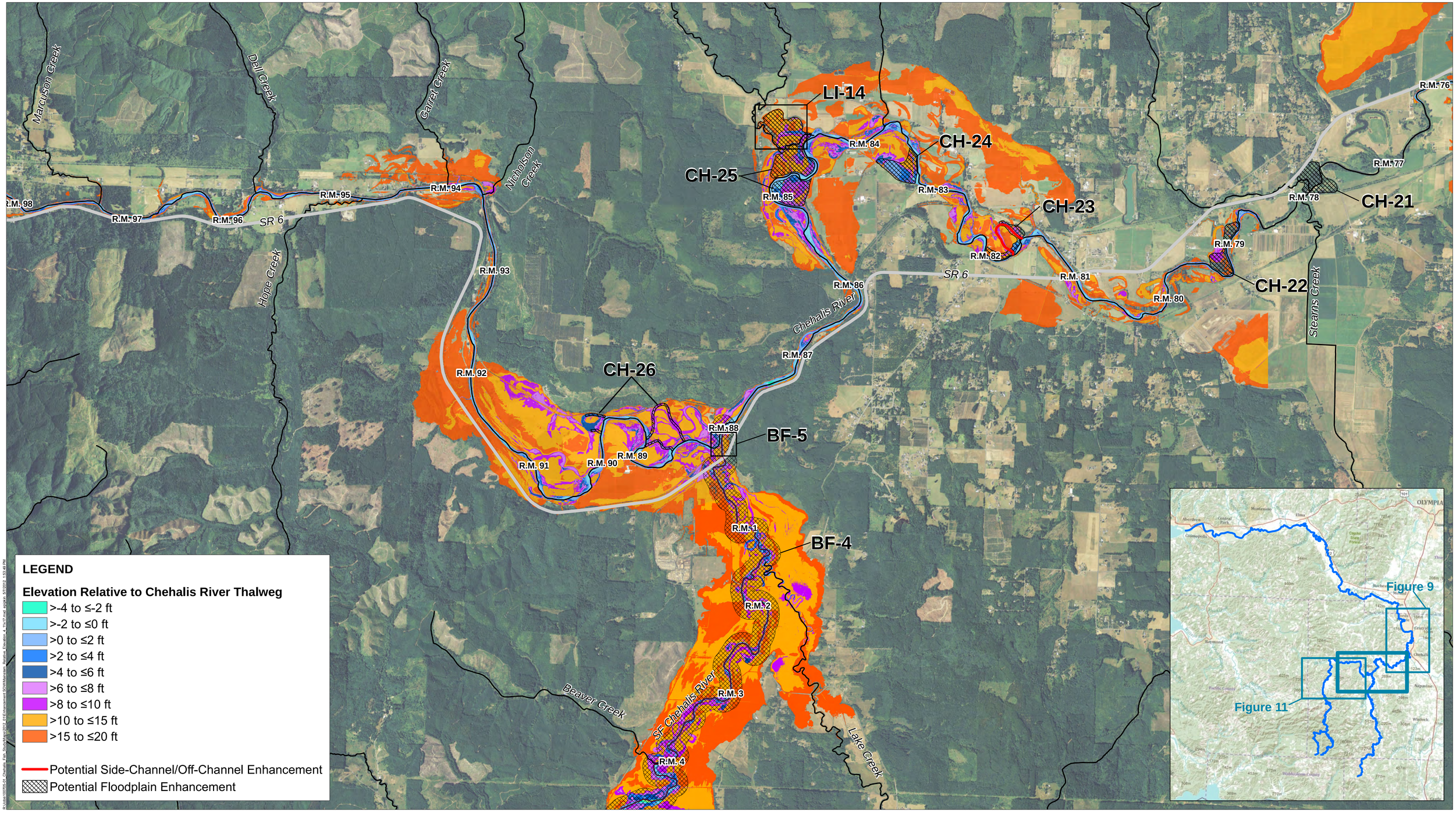
Miles
0 0.5 1

Figure 9
Mainstem Chehalis River Relative Elevation Map 3 of 5
Chehalis River Basin Comprehensive Salmonid Enhancement Plan
Chehalis River Basin Flood Authority

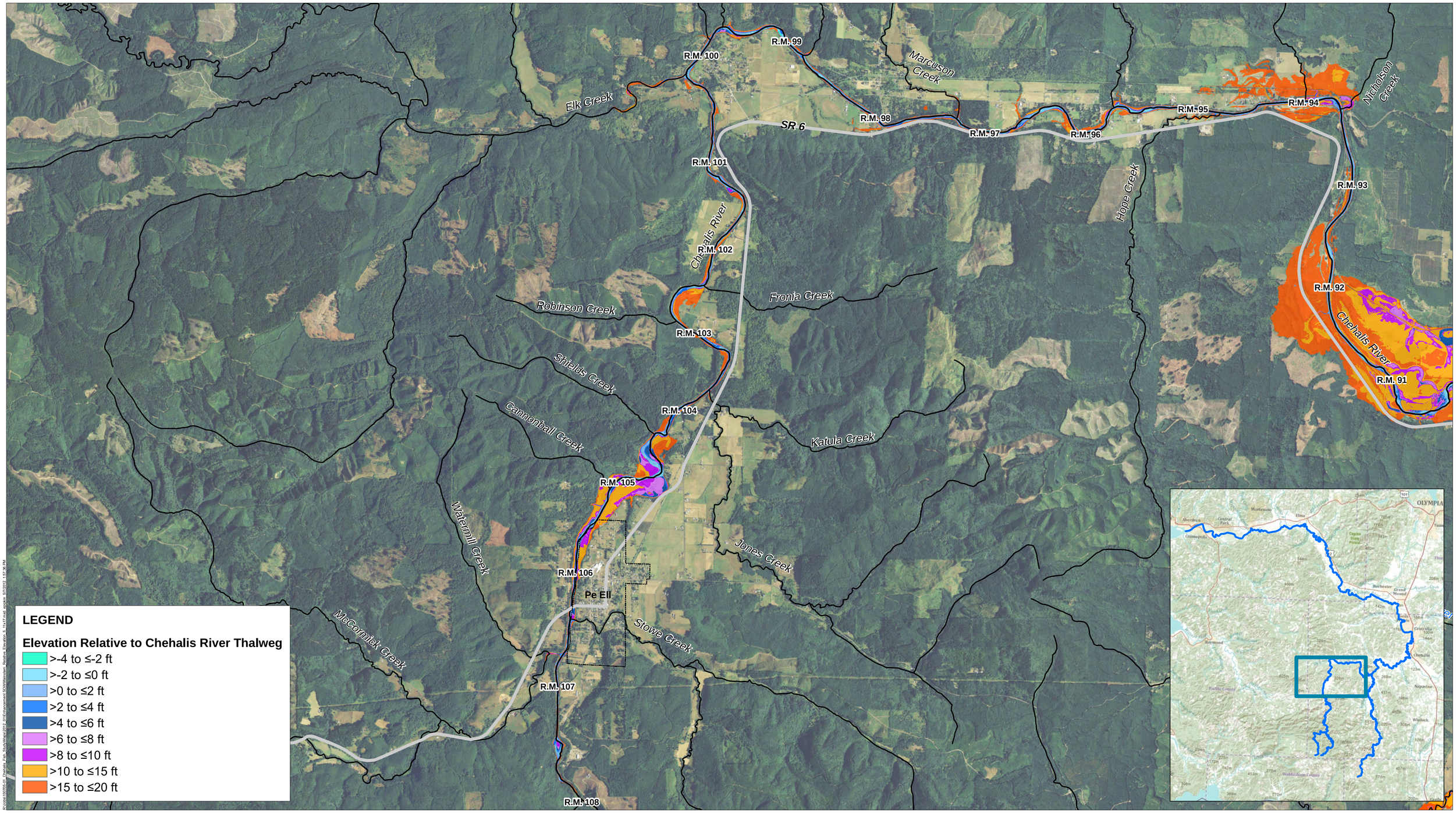


ANCHOR QEA

NOTES:
1. Relative elevation mapping completed using elevation data compiled from multiple sources.
2. Aerial image is National Agriculture Imagery Program, 2011.

Miles
0 0.5 1

Figure 10
Mainstem Chehalis River Relative Elevation Map 4 of 5
Chehalis River Basin Comprehensive Salmonid Enhancement Plan
Chehalis River Basin Flood Authority

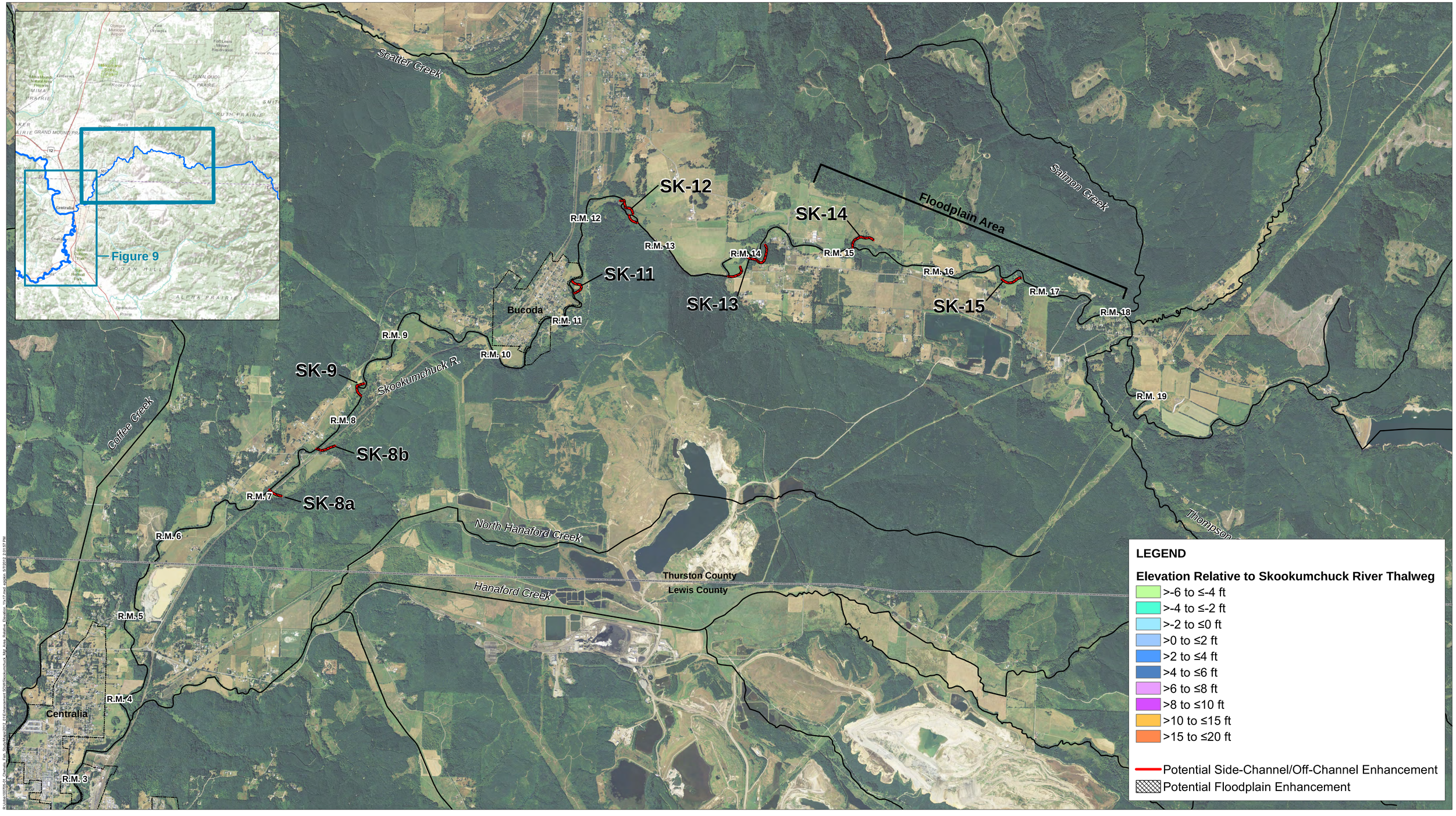


NOTES:
1. Relative elevation mapping completed using elevation data compiled from multiple sources.
2. Aerial image is National Agriculture Imagery Program, 2011.

Miles
0 0.5 1

ANCHOR QEA

Figure 11
Mainstem Chehalis River Relative Elevation Map 5 of 5
Chehalis River Basin Comprehensive Salmonid Enhancement Plan
Chehalis River Basin Flood Authority



ANCHOR QEA

NOTES:
1. Relative elevation mapping completed using elevation data compiled from multiple sources.
2. Aerial image is National Agriculture Imagery Program, 2011.
3. Skookumchuck river miles 5-9 are approximate.

Miles
0 0.5 1

Figure 12
Skookumchuck River Relative Elevation Map
Chehalis River Basin Comprehensive Salmonid Enhancement Plan
Chehalis River Basin Flood Authority

APPENDIX A
ENHANCEMENT WORKSHOP SUMMARY

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Seattle, Washington 98101
Phone 206.287.9130
Fax 206.287.9131
www.anchorqea.com

CHEHALIS RIVER COMPREHENSIVE SALMON ENHANCEMENT PLAN WORKSHOP SUMMARY

Date:	October 19, 2011	**Time:**	1:00 – 4:00	**Location:**	Veterans Museum, Chehalis, Washington
Subject:	Chehalis River Comprehensive Salmon Enhancement Plan Workshop Summary			**Prepared by:**	Jim Shannon, Margaret Murphy, Bob Montgomery

Attendees

Attendee	Representing
Mark Mobbs	Quinalt Indian Nation
Travis Nelson	Washington Department of Fish and Wildlife
Mike Barber	Washington Department of Transportation
Bob Amrine	Lewis County Conservation District
Lonnie Crumley	Streamworks
Janel Spaulding	Grays Harbor College
Paul McFadden	City of Centralia
Dan Kay	Lewis County Public Utility District
Greg Hueckel	SBGH-Partners
Chanelle Shaw	Heernet Environmental Foundation
Kelly Verd	Lewis County Conservation District
Ron Averill	Lewis County
Paul Pickett	Washington Department of Ecology
Bruce Treichler	Lewis County
Laurence Reeves	Capitol Land Trust
Julie Balmelli-Powe	City of Chehalis
Miranda Plumb	United States Fish and Wildlife Service
Mike Kohn	Lewis County Public Utility District
Katherine Moore	Washington Recreation and Conservation Office
Jim Shannon	Anchor QEA
Robert Montgomery	Anchor QEA
Margaret Murphy	Anchor QEA

Workshop Summary

Anchor QEA led the workshop and covered Introductions, Workshop Purpose and Approach, and Methods. Greg Hueckel was invited as a moderator to help keep the workshop on task and on time. Greg is also working with the Flood Authority to develop a list of flood relief projects, and the Authority wants to ensure that the enhancement projects will be complementary to the flood relief projects.

Below is a summary of the workshop, discussions, and highlighted action items from those discussions. Action items are called out, except those to be conducted by Anchor QEA during the continued development of the project.

Workshop highlights:

- Jim Shannon of Anchor QEA led the workshop. This included introductions, project background, project purpose, and workshop purpose and methods.
- The Chehalis River Comprehensive Salmon Enhancement Plan came about through the Engrossed Substitute House Bill 2020. This bill states that the Chehalis River Basin Flood Authority (CRBFA) shall "address the potential for flood mitigation through upstream water retention facilities, including benefits and impacts to fish and potential mitigation of impacts."
- The CRBFA contracted with Anchor QEA to develop the Chehalis River Comprehensive Salmon Enhancement Plan to identify and prioritize salmon enhancement projects in Water Resource Inventory Area (WRIA) 23.
- The Anchor QEA scope contains two tasks: 1) to identify salmon habitat enhancement projects using existing literature and geographic information in WRIA 23; and 2) to prioritize identified enhancement projects and complete the Comprehensive Salmon Habitat Enhancement Plan.
- The purpose of the workshop was to bring Chehalis River Basin biologists and planners together to discuss potential enhancement projects and prioritization methods.
- Anchor QEA presented a list of potential projects (Table 1) for discussion. These projects were identified from existing data sources including culvert databases and lead entity restoration plans. Some suggested changes included adding a column to reflect the owner of proposed projects.
- These projects also were displayed on topographic maps at three stations throughout the room. These maps were separated by management units (MU) defined in the Chehalis Basin Salmon Habitat Restoration and Preservation Work Plan for WRIAs 22 and 23 (2011). Topographic maps displayed projects from culvert databases, the WRIA 22/23 Limiting Factors analysis (Smith and Wegner 2001), the Chehalis Basin Salmon Habitat Restoration and Preservation Work Plan for WRIAs 22 and 23 (2011), PRisM database, the conceptual habitat database, and other sources.
- Anchor QEA also developed and presented relative elevation maps (also separated by MU) of floodplain areas to identify side-channel and off-channel areas that may have enhancement potential.
- Questions about the reasons/motive for the Chehalis River Comprehensive Salmon Enhancement Plan were discussed. It was explained that the CRBFA Projects Subcommittee is developing a list of flood relief (i.e., infrastructure) projects that are likely to take place in the Chehalis basin. The CRBFA is interested in developing a list of enhancement projects that could mitigate for these upcoming flood relief projects. Flood relief projects include levees, dikes, bank stabilization, and road infrastructure improvements.
- Bob Montgomery of Anchor QEA introduced the next stage of the workshop, which included individual and group discussions focused around the relative elevation maps and topographic maps. Workshop participants were invited to view each set of maps and identify projects that may have been completed or in progress and any additional projects not included on the maps.
- Jim Shannon of Anchor QEA led the discussion for the Black and Lincoln MUs and the mainstem Chehalis in those areas. Several culvert projects in the Black MU were already complete

including Bailey and Cedar Creek culverts. Wolf-Davis is complete and all of Davis Creek is passable now. The Porter/Oakville area was discussed as having the potential to improve off-channel rearing habitat. The Confederated Tribes of the Chehalis Reservation are currently doing restoration in this area. Comments on maps included the need to label projects on the maps and include land ownership/parcel data if possible (e.g., DNR ownership layer). Jim Shannon also received recommendations to contact Janel Spaulding (Coordinator of the Chehalis Basin Partnership), Lee Napier (WRIA 22/23 Lead Entity), and Scott Brummer and Bob Burkle of Washington Department of Fish and Wildlife (WDFW) for additional project information.

****Action Items: Update project list and maps with suggestions and contact local biologists/planners.**

- Margaret Murphy of Anchor QEA led the discussion for the Boistfort MU and the mainstem Chehalis in those areas. There was a question regarding Elk Creek and why no projects were identified in this area as it is a significant stream. We are not aware of any projects here, but this may be an area to assess for preservation of salmon habitat. The area downstream of Pe Ell tends to get quite warm during the summer and precludes salmon use; a few participants wondered if instream or riparian projects could be conducted to reduce temperatures and create more nursery habitat. Someone also alerted the group to a riparian planting project partially funded by an Ecology 319 grant in the area between Doty and Pe Ell.

  ****Action Items: Update project list and maps with suggestions and contact local biologists/planners.**
- Bob Montgomery of Anchor QEA led the discussion for the Skookumchuck and Newaukum MUs and the mainstem Chehalis in those areas. Several culvert replacement projects in the Skookumchuck MU are proposed or complete. This includes the downstream most barrier of China Creek and two culverts replaced with bridges on Scatter Creek near Tenino.

  ****Action Items: Update project list and maps with suggestions and contact local biologists/planners**
- The final part of the workshop focused on discussion about prioritization of projects. Questions and statements about prioritization included:
  1. Who is going to fund this list of projects? Right now there is no funding for this list of projects. It is just a list to be used in future planning.
  2. Should land ownership be factored into pritoritization? The likelihood of completing a project based on ownership could be a factor.
  3. Is cost of the project a consideration? Not at this stage of the process.
  4. Different project types should be prioritized with more or less weight such as fish passage versus floodplain improvement.
  5. Sponsors are worried about ranking projects. If a project in a jurisdiction gets a low ranking for this exercise, then it may not get funding from other sources.
  6. Will projects be categorized by subbasin or by project type?
  7. Why are we prioritizing this list of projects? It is hard to separate the list and prioritization from what the projects are mitigating for. What is the project list for?
  8. One suggestion was to prioritize by project type or by function; then one type of project is not valued against a project of a different type.

- Conclusions and next steps were discussed. There are a wide range and number of opportunities in the basin to enhance salmon habitat. Our next step is to incorporate workshop suggestions and comments into a memorandum that will list potential enhancement projects in the basin. We ask that any further comments on the project list or prioritization methods be submitted by November 14, 2011. We will continue to work on a ranking/prioritization system to be included in the final report.

APPENDIX B
PROJECT RANKINGS

Project Identifier	Location	Limiting Factor Addressed and Tier (Tier 1 = 5 pts, Tier 2 = 3 pts, Tier 3 = 1 pt)				Salmon Species (3 points per species)							Potential Amount of Habitat Restored [(side channel/off channel: > 10,000 feet = 5 pts, between 1,000-10,000 feet = 3 pts, < 1,000 = 1 pt) (Riparian: >100 acres = 5pts, between 10-100 acres = 3 pts, <10 acres = 1 pt)]					Certainty of Project Success (preservation = 7 points, barrier removal = 5 pts, Restore watershed processes = 3 pts, Instream habitat enhancement = 1 pt)	Weighted	Total Weighted Score	Ranking	Description of Project	Comments
		Riparian Conditions	Floodplain Conditions	LWD	Weighted	Spring Chinook	Fall Chinook	Coho	Winter Steelhead	Fall Chum	Cutthroat	Weighted	Side Channel/Off Channel Length (ft)	Points	Riparian Area (acres)	Points	Weighted					
Black Management Unit (includes Black River, Porter Creek subbasins)																					
BL-6	Black River Preservation River Miles (RM) 0-10	5	1	3	**8.3**	0	3	3	3	3	3	**16.5**	0	0	200	5	**4.3**	7	**8.5**	**37.5**		Preserve lower reach habitat buy acquisition of riparian, off-channel, and wetland habitats.	Comment by local planner/biologist from October 2011 Chehalis Salmon Enhancement Plan Workshop. Assume the purchase of 200 acres.
Boistfort Management Unit (Upper Chehalis, South Fork Chehalis, Stillman Creek, Lake Creek)																					
BF-4	South Fork Chehalis, RM 0-5	5	1	0	**5.5**	3	3	3	3	0	3	**16.5**	0	0	197	5	**4.3**	3	**3.6**	**29.9**		Includes revegetating and regrading banks to 2:1 slopes with a bench or 3:1 slope and removing invasive/planting a native understory.	Draft Twin Cities Flood Reduction Project, Mitigation Site Evaluations. Appendix A. Dated March 2011.
BF-5	South Fork Chehalis Confluence, RM 0	5	1	0	**5.5**	3	3	3	3	0	3	**16.5**	0	0	7	1	**0.9**	3	**3.6**	**26.5**		Includes revegetating and regrading banks to 2:1 slopes with a bench or 3:1 slope and removing invasive/planting a native understory. Also includes e1cavation along South Fork to create wetland bench and install LWD clusters on bank.	Draft Twin Cities Flood Reduction Project, Mitigation Site Evaluations. Appendix A. Dated March 2011.
BF-6	Elk Creek Preservation	5	1	3	**8.3**	3	3	3	3	0	3	**16.5**	0	0	200	5	**4.3**	7	**8.5**	**37.5**		Preserve habitat buy acquisition of intact riparian, off-channel, and wetland habitats.	Assume purchase of 200 acres.
Chehalis Mainstem Management Unit																					
CH-1	River Miles 66 to 81	5	5	3	**11.9**	3	3	3	3	0	3	**16.5**	0	0	389	5	**4.3**	3	**3.6**	**36.3**		Includes revegetating and regrading banks to 2:1 slopes with a bench or 3:1 slope and removing invasives/planting a native understory.	Draft Twin Cities Flood Reduction Project, Mitigation Site Evaluations. Appendix A. Dated March 2011.
CH-6	State Route 6 oxbow	5	5	3	**11.9**	3	3	3	3	0	3	**16.5**	5,450	3	74	3	**5.1**	5	**6.1**	**39.6**		City of Chehalis owns two-thirds of the property (130 acres). City of Chehalis owns Poplar farm on the north side of SR-6 that may be available for restoration. Landowner in the SR-6 oxbow site may be interested in conservation. This oxbow is currently connected to the Chehalis at approximately a 1.2-year flow.	Draft Twin Cities Flood Reduction Project, Mitigation Site Evaluations. Appendix A. Dated March 2011.
CH-7	Oxbow Lake Reconnection	5	5	3	**11.9**	3	3	3	3	0	3	**16.5**	5,077	3	12	3	**5.1**	5	**6.1**	**39.6**		approximately 75 acres; 2 landowners. Improve connection to main channel—not currently a connection but when floodwaters e1ceed the bank elevation (something above a 2-year flow, maybe 5-year flow), then it may briefly connect. Will require about 12 feet of e1cavation to create a channel connection to Chehalis River for winter rearing (i.e., November to May).	Draft Twin Cities Flood Reduction Project, Mitigation Site Evaluations. Appendix A. Dated March 2011.
CH-8	WDFW Pheasant Farm	5	5	0	**9.2**	3	3	3	3	0	3	**16.5**	3,495	3	8	1	**3.4**	5	**6.1**	**35.1**		200 acres (combined Washington Department of Fish and Wildlife [WDFW] and private landowner just downstream). WDFW owns a pheasant farm and may be open to conservation. Good floodplain area with potential e1cavation and enhancement. The area closest to the river already has a number of higher flow side channels and good riparian cover; existing good quality. There are a few fields that are hayed that could be Excavated for wetlands and side channels and also revegetated.	Draft Twin Cities Flood Reduction Project, Mitigation Site Evaluations. Appendix A. Dated March 2011.
CH-9	Scheuber Ditch	5	5	3	**11.9**	0	0	0	0	0	3	**3.3**	12,600	5	79	3	**6.8**	5	**6.1**	**28.1**		Connect Scheuber Ditch to State Route 6 oxbow at upstream end and Excavate new meandering stream with benches on the inside. Also create and enhance emergent wetlands along newly Excavated stream. Install engineered log jam at confluence of newly Excavated stream and Chehalis River. Landowners to the north along Scheuber Ditch are less amenable to restoration.	Draft Twin Cities Flood Reduction Project, Mitigation Site Evaluations. Appendix A. Dated March 2011.
CH-10	Near Gaddis Creek Confluence RM 34	5	5	3	**11.9**	3	3	3	3	0	3	**16.5**	13,744	5	35	3	**6.8**	3	**3.6**	**38.9**		Enhance low elevation areas, side channels, and floodplain habitat with vegetated benches and LWD.	Geomorphic analysis from aerial photos and elevation maps.
CH-11	Near RM 36	5	5	3	**11.9**	3	3	3	3	0	3	**16.5**	8,754	3	20	3	**5.1**	5	**6.1**	**39.6**		Reconnect oxbow with mainstem Chehalis. Enhance low elevation areas, side channels, and floodplain habitat with vegetated benches and LWD.	Geomorphic analysis from aerial photos and elevation maps.
CH-12	Near RM 42	5	5	3	**11.9**	3	3	3	3	0	3	**16.5**	4,381	3	10	3	**5.1**	3	**3.6**	**37.2**		Enhance low elevation areas, side channels, and floodplain habitat with vegetated benches and LWD.	Geomorphic analysis from aerial photos and elevation maps.
CH-13	Near RM 43	5	5	3	**11.9**	3	3	3	3	0	3	**16.5**	16,075	5	49	3	**6.8**	5	**6.1**	**41.3**		Reconnect oxbow with mainstem Chehalis. Enhance low elevation areas, side channels, and floodplain habitat with vegetated benches and LWD.	Geomorphic analysis from aerial photos and elevation maps.
CH-14	Near Garrard Creek Confluence Chehalis RM 46	5	5	3	**11.9**	3	3	3	3	0	3	**16.5**	7,062	3	16	3	**5.1**	3	**3.6**	**37.2**		Enhance low elevation areas, side channels, and floodplain habitat with vegetated benches and LWD.	Geomorphic analysis from aerial photos and elevation maps.
CH-15	Near RM 50	5	5	3	**11.9**	3	3	3	3	0	3	**16.5**	5,409	3	17	3	**5.1**	3	**3.6**	**37.2**		Enhance low elevation areas, side channels, and floodplain habitat with vegetated benches and LWD.	Geomorphic analysis from aerial photos and elevation maps.
CH-16	Near Chehalis Village Chehalis RM 54	5	5	3	**11.9**	3	3	3	3	0	3	**16.5**	8,868	3	25	3	**5.1**	3	**3.6**	**37.2**		Enhance low elevation areas, side channels, and floodplain habitat with vegetated benches and LWD.	Geomorphic analysis from aerial photos and elevation maps.
CH-17	Near RM 56-58	5	5	3	**11.9**	3	3	3	3	0	3	**16.5**	11,995	5	27	3	**6.8**	3	**3.6**	**38.9**		Enhance low elevation areas, side channels, and floodplain habitat with vegetated benches and LWD.	Geomorphic analysis from aerial photos and elevation maps.
CH-17a	Near RM 58	5	5	3	**11.9**	3	3	3	3	0	3	**16.5**	1,951	3.0	9	1	**3.4**	5	**6.1**	**37.9**		Enhance low elevation areas, side channels, and floodplain habitat with vegetated benches and LWD.	Geomorphic analysis from aerial photos and elevation maps.
CH-18	Dry Creek confluence Chehalis RM 60	5	5	3	**11.9**	3	3	3	3	0	3	**16.5**	2,423	3	6	1	**3.4**	3	**3.6**	**35.5**		Enhance low elevation areas and floodplain habitat with vegetated benches and LWD.	Geomorphic analysis from aerial photos and elevation maps.
CH-20	Near RM 68	5	5	3	**11.9**	3	3	3	3	0	3	**16.5**	285	1.0	2	1	**1.7**	5	**6.1**	**36.2**		Reconnect oxbow with mainstem Chehalis. Enhance low elevation areas, side channels, and floodplain habitat with vegetated benches and LWD.	Geomorphic analysis from aerial photos and elevation maps.
CH-21	Near RM 78	5	5	3	**11.9**	3	3	3	3	0	3	**16.5**	2,350	3	12	3	**5.1**	3	**3.6**	**37.2**		Reconnect oxbow with mainstem Chehalis. Enhance low elevation areas, side channels, and floodplain habitat with vegetated benches and LWD.	Geomorphic analysis from aerial photos and elevation maps.
CH-22	Near RM 79	5	5	3	**11.9**	3	3	3	3	0	3	**16.5**	893	1	2	1	**1.7**	3	**3.6**	**33.8**		Enhance low elevation areas and floodplain habitat with vegetated benches and LWD.	Geomorphic analysis from aerial photos and elevation maps.
CH-23	Near RM 82	5	5	3	**11.9**	3	3	3	3	0	3	**16.5**	1,061	3	2	1	**3.4**	3	**3.6**	**35.5**		Enhance low elevation areas and floodplain habitat with vegetated benches and LWD.	Geomorphic analysis from aerial photos and elevation maps.
CH-24	Near RM 83	5	5	3	**11.9**	3	3	3	3	0	3	**16.5**	876	1	16	3	**3.4**	3	**3.6**	**35.5**		Enhance low elevation areas and floodplain habitat with vegetated benches and LWD.	Geomorphic analysis from aerial photos and elevation maps.
CH-25	Near RM 85	5	5	3	**11.9**	3	3	3	3	0	3	**16.5**	0	0	33	3	**2.6**	3	**3.6**	**34.6**		Enhance low elevation areas and floodplain habitat with vegetated benches and LWD.	Geomorphic analysis from aerial photos and elevation maps.
CH-26	Near RM 88	5	5	3	**11.9**	3	3	3	3	0	3	**16.5**	6,042	3	16	3	**5.1**	3	**3.6**	**37.2**			
Lincoln Management Unit (Lincoln Creek, Independence Creek, Garrard Creek, Gaddis Creek, Rock/Williams Creek, Bunker Creek, Scammon Creek, Mill Creek, Stearns Creek)																					
LI-12	Gaddis Creek floodplain Near Chehalis RM 34	3	5	3	**10.1**	0	0	3	0	0	3	**6.6**	0	0	0	0	**0.0**	3	**3.6**	**20.3**		Enhance low elevation areas and floodplain habitat with vegetated benches and LWD. Meander Gaddis Creek due to straight channel s. Add LWD to channel.	Tier 1 for floodlain conditions. Geomorphic analysis from aerial photos and elevation maps.
LI-13	Rock/Williams Creek floodplain Near Chehalis RM 40	3	5	3	**10.1**	3	3	3	3	0	3	**16.5**	0	0	0	0	**0.0**	3	**3.6**	**30.2**		Enhance low elevation areas and floodplain habitat with vegetated benches and LWD. Meander Rock/Williams Creek due to straightg channels. Add LWD to channel.	Tier 1 for floodlain conditions. Geomorphic analysis from aerial photos and elevation maps.

Project Identifier	Location	Limiting Factor Addressed and Tier (Tier 1 = 5 pts, Tier 2 = 3 pts, Tier 3 = 1 pt)				Salmon Species (3 points per species)							Potential Amount of Habitat Restored [(side channel/off channel: > 10,000 feet = 5 pts, between 1,000-10,000 feet = 3 pts, < 1,000 = 1 pt) (Riparian: >100 acres = 5pts, between 10-100 acres = 3 pts, <10 acres = 1 pt)]					Certainty of Project Success (preservation = 7 points, barrier removal = 5 pts, Restore watershed processes = 3 pts, Instream habitat enhancement = 1 pt)	Weighted	Total Weighted Score	Ranking	Description of Project	Comments
		Riparian Conditions	Floodplain Conditions	LWD	Weighted	Spring Chinook	Fall Chinook	Coho	Winter Steelhead	Fall Chum	Cutthroat	Weighted	Side Channel/Off Channel Length (ft)	Points	Riparian Area (acres)	Points	Weighted					
LI-14	Bunker Creek floodplain Near Chehalis RM 85	3	5	3	**10.1**	0	0	3	3	0	3	**9.9**	0	0	0	0	**0.0**	1	**1.2**	**21.2**		Enhance low elevation areas and floodplain habitat with vegetated benches and LWD. Meander Bunker Creek due to straight channels. Add LWD to channel.	Tier 1 for floodlain conditions. Geomorphic analysis from aerial photos and elevation maps.
Newaukum Management Unit (Newaukum Mainstem, North Fork, Middle Fork, Salzer Creek, Coal Creek, Dillenbaugh Creek, Berwick Creek, China Creek)																							
NE-8	Dillenbaugh Creek	5	1	3	**8.3**	0	0	3	0	0	3	**6.6**	1,550	3	22	3	**5.1**	5	**6.1**	**26.0**		Near Dillenbaugh Creek; demolish old sewage treatment plant. Look at route of Dillenbaugh Creek (lower 2 miles or so) that traverses the Chehalis River floodplain. Could either reroute Dillenbaugh Creek into the Newaukum at Stan Hedwall Park, or could improve its existing course and send towards old sewage treatment plant. Bob Burkle has been a fan of rerouting it into Newaukum.	Draft Twin Cities Flood Reduction Project, Mitigation Site Evaluations. Appendix A. Dated March 2011.
NE-9	Newaukum River Riparian Restoration RM 0-10	5	3	0	**7.3**	3	3	3	3	0	3	**16.5**	0	0	347	3	**2.6**	3	**3.6**	**30.0**		Includes revegetating and regrading banks to 2:1 slopes with a bench or 3:1 slope and removing invasives/planting a native understory.	Draft Twin Cities Flood Reduction Project, Mitigation Site Evaluations. Appendix A. Dated March 2011.
NE-10a	Salzer Creek Lower Mile Oxbow Reconnection and Riparian Restoration	5	3	1	**8.3**	0	0	3	0	0	3	**6.6**	950	1	27	3	**3.4**	5	**6.1**	**24.3**		Connect Salzer Creek to old Chehalis River oxbow. Includes revegetating and regrading banks of Salzer Creek to 2:1 slopes with a bench or 3:1 slopes and removing invasives/planting a native understory. Also includes wetland creation, enhancement, and installation of LWD.	Draft Twin Cities Flood Reduction Project, Mitigation Site Evaluations. Appendix A. Dated March 2011.
NE-10b	Salzer Creek I-5 to BNRR Riparian and In-Channel Restoration	5	3	1	**8.3**	0	0	3	0	0	3	**6.6**	0	0	11	3	**2.6**	3	**3.6**	**21.0**		Realign stream and install LWD between I-5 and the BNRR railroad. Revegetate with native trees and shrubs.	Draft Twin Cities Flood Reduction Project, Mitigation Site Evaluations. Appendix A. Dated March 2011.
NE-10c	Salzer-Coal Creek Fairgrounds Floodplain and Channel Restoration	5	3	0	**7.3**	0	0	3	0	0	3	**6.6**	0	0	59	3	**2.6**	3	**3.6**	**20.1**		Remove existing levee and realign Salzer and Coal Creeks to create sinuosity and improved instream habitat. Also includes wetland creation, enhancement, and riparian revegetation.	Draft Twin Cities Flood Reduction Project, Mitigation Site Evaluations. Appendix A. Dated March 2011.
NE-10d	Salzer Creek at Centralia Alpha Road Floodplain Storage and Riparian Restoration	5	3	1	**8.3**	0	0	3	0	0	3	**6.6**	0	0	16	3	**2.6**	3	**3.6**	**21.0**		Create approximately 2,000 feet of sinuous stream and install LWD log clusters. Revegetate with native trees and shrubs. Excavate emergent wetland and revegetate with wetland plants.	Draft Twin Cities Flood Reduction Project, Mitigation Site Evaluations. Appendix A. Dated March 2011.
NE-10e	Salzer Creek at Proffitt Road Riparian Restoration	5	3	1	**8.3**	0	0	3	0	0	3	**6.6**	0	0	15	3	**2.6**	3	**3.6**	**21.0**		Includes revegetating and regrading banks to 2:1 slopes with a bench or 3:1 and removing invasives/planting a native understory. Also includes installation of LWD.	Draft Twin Cities Flood Reduction Project, Mitigation Site Evaluations. Appendix A. Dated March 2011.
NE-13	Newaukum River/Newaukum Valley Golf Course	5	3	0	**7.3**	3	3	3	3	0	3	**16.5**	0	0	0	0	**0.0**	3	**3.6**	**27.5**		Golf course landowner is interested in enhancements. Potential for riparian and in-channel enhancements – area of channel migration.	Personal communication with Merri Martz of TetraTech Inc. Authors of Draft Twin Cities Flood Reduction Project.
NE-15	Newaukum Confluence with Chehalis	5	3	1	**8.3**	3	3	3	3	0	3	**16.5**	0	0	6	1	**0.9**	3	**3.6**	**29.2**		Includes revegetating and regrading banks to 2:1 slopes with a bench and removing invasives/planting a native understory. Also includes installation of LWD.	Draft Twin Cities Flood Reduction Project, Mitigation Site Evaluations. Appendix A. Dated March 2011.
NE-16	Stan Hedwall Park Floodplain Reconnection	5	3	1	**8.3**	3	3	3	3	0	3	**16.5**	600	1	48	3	**3.4**	5	**6.1**	**34.2**		Includes reconnecting existing side-channels, four engineered log jams, and riparian revegetation over 40 acres.	Draft Twin Cities Flood Reduction Project, Mitigation Site Evaluations. Appendix A. Dated March 2011.
NE-17	Rice Road Floodplain/Side Channel Restoration	5	3	1	**8.3**	3	3	3	3	0	3	**16.5**	0	0	15	3	**2.6**	5	**6.1**	**33.4**		Includes reconnecting existing side-channels, one engineered log jam, and riparian revegetation over 14 acres.	Draft Twin Cities Flood Reduction Project, Mitigation Site Evaluations. Appendix A. Dated March 2011.
NE-18	North Fork/South Fork Newaukum Confluence Riparian Restoration	5	0	1	**5.5**	3	3	3	3	0	3	**16.5**	0	0	30	3	**2.6**	3	**3.6**	**28.2**		Includes revegetating and regrading banks to 2:1 slopes with a bench and removing invasives/planting a native understory. Also includes installation of LWD.	Draft Twin Cities Flood Reduction Project, Mitigation Site Evaluations. Appendix A. Dated March 2011.
NE-19	North Fork Newaukum River at Tauscher Road	5	0	1	**5.5**	3	3	3	3	0	3	**16.5**	0	0	8	1	**0.9**	3	**3.6**	**26.5**		Includes revegetating and regrading banks to 2:1 slopes with a bench and removing invasives/planting a native understory. Also includes installation of LWD.	Draft Twin Cities Flood Reduction Project, Mitigation Site Evaluations. Appendix A. Dated March 2011.
NE-20	Middle Fork Newaukum at Tauscher Road Preservation	5	1	1	**6.4**	0	0	3	3	0	3	**9.9**	0	0	16	3	**2.6**	7	**8.5**	**27.4**		Preserve 4 acres of riparian forest along Middle Fork Newaukum River and restore 16 acres.	Draft Twin Cities Flood Reduction Project, Mitigation Site Evaluations. Appendix A. Dated March 2011.
NE-21	Middle Fork Newaukum Preservation	5	1	1	**6.4**	0	0	3	3	0	3	**9.9**	0	0	200	5	**4.3**	7	**8.5**	**29.1**		Preserve habitat buy acquisition of intact riparian, off-channel, and wetland habitats.	Personal communication with Bob Amrine of Lewis County Conservation District.
Skookumchuck Management Unit (Skookumchuck River, Scatter Creek)																							
SK-5	Scatter Creek	5	1	5	**10.1**	0	0	3	0	0	3	**6.6**	0	0	10	3	**2.6**	3	**3.6**	**22.9**		30% design project; part of larger conceptual plan to develop wetland comple1/refugia; larger project appro1. 10+ acres submerged wetland	Conceptual Project HWS database
SK-8a	Near RM 6	5	5	1	**10.1**	3	3	3	3	0	3	**16.5**	548	1	1	1	**1.7**	3	**3.6**	**31.9**		Off-Channel Area (old meander), Open Space with some riparian cover, Excavate perennial off-channel connection, railroad present.	Geomorphic analysis from aerial photos and elevation maps.
SK-8b	Near RM 6.5	5	5	1	**10.1**	3	3	3	3	0	3	**16.5**	807	1	2	1	**1.7**	3	**3.6**	**31.9**		Off-Channel Area (old meander), Open Space with some riparian cover, Excavate perennial off-channel connection, railroad present.	Geomorphic analysis from aerial photos and elevation maps.
SK-9	Near RM 7	5	5	1	**10.1**	3	3	3	3	0	3	**16.5**	846	1	2	1	**1.7**	5	**6.1**	**34.4**		Off-Channel Area (old meander), Left Bank Off Channel Floodplain Area, Meander Cutoff by Railroad, Off-Channel Refuge, Open Space Area with Trees, Limited to no infrastructure present along both side channel banks.	Geomorphic analysis from aerial photos and elevation maps.
SK-11	Near RM 10	5	5	1	**10.1**	3	3	3	3	0	3	**16.5**	1,012	3	2	1	**3.4**	5	**6.1**	**36.1**		Off-Channel Area (old meander), Open Space with some riparian cover, Excavate perennial off-channel connection, Limited to no infrastructure (houses) present	Geomorphic analysis from aerial photos and elevation maps.
SK-12	Near RM 11	5	5	1	**10.1**	3	3	3	3	0	3	**16.5**	1,553	3	4	1	**3.4**	3	**3.6**	**33.6**		Right Bank Low Lying Area (potential floodplain), Confined along left bank by RR, Limited by structures on left bank	Geomorphic analysis from aerial photos and elevation maps.
SK-13	Near RM 12	5	5	1	**10.1**	3	3	3	3	0	3	**16.5**	2,589	3	6	1	**3.4**	5	**6.1**	**36.1**		Off-Channel Area (old meander), Confined along left bank by RR, Excavate off-channel connection, Infrastructure present (houses, road, structures)	Geomorphic analysis from aerial photos and elevation maps.
SK-14	Near RM 13	5	5	1	**10.1**	3	3	3	3	0	3	**16.5**	1,266	3	3	1	**3.4**	5	**6.1**	**36.1**		Includes removing invasives/planting native forest trees and understory.	Draft Twin Cities Flood Reduction Project, Mitigation Site Evaluations. Appendix A. Dated March 2011.
SK-15	Near RM 14	5	5	1	**10.1**	3	3	3	3	0	3	**16.5**	976	1	2	1	**1.7**	5	**6.1**	**34.4**		Left Bank Side Channel (verify), Left Bank Low Lying Area (potential floodplain)(open field area), Improve Side Channel Connection As Necessary, E1cavation, Little Riparian Vegetation Present-improve riparian cover	Geomorphic analysis from aerial photos and elevation maps.

APPENDIX C
COST ESTIMATES

Appendix C

Management Area	Number of Projects	Estimated Culvert Replacement Cost
Black River	15	$ 1,205,000
Boistfort	73	$ 5,049,000
Lincoln	116	$ 8,271,000
Newaukum	54	$ 3,777,000
Skookumchuck	44	$ 3,125,000

Culvert ID	Stream Name	Management Unit	Estimated Culvert Replacement Cost
990963	Black River	Black River	$ 80,000
343206	Black River	Black River	$ 80,000
343629	Black River	Black River	$ 90,000
990365	Black River	Black River	$ 90,000
341513	Black River	Black River	$ 90,000
341711	Black River	Black River	$ 90,000
990040	Black River	Black River	$ 90,000
990962	Black River	Black River	$ 90,000
23.0543 A 0.10	Porter Creek	Black River	$ 65,000
991536	Porter Creek	Black River	$ 65,000
125 1703W17A	Unnamed	Black River	$ 65,000
125 1703W17G	Unnamed	Black River	$ 65,000
125 1703W17H	Unnamed	Black River	$ 65,000
342722	Waddel Creek	Black River	$ 90,000
340958	Waddel Creek	Black River	$ 90,000
125 1203W31B	Chehalis, SF	Boistfort	$ 53,000
125 1203W30A	Chehalis, SF	Boistfort	$ 72,000
125 1204W36A	Chehalis, SF	Boistfort	$ 90,000
021(92004)(05661)	Chehalis, SF	Boistfort	$ 80,000
021(92004)(08538)	Chehalis, SF	Boistfort	$ 80,000
125 1104W34A	Chehalis, SF	Boistfort	$ 53,000
021(92004)(07883)	Chehalis, SF	Boistfort	$ 59,000
021(92004)(07238)	Chehalis, SF	Boistfort	$ 87,000
021(92004)(07013)	Chehalis, SF	Boistfort	$ 90,000
021(92004)(02984)	Chehalis, SF	Boistfort	$ 90,000
021(92004)(03525)	Chehalis, SF	Boistfort	$ 90,000
021(92004)(03836)	Chehalis, SF	Boistfort	$ 90,000
125 1203W05B	Curtis	Boistfort	$ 65,000
125 1304W35A	Curtis	Boistfort	$ 53,000

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Culvert ID	Stream Name	Management Unit	Estimated Culvert Replacement Cost
125 1304W17A	Curtis	Boistfort	$ 53,000
125 1304W13C	Curtis	Boistfort	$ 41,000
125 1203W05A	Curtis	Boistfort	$ 53,000
125 1304W36B	Curtis	Boistfort	$ 80,000
125 1204W03B	Curtis	Boistfort	$ 80,000
125 1203W10A	Curtis	Boistfort	$ 65,000
125 1304W13B	Curtis	Boistfort	$ 65,000
125 1304W23A	Curtis	Boistfort	$ 80,000
125 1304W03A	Curtis	Boistfort	$ 90,000
991542	Curtis	Boistfort	$ 41,000
021(24017)(11680)	Curtis	Boistfort	$ 41,000
021(27651)(00273)	Curtis	Boistfort	$ 41,000
021(28051)(00450)	Curtis	Boistfort	$ 41,000
990764	Curtis	Boistfort	$ 41,000
990423	Curtis	Boistfort	$ 47,000
990758	Curtis	Boistfort	$ 47,000
991221	Curtis	Boistfort	$ 47,000
021(24017)(09046)	Curtis	Boistfort	$ 47,000
021(24017)(12280)	Curtis	Boistfort	$ 53,000
125 1303W05A	Curtis	Boistfort	$ 53,000
021(23650)(02800)	Curtis	Boistfort	$ 59,000
021(24017)(10900)	Curtis	Boistfort	$ 59,000
990760	Curtis	Boistfort	$ 65,000
021(24036)(00519)	Curtis	Boistfort	$ 65,000
021(27000)(02202)	Curtis	Boistfort	$ 80,000
021(27820)(02365)	Curtis	Boistfort	$ 90,000
021(27000)(02426)	Curtis	Boistfort	$ 90,000
021(27820)(02631)	Curtis	Boistfort	$ 90,000
021(24017)(08876)	Curtis	Boistfort	$ 90,000
021(27501)(02750)	Curtis	Boistfort	$ 90,000
125 1305W17B	Elk Creek	Boistfort	$ 72,000
125 1305W18B	Elk Creek	Boistfort	$ 90,000
125 1305W17A	Elk Creek	Boistfort	$ 80,000
125 1305W18C	Elk Creek	Boistfort	$ 80,000
021(24019)(04032)	Halfway Cr	Boistfort	$ 53,000
125 1205W05C	Rock-Jones	Boistfort	$ 90,000
125 1205W05A	Rock-Jones	Boistfort	$ 65,000
125 1305W23D	Rock-Jones	Boistfort	$ 53,000
125 1305W23A	Rock-Jones	Boistfort	$ 65,000
125 1305W25B	Rock-Jones	Boistfort	$ 90,000
125 1303W31A	Rock-Jones	Boistfort	$ 65,000
125 1305W25A	Rock-Jones	Boistfort	$ 90,000

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Culvert ID	Stream Name	Management Unit	Estimated Culvert Replacement Cost
125 1205W05B	Rock-Jones	Boistfort	$ 90,000
021(24019)(02402)	Rock-Jones	Boistfort	$ 65,000
021(26390)(00612)	Rock-Jones	Boistfort	$ 65,000
990473	Rock-Jones	Boistfort	$ 87,000
021(24019)(02040)	Rock-Jones	Boistfort	$ 90,000
1080120	Rock-Jones	Boistfort	$ 90,000
021(26661)(00060)	Rock-Jones	Boistfort	$ 90,000
125 1204W05C	Stillman Creek	Boistfort	$ 31,000
021(25510)(00106)	Stillman Creek	Boistfort	$ 53,000
021(25570)(00024)	Stillman Creek	Boistfort	$ 53,000
021(25401)(01657)	Stillman Creek	Boistfort	$ 53,000
021(24019)(04966)	Stillman Creek	Boistfort	$ 59,000
021(25510)(00722)	Stillman Creek	Boistfort	$ 59,000
125 1204W33A	Stillman Creek	Boistfort	$ 65,000
021(25401)(03620)	Stillman Creek	Boistfort	$ 90,000
021(25401)(03773)	Stillman Creek	Boistfort	$ 90,000
021(24019)(04778)	Stillman Creek	Boistfort	$ 90,000
021(24034)(00730)	Bunker Creek	Lincoln	$ 41,000
021(28001)(06343)	Bunker Creek	Lincoln	$ 41,000
021(24034)(02386)	Bunker Creek	Lincoln	$ 31,000
125 1404W17A	Bunker Creek	Lincoln	$ 31,000
125 1404W15A	Bunker Creek	Lincoln	$ 47,000
021(24024)(01701)	Bunker Creek	Lincoln	$ 47,000
021(24034)(05678)	Bunker Creek	Lincoln	$ 59,000
125 1303W04A	Bunker Creek	Lincoln	$ 65,000
125 1403W07A	Bunker Creek	Lincoln	$ 80,000
021(24034)(08899)	Bunker Creek	Lincoln	$ 87,000
125 1303W04C	Bunker Creek	Lincoln	$ 65,000
125 1404W23A	Bunker Creek	Lincoln	$ 53,000
125 1403W32C	Bunker Creek	Lincoln	$ 90,000
125 1303W04D	Bunker Creek	Lincoln	$ 90,000
125 1403W32A	Bunker Creek	Lincoln	$ 80,000
125 1304W01A	Bunker Creek	Lincoln	$ 31,000
125 1304W12A	Bunker Creek	Lincoln	$ 80,000
125 1404W20B	Bunker Creek	Lincoln	$ 80,000
125 1403W32B	Bunker Creek	Lincoln	$ 90,000
125 1303W07A	Bunker Creek	Lincoln	$ 53,000
125 1303W06A	Bunker Creek	Lincoln	$ 90,000
125 1403W30A	Bunker Creek	Lincoln	$ 47,000
125 1403W29B	Bunker Creek	Lincoln	$ 80,000
125 1404W24A	Bunker Creek	Lincoln	$ 90,000
021(24024)(03932)	Bunker Creek	Lincoln	$ 90,000

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Culvert ID	Stream Name	Management Unit	Estimated Culvert Replacement Cost
021(28001)(05816)	Bunker Creek	Lincoln	$ 90,000
125 1504W06A	Garrard Creek	Lincoln	$ 59,000
125 1505W10A	Garrard Creek	Lincoln	$ 80,000
125 1505W04A	Garrard Creek	Lincoln	$ 47,000
125 1505W02G	Garrard Creek	Lincoln	$ 72,000
125 1504W06B	Garrard Creek	Lincoln	$ 47,000
125 1505W16A	Garrard Creek	Lincoln	$ 59,000
125 1505W11C	Garrard Creek	Lincoln	$ 47,000
125 1505W11B	Garrard Creek	Lincoln	$ 80,000
125 1505W08A	Garrard Creek	Lincoln	$ 41,000
125 1505W21A	Garrard Creek	Lincoln	$ 31,000
125 1503W07A	Lincoln Creek	Lincoln	$ 80,000
125 1504W26A	Lincoln Creek	Lincoln	$ 31,000
125 1503W31C	Lincoln Creek	Lincoln	$ 47,000
125 1504W33A	Lincoln Creek	Lincoln	$ 72,000
125 1503W31A	Lincoln Creek	Lincoln	$ 90,000
125 1504W15A	Lincoln Creek	Lincoln	$ 53,000
125 1503W31D	Lincoln Creek	Lincoln	$ 90,000
125 1504W21C	Lincoln Creek	Lincoln	$ 90,000
125 1503W31B	Lincoln Creek	Lincoln	$ 90,000
125 1504W28A	Lincoln Creek	Lincoln	$ 65,000
125 1503W17B	Lincoln Creek	Lincoln	$ 90,000
125 1403W04C	Lincoln Creek	Lincoln	$ 31,000
125 1503W12A	Lincoln Creek	Lincoln	$ 65,000
125 1504W14A	Lincoln Creek	Lincoln	$ 90,000
125 1503W17A	Lincoln Creek	Lincoln	$ 47,000
125 1504W29A	Lincoln Creek	Lincoln	$ 47,000
021(10000)(00271)	Lincoln Creek	Lincoln	$ 65,000
021(10004)(00013)	Lincoln Creek	Lincoln	$ 65,000
021(91009)(02604)	Lincoln Creek	Lincoln	$ 65,000
021(91015)(00761)	Lincoln Creek	Lincoln	$ 65,000
021(91009)(02925)	Lincoln Creek	Lincoln	$ 65,000
021(10004)(01536)	Lincoln Creek	Lincoln	$ 53,000
021(91015)(06963)	Lincoln Creek	Lincoln	$ 53,000
021(10004)(01168)	Lincoln Creek	Lincoln	$ 59,000
341972	Lincoln Creek	Lincoln	$ 65,000
021(10004)(01019)	Lincoln Creek	Lincoln	$ 65,000
021(10004)(00716)	Lincoln Creek	Lincoln	$ 72,000
021(10024)(00877)	Lincoln Creek	Lincoln	$ 87,000
021(10000)(01485)	Lincoln Creek	Lincoln	$ 90,000
021(10026)(02100)	Lincoln Creek	Lincoln	$ 90,000
021(91009)(01364)	Lincoln Creek	Lincoln	$ 90,000

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Culvert ID	Stream Name	Management Unit	Estimated Culvert Replacement Cost
021(10019)(13700)	Lincoln Creek	Lincoln	$ 90,000
021(10000)(00064)	Lincoln Creek	Lincoln	$ 90,000
125 1302W32B	Scammon-Stearns	Lincoln	$ 80,000
125 1302W28B	Scammon-Stearns	Lincoln	$ 90,000
125 1302W31A	Scammon-Stearns	Lincoln	$ 59,000
125 1403W10C	Scammon-Stearns	Lincoln	$ 90,000
125 1303W10A	Scammon-Stearns	Lincoln	$ 72,000
125 1303W16A	Scammon-Stearns	Lincoln	$ 65,000
125 1302W29B	Scammon-Stearns	Lincoln	$ 90,000
125 1302W31B	Scammon-Stearns	Lincoln	$ 90,000
125 1303W14A	Scammon-Stearns	Lincoln	$ 47,000
125 1403W25A	Scammon-Stearns	Lincoln	$ 53,000
125 1303W24C	Scammon-Stearns	Lincoln	$ 59,000
125 1303W24E	Scammon-Stearns	Lincoln	$ 90,000
125 1303W17A	Scammon-Stearns	Lincoln	$ 72,000
125 1403W34A	Scammon-Stearns	Lincoln	$ 90,000
125 1303W15A	Scammon-Stearns	Lincoln	$ 65,000
125 1302W19A	Scammon-Stearns	Lincoln	$ 90,000
125 1303W23A	Scammon-Stearns	Lincoln	$ 90,000
021(22850)(02861)	Scammon-Stearns	Lincoln	$ 47,000
021(24005)(01131)	Scammon-Stearns	Lincoln	$ 47,000
021(44002)(00595)	Scammon-Stearns	Lincoln	$ 47,000
021(30100)(04686)	Scammon-Stearns	Lincoln	$ 65,000
021(22850)(03024)	Scammon-Stearns	Lincoln	$ 72,000
021(22901)(00022)	Scammon-Stearns	Lincoln	$ 72,000
021(30100)(02179)	Scammon-Stearns	Lincoln	$ 72,000
991544	Scammon-Stearns	Lincoln	$ 80,000
021(22850)(03138)	Scammon-Stearns	Lincoln	$ 80,000
021(24021)(02297)	Scammon-Stearns	Lincoln	$ 80,000
021(91017)(00973)	Scammon-Stearns	Lincoln	$ 80,000
021(24038)(07422)	Scammon-Stearns	Lincoln	$ 90,000
021(24002)(01505)	Scammon-Stearns	Lincoln	$ 90,000
021(23000)(02686)	Scammon-Stearns	Lincoln	$ 90,000
021(31013)(02557)	Scammon-Stearns	Lincoln	$ 90,000
021(31013)(00854)	Scammon-Stearns	Lincoln	$ 90,000
021(31013)(02326)	Scammon-Stearns	Lincoln	$ 90,000
991757	Scammon-Stearns	Lincoln	$ 90,000
021(14004)(00698)	Scammon-Stearns	Lincoln	$ 90,000
021(24002)(01242)	Scammon-Stearns	Lincoln	$ 90,000
021(91025)(01010)	Scammon-Stearns	Lincoln	$ 90,000
021(14001)(01340)	Scammon-Stearns	Lincoln	$ 90,000
341973	Unnamed	Lincoln	$ 72,000

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Culvert ID	Stream Name	Management Unit	Estimated Culvert Replacement Cost
021(23000)(00460)	Unnamed	Lincoln	$ 72,000
125 1505W11A	Unnamed	Lincoln	$ 80,000
125 1505W11B	Unnamed	Lincoln	$ 90,000
125 1405W24A	Unnamed	Lincoln	$ 90,000
125 1504W21A	Unnamed	Lincoln	$ 65,000
125 1707W13A	Unnamed	Lincoln	$ 90,000
125 1707W14A	Unnamed	Lincoln	$ 90,000
021(94006)(01315)	Allen Creek	Newaukum	$ 90,000
125 1301E23B	Lost Cr	Newaukum	$ 59,000
125 1301E10B	MF Newaukum River	Newaukum	$ 72,000
125 1302W12E	Newaukum, Lower NF	Newaukum	$ 53,000
125 1302W12A	Newaukum, Lower NF	Newaukum	$ 53,000
125 1402W34B	Newaukum, Lower NF	Newaukum	$ 53,000
125 1402W28A	Newaukum, Lower NF	Newaukum	$ 53,000
125 1302W12B	Newaukum, Lower NF	Newaukum	$ 53,000
995539	Newaukum, Lower NF	Newaukum	$ 47,000
021(15051)(01999)	Newaukum, Lower NF	Newaukum	$ 47,000
021(15080)(00490)	Newaukum, Lower NF	Newaukum	$ 41,000
021(15082)(00259)	Newaukum, Lower NF	Newaukum	$ 41,000
021(40046)(00032)	Newaukum, Lower NF	Newaukum	$ 47,000
021(40051)(01242)	Newaukum, Lower NF	Newaukum	$ 47,000
021(40077)(00103)	Newaukum, Lower NF	Newaukum	$ 47,000
021(91005)(02938)	Newaukum, Lower NF	Newaukum	$ 47,000
125 1302W23A	Newaukum, Lower NF	Newaukum	$ 47,000
021(15781)(00325)	Newaukum, Lower NF	Newaukum	$ 47,000
021(17121)(00400)	Newaukum, Lower NF	Newaukum	$ 59,000
021(15051)(04407)	Newaukum, Lower NF	Newaukum	$ 65,000
021(15080)(01316)	Newaukum, Lower NF	Newaukum	$ 72,000
125 1301W04A	Newaukum, Lower NF	Newaukum	$ 72,000
021(15051)(03086)	Newaukum, Lower NF	Newaukum	$ 87,000
021(15051)(04436)	Newaukum, Lower NF	Newaukum	$ 90,000
021(40017)(02135)	Newaukum, Lower NF	Newaukum	$ 90,000
021(40077)(01126)	Newaukum, Lower NF	Newaukum	$ 90,000
125 1302W12C	Newaukum, Lower NF	Newaukum	$ 90,000
994286	Newaukum, Lower NF	Newaukum	$ 90,000
021(40031)(00620)	Newaukum, Lower NF	Newaukum	$ 90,000
021(40051)(01588)	Newaukum, Lower NF	Newaukum	$ 90,000
021(94006)(01315)	Newaukum, Lower NF	Newaukum	$ 90,000
021(40028)(02366)	Newaukum, Lower NF	Newaukum	$ 90,000
021(40106)(00918)	Newaukum, MF	Newaukum	$ 41,000
021(96001)(16720)	Newaukum, MF	Newaukum	$ 65,000
125 1301W23A	Newaukum, MF	Newaukum	$ 65,000

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Culvert ID	Stream Name	Management Unit	Estimated Culvert Replacement Cost
125 1301W22B	Newaukum, MF	Newaukum	$ 87,000
021(94001)(15790)	Newaukum, MF	Newaukum	$ 90,000
125 1301W26A	Newaukum, MF	Newaukum	$ 90,000
021(40106)(00558)	Newaukum, MF	Newaukum	$ 90,000
021(45011)(07070)	Newaukum, MF	Newaukum	$ 90,000
125 1301E18A	Newaukum, MF	Newaukum	$ 90,000
125 1301E34A	Newaukum, MF	Newaukum	$ 90,000
125 1301W23D	Newaukum, MF	Newaukum	$ 90,000
021(40031)(01647)	Newaukum, Upper NF	Newaukum	$ 41,000
021(64022)(00529)	Newaukum, Upper NF	Newaukum	$ 41,000
021(46005)(04239)	Newaukum, Upper NF	Newaukum	$ 65,000
021(46004)(00077)	Newaukum, Upper NF	Newaukum	$ 90,000
021(46005)(04386)	Newaukum, Upper NF	Newaukum	$ 90,000
021(66430)(00541)	Newaukum, Upper NF	Newaukum	$ 90,000
021(46005)(05173)	Newaukum, Upper NF	Newaukum	$ 90,000
021(46005)(03006)	Newaukum, Upper NF	Newaukum	$ 90,000
125 1301E23A	Unnamed	Newaukum	$ 53,000
125 1402W24B	Unnamed	Newaukum	$ 65,000
125 1402W24A	Unnamed	Newaukum	$ 65,000
125 1501W33A	Hanaford	Skookumchuck	$ 31,000
125 1502W27A	Hanaford	Skookumchuck	$ 31,000
125 1401W16A	Hanaford	Skookumchuck	$ 65,000
125 1501W27B	Hanaford	Skookumchuck	$ 65,000
125 1502W27B	Hanaford	Skookumchuck	$ 80,000
125 1401W17A	Hanaford	Skookumchuck	$ 90,000
125 1501W26A	Hanaford	Skookumchuck	$ 90,000
125 1402W01A	Hanaford	Skookumchuck	$ 90,000
125 1501W33B	Hanaford	Skookumchuck	$ 90,000
125 1501W33C	Hanaford	Skookumchuck	$ 90,000
125 1502W26A	Hanaford	Skookumchuck	$ 90,000
125 1501W27D	Hanaford	Skookumchuck	$ 90,000
125 1401W03A	Hanaford	Skookumchuck	$ 65,000
125 1402W08A	Hanaford	Skookumchuck	$ 72,000
125 1401W03B	Hanaford	Skookumchuck	$ 90,000
125 1401W10A	Hanaford	Skookumchuck	$ 31,000
021(16990)(00052)	Hanaford	Skookumchuck	$ 53,000
021(17151)(07924)	Hanaford	Skookumchuck	$ 53,000
021(17190)(01308)	Hanaford	Skookumchuck	$ 53,000
021(91019)(06725)	Hanaford	Skookumchuck	$ 53,000
021(17151)(07992)	Hanaford	Skookumchuck	$ 31,000
021(16990)(00016)	Hanaford	Skookumchuck	$ 53,000
021(17151)(05946)	Hanaford	Skookumchuck	$ 65,000

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Culvert ID	Stream Name	Management Unit	Estimated Culvert Replacement Cost
021(17151)(08005)	Hanaford	Skookumchuck	$ 65,000
994301	Hanaford	Skookumchuck	$ 90,000
021(91019)(05513)	Hanaford	Skookumchuck	$ 90,000
23.0720 0.25	Scatter Creek	Skookumchuck	$ 59,000
981727	Scatter Creek	Skookumchuck	$ 59,000
125 1502W21B	Skookumchuck, Lower	Skookumchuck	$ 31,000
125 1502W32B	Skookumchuck, Lower	Skookumchuck	$ 80,000
125 1502W15C	Skookumchuck, Lower	Skookumchuck	$ 80,000
125 1501W06C	Skookumchuck, Lower	Skookumchuck	$ 65,000
125 1501W05B	Skookumchuck, Lower	Skookumchuck	$ 90,000
125 1502W02A	Skookumchuck, Lower	Skookumchuck	$ 80,000
343717	Skookumchuck, Lower	Skookumchuck	$ 90,000
340868	Skookumchuck, Lower	Skookumchuck	$ 90,000
340733	Skookumchuck, Lower	Skookumchuck	$ 72,000
343112	Skookumchuck, Lower	Skookumchuck	$ 90,000
125 1502W11B	Skookumchuck, Lower	Skookumchuck	$ 80,000
991040	Skookumchuck, Lower	Skookumchuck	$ 53,000
996468	Skookumchuck, Lower	Skookumchuck	$ 80,000
021(91011)(00487)	Skookumchuck, Lower	Skookumchuck	$ 80,000
341468	Skookumchuck, Lower	Skookumchuck	$ 90,000
996469	Skookumchuck, Lower	Skookumchuck	$ 90,000

Line	Item	Unit	Quantity	Unit Cost	Cost
1.00	**BL-1**				
1.01	Riparian Revegetation	Acre	0	$ 21,000	$ -
1.02	Invasive Species Removal	Acre	0	$ 9,000	$ -
1.03	Land Acquisition/Easement	Acre	200	$ 10,000	$ 200,000
1.04	Mobilization, including demobilization (8%)	LS	0	$ 16,000	$ -
2.00	**SUMMARY**				
2.01	Subtotal				$ 200,000
2.02	Lewis County sales tax (7.8%)				$ 15,600
2.03	Engineering, Permitting, Administraton (20%)				$ 40,000
2.04	Contingencies (30%)				$ 60,000
2.05	**Project Total**				**$ 315,600**

Line	Item	Unit	Quantity	Unit Cost	Cost
1.00	**BF-4**				
1.01	Riparian Revegetation	Acre	196	$ 21,000	$ 4,109,700
1.02	Invasive Species Removal	Acre	91	$ 9,000	$ 814,500
1.03	Land Acquisition/Easement	Acre	196	$ 10,000	$ 1,957,000
1.04	Mobilization, including demobilization (8%)	LS	1	$ 550,496	$ 550,496
2.00	**SUMMARY**				
2.01	Subtotal				$ 7,431,696
2.02	Lewis County sales tax (7.8%)				$ 579,672
2.03	Engineering, Permitting, Administraton (20%)				$ 1,486,339
2.04	Contingencies (30%)				$ 2,229,509
2.05	**Project Total**				**$ 11,727,216**

Line	Item	Unit	Quantity	Unit Cost	Cost
1.00	**BF-5**				
1.01	Riparian Revegetation	Acre	6	$ 21,000	$ 128,100
1.02	Land Acquisition/Easement	Acre	6	$ 10,000	$ 61,000
1.03	Mobilization, including demobilization (8%)	LS	1	$ 15,128	$ 15,128
2.00	**SUMMARY**				
2.01	Subtotal				$ 204,228
2.02	Lewis County sales tax (7.8%)				$ 15,930
2.03	Engineering, Permitting, Administraton (20%)				$ 40,846
2.04	Contingencies (30%)				$ 61,268
2.05	**Project Total**				**$ 322,272**

Line	Item	Unit	Quantity	Unit Cost	Cost
1.00	**BF-6**				
1.01	Riparian Revegetation	Acre	0	$ 21,000	$ -
1.02	Land Acquisition/Easement	Acre	200	$ 10,000	$ 200,000
1.03	Mobilization, including demobilization (8%)	LS	0	$ 16,000	$ -
2.00	**SUMMARY**				
2.01	Subtotal				$ 200,000
2.02	Lewis County sales tax (7.8%)				$ 15,600
2.03	Engineering, Permitting, Administraton (20%)				$ 40,000
2.04	Contingencies (30%)				$ 60,000
2.05	**Project Total**				**$ 315,600**

Line	Item	Unit	Quantity	Unit Cost	Cost
1.00	**CH-1**				
1.01	Riparian Revegetation	Acre	389	$ 21,000	$ 8,169,900
1.02	Invasive Species Removal	Acre	195	$ 9,000	$ 1,750,700
1.03	Land Acquisition/Easement	Acre	389	$ 20,000	$ 7,780,800
1.04	Mobilization, including demobilization (8%)	LS	1	$ 1,416,112	$ 1,416,112
2.00	**SUMMARY**				
2.01	Subtotal				$ 19,117,512
2.02	Lewis County sales tax (7.8%)				$ 1,491,166
2.03	Engineering, Permitting, Administraton (20%)				$ 3,823,502
2.04	Contingencies (30%)				$ 5,735,254
2.05	**Project Total**				**$ 30,167,434**

Line	Item	Unit	Quantity	Unit Cost	Cost
1.00	**CH-6**				
1.01	Earthwork	CY	370	$ 8	$ 3,000
1.02	Engineered Log Jams	EA	2	$ 40,000	$ 80,000
1.03	Large Woody Debris	EA	1	$ 1,000	$ 1,000
1.04	Riparian Revegetation	Acre	74	$ 21,000	$ 1,547,700
1.05	Invasive Species Removal	Acre	19	$ 9,000	$ 171,000
1.06	Land Acquisition/Easement	Acre	74	$ 10,000	$ 737,000
1.07	TESC & Care and diversion of water (1%)	LS	1	$ 25,400	$ 25,400
1.08	Mobilization, including demobilization (8%)	LS	1	$ 205,208	$ 205,208
2.00	**SUMMARY**				
2.01	Subtotal				$ 2,770,308
2.02	Lewis County sales tax (7.8%)				$ 216,084
2.03	Engineering, Permitting, Administraton (20%)				$ 554,062
2.04	Contingencies (30%)				$ 831,092
2.05	**Project Total**				**$ 4,371,546**

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Line	Item	Unit	Quantity	Unit Cost	Cost
1.00	**CH-7**				
1.01	Earthwork	CY	1,620	$ 8	$ 13,000
1.02	Riparian Revegetation	Acre	12	$ 21,000	$ 248,600
1.03	Invasive Species Removal	Acre	19	$ 9,000	$ 171,000
1.04	Land Acquisition/Easement	Acre	12	$ 10,000	$ 118,400
1.05	TESC & Care and diversion of water (1%)	LS	1	$ 5,510	$ 5,510
1.06	Mobilization, including demobilization (8%)	LS	1	$ 44,521	$ 44,521
2.00	**SUMMARY**				
2.01	Subtotal				$ 601,031
2.02	Lewis County sales tax (7.8%)				$ 46,880
2.03	Engineering, Permitting, Administraton (20%)				$ 120,206
2.04	Contingencies (30%)				$ 180,309
2.05	**Project Total**				**$ 948,427**

Line	Item	Unit	Quantity	Unit Cost	Cost
1.00	**CH-8**				
1.01	Earthwork	CY	3,971	$ 8	$ 31,800
1.02	Engineered Log Jams	EA	2	$ 40,000	$ 80,000
1.03	Large Woody Debris	EA	18	$ 1,000	$ 18,000
1.04	Riparian Revegetation	Acre	8	$ 21,000	$ 163,400
1.05	Invasive Species Removal	Acre	4	$ 9,000	$ 35,000
1.06	Land Acquisition/Easement	Acre	8	$ 10,000	$ 77,800
1.07	TESC & Care and diversion of water (1%)	LS	1	$ 4,060	$ 4,060
1.08	Mobilization, including demobilization (8%)	LS	1	$ 32,805	$ 32,805
2.00	**SUMMARY**				
2.01	Subtotal				$ 442,865
2.02	Lewis County sales tax (7.8%)				$ 34,543
2.03	Engineering, Permitting, Administraton (20%)				$ 88,573
2.04	Contingencies (30%)				$ 132,859
2.05	**Project Total**				**$ 698,841**

Line	Item	Unit	Quantity	Unit Cost	Cost
1.00	**CH-9**				
1.01	Earthwork	CY	9,583	$ 8	$ 76,700
1.02	Engineered Log Jams	EA	2	$ 40,000	$ 80,000
1.03	Large Woody Debris	EA	35	$ 1,000	$ 35,000
1.04	Riparian Revegetation	Acre	79	$ 21,000	$ 1,659,000
1.05	Land Acquisition/Easement	Acre	79	$ 10,000	$ 790,000
1.06	Bridge	EA	4	$ 180,000	$ 720,000
1.07	TESC & Care and diversion of water (1%)	LS	1	$ 33,610	$ 33,610
1.08	Mobilization, including demobilization (8%)	LS	1	$ 271,545	$ 271,545
2.00	**SUMMARY**				
2.01	Subtotal				$ 3,665,855
2.02	Lewis County sales tax (7.8%)				$ 285,937
2.03	Engineering, Permitting, Administraton (20%)				$ 733,171
2.04	Contingencies (30%)				$ 1,099,756
2.05	**Project Total**				**$ 5,784,719**

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Line	Item	Unit	Quantity	Unit Cost	Cost
1.00	**CH-10**				
1.01	Earthwork	CY	31,856	$ 8	$ 254,900
1.02	Engineered Log Jams	EA	7	$ 40,000	$ 280,000
1.03	Large Woody Debris	EA	77	$ 1,000	$ 77,000
1.04	Riparian Revegetation	Acre	35	$ 21,000	$ 730,100
1.05	Invasive Species Removal	Acre	17	$ 9,000	$ 156,500
1.06	Land Acquisition/Easement	Acre	35	$ 10,000	$ 347,700
1.07	TESC & Care and diversion of water (1%)	LS	1	$ 18,470	$ 18,470
1.08	Mobilization, including demobilization (8%)	LS	1	$ 149,174	$ 149,174
2.00	**SUMMARY**				
2.01	Subtotal				$ 2,013,844
2.02	Lewis County sales tax (7.8%)				$ 157,080
2.03	Engineering, Permitting, Administraton (20%)				$ 402,769
2.04	Contingencies (30%)				$ 604,153
2.05	**Project Total**				**$ 3,177,845**

Line	Item	Unit	Quantity	Unit Cost	Cost
1.00	**CH-11**				
1.01	Earthwork	CY	19,087	$ 8	$ 152,700
1.02	Engineered Log Jams	EA	6	$ 40,000	$ 240,000
1.03	Large Woody Debris	EA	44	$ 1,000	$ 44,000
1.04	Riparian Revegetation	Acre	20	$ 21,000	$ 417,100
1.05	Invasive Species Removal	Acre	10	$ 9,000	$ 89,400
1.06	Land Acquisition/Easement	Acre	20	$ 10,000	$ 198,700
1.07	TESC & Care and diversion of water (1%)	LS	1	$ 11,420	$ 11,420
1.08	Mobilization, including demobilization (8%)	LS	1	$ 92,266	$ 92,266
2.00	**SUMMARY**				
2.01	Subtotal				$ 1,245,586
2.02	Lewis County sales tax (7.8%)				$ 97,156
2.03	Engineering, Permitting, Administraton (20%)				$ 249,117
2.04	Contingencies (30%)				$ 373,676
2.05	**Project Total**				**$ 1,965,534**

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Line	Item	Unit	Quantity	Unit Cost	Cost
1.00	**CH-12**				
1.01	Earthwork	CY	8,759	$ 8	$ 70,100
1.02	Engineered Log Jams	EA	4	$ 40,000	$ 160,000
1.03	Large Woody Debris	EA	22	$ 1,000	$ 22,000
1.04	Riparian Revegetation	Acre	84	$ 21,000	$ 1,766,500
1.05	Invasive Species Removal	Acre	42	$ 9,000	$ 378,600
1.06	Land Acquisition/Easement	Acre	84	$ 10,000	$ 841,200
1.07	TESC & Care and diversion of water (1%)	LS	1	$ 32,390	$ 32,390
1.08	Mobilization, including demobilization (8%)	LS	1	$ 261,663	$ 261,663
2.00	**SUMMARY**				
2.01	Subtotal				$ 3,532,453
2.02	Lewis County sales tax (7.8%)				$ 275,531
2.03	Engineering, Permitting, Administraton (20%)				$ 706,491
2.04	Contingencies (30%)				$ 1,059,736
2.05	**Project Total**				**$ 5,574,211**

Line	Item	Unit	Quantity	Unit Cost	Cost
1.00	**CH-13**				
1.01	Earthwork	CY	53,489	$ 8	$ 428,000
1.02	Engineered Log Jams	EA	4	$ 40,000	$ 160,000
1.03	Large Woody Debris	EA	107	$ 1,000	$ 107,000
1.04	Riparian Revegetation	Acre	48	$ 21,000	$ 1,015,100
1.05	Invasive Species Removal	Acre	24	$ 9,000	$ 217,600
1.06	Land Acquisition/Easement	Acre	48	$ 10,000	$ 483,400
1.07	TESC & Care and diversion of water (1%)	LS	1	$ 24,120	$ 24,120
1.08	Mobilization, including demobilization (8%)	LS	1	$ 194,818	$ 194,818
2.00	**SUMMARY**				
2.01	Subtotal				$ 2,630,038
2.02	Lewis County sales tax (7.8%)				$ 205,143
2.03	Engineering, Permitting, Administraton (20%)				$ 526,008
2.04	Contingencies (30%)				$ 789,011
2.05	**Project Total**				**$ 4,150,199**

Line	Item	Unit	Quantity	Unit Cost	Cost
1.00	**CH-14**				
1.01	Earthwork	CY	11,760	$ 8	$ 94,100
1.02	Engineered Log Jams	EA	3	$ 40,000	$ 120,000
1.03	Large Woody Debris	EA	36	$ 1,000	$ 36,000
1.04	Riparian Revegetation	Acre	16	$ 21,000	$ 337,700
1.05	Invasive Species Removal	Acre	8	$ 9,000	$ 72,400
1.06	Land Acquisition/Easement	Acre	16	$ 10,000	$ 160,800
1.07	TESC & Care and diversion of water (1%)	LS	1	$ 8,210	$ 8,210
1.08	Mobilization, including demobilization (8%)	LS	1	$ 66,337	$ 66,337
2.00	**SUMMARY**				
2.01	Subtotal				$ 895,547
2.02	Lewis County sales tax (7.8%)				$ 69,853
2.03	Engineering, Permitting, Administraton (20%)				$ 179,109
2.04	Contingencies (30%)				$ 268,664
2.05	**Project Total**				**$ 1,413,173**

Line	Item	Unit	Quantity	Unit Cost	Cost
1.00	**CH-15**				
1.01	Earthwork	CY	12,592	$ 8	$ 100,800
1.02	Engineered Log Jams	EA	3	$ 40,000	$ 120,000
1.03	Large Woody Debris	EA	37	$ 1,000	$ 37,000
1.04	Riparian Revegetation	Acre	27	$ 21,000	$ 576,700
1.05	Invasive Species Removal	Acre	14	$ 9,000	$ 123,600
1.06	Land Acquisition/Easement	Acre	27	$ 10,000	$ 274,600
1.07	TESC & Care and diversion of water (1%)	LS	1	$ 12,330	$ 12,330
1.08	Mobilization, including demobilization (8%)	LS	1	$ 99,602	$ 99,602
2.00	**SUMMARY**				
2.01	Subtotal				$ 1,344,632
2.02	Lewis County sales tax (7.8%)				$ 104,881
2.03	Engineering, Permitting, Administraton (20%)				$ 268,926
2.04	Contingencies (30%)				$ 403,390
2.05	**Project Total**				**$ 2,121,830**

Line	Item	Unit	Quantity	Unit Cost	Cost
1.00	**CH-16**				
1.01	Earthwork	CY	15,911	$ 8	$ 127,300
1.02	Engineered Log Jams	EA	4	$ 40,000	$ 160,000
1.03	Large Woody Debris	EA	42	$ 1,000	$ 42,000
1.04	Riparian Revegetation	Acre	25	$ 21,000	$ 521,100
1.05	Invasive Species Removal	Acre	12	$ 9,000	$ 111,700
1.06	Land Acquisition/Easement	Acre	25	$ 10,000	$ 248,200
1.07	TESC & Care and diversion of water (1%)	LS	1	$ 12,110	$ 12,110
1.08	Mobilization, including demobilization (8%)	LS	1	$ 97,793	$ 97,793
2.00	**SUMMARY**				
2.01	Subtotal				$ 1,320,203
2.02	Lewis County sales tax (7.8%)				$ 102,976
2.03	Engineering, Permitting, Administraton (20%)				$ 264,041
2.04	Contingencies (30%)				$ 396,061
2.05	**Project Total**				**$ 2,083,280**

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Line	Item	Unit	Quantity	Unit Cost	Cost
1.00	**CH-17**				
1.01	Earthwork	CY	29,082	$ 8	$ 232,700
1.02	Engineered Log Jams	EA	3	$ 40,000	$ 120,000
1.03	Large Woody Debris	EA	60	$ 1,000	$ 60,000
1.04	Riparian Revegetation	Acre	27	$ 21,000	$ 573,500
1.05	Invasive Species Removal	Acre	14	$ 9,000	$ 122,900
1.06	Land Acquisition/Easement	Acre	27	$ 10,000	$ 273,100
1.07	TESC & Care and diversion of water (1%)	LS	1	$ 13,830	$ 13,830
1.08	Mobilization, including demobilization (8%)	LS	1	$ 111,682	$ 111,682
2.00	**SUMMARY**				
2.01	Subtotal				$ 1,507,712
2.02	Lewis County sales tax (7.8%)				$ 117,602
2.03	Engineering, Permitting, Administraton (20%)				$ 301,542
2.04	Contingencies (30%)				$ 452,314
2.05	**Project Total**				**$ 2,379,170**

Line	Item	Unit	Quantity	Unit Cost	Cost
1.00	**CH-17a**				
1.01	Earthwork	CY	4,278	$ 8	$ 34,300
1.02	Engineered Log Jams	EA	2	$ 40,000	$ 80,000
1.03	Large Woody Debris	EA	10	$ 1,000	$ 10,000
1.04	Riparian Revegetation	Acre	9	$ 21,000	$ 192,400
1.05	Invasive Species Removal	Acre	5	$ 9,000	$ 41,300
1.06	Land Acquisition/Easement	Acre	9	$ 10,000	$ 91,600
1.07	TESC & Care and diversion of water (1%)	LS	1	$ 4,500	$ 4,500
1.08	Mobilization, including demobilization (8%)	LS	1	$ 36,328	$ 36,328
2.00	**SUMMARY**				
2.01	Subtotal				$ 490,428
2.02	Lewis County sales tax (7.8%)				$ 38,253
2.03	Engineering, Permitting, Administraton (20%)				$ 98,086
2.04	Contingencies (30%)				$ 147,128
2.05	**Project Total**				**$ 773,895**

Line	Item	Unit	Quantity	Unit Cost	Cost
1.00	**CH-18**				
1.01	Earthwork	CY	9,055	$ 8	$ 72,500
1.02	Engineered Log Jams	EA	2	$ 40,000	$ 80,000
1.03	Large Woody Debris	EA	13	$ 1,000	$ 13,000
1.04	Riparian Revegetation	Acre	6	$ 21,000	$ 116,600
1.05	Invasive Species Removal	Acre	3	$ 9,000	$ 25,000
1.06	Land Acquisition/Easement	Acre	6	$ 10,000	$ 55,600
1.07	TESC & Care and diversion of water (1%)	LS	1	$ 3,630	$ 3,630
1.08	Mobilization, including demobilization (8%)	LS	1	$ 29,306	$ 29,306
2.00	**SUMMARY**				
2.01	Subtotal				$ 395,636
2.02	Lewis County sales tax (7.8%)				$ 30,860
2.03	Engineering, Permitting, Administraton (20%)				$ 79,127
2.04	Contingencies (30%)				$ 118,691
2.05	**Project Total**				**$ 624,314**

Line	Item	Unit	Quantity	Unit Cost	Cost
1.00	**CH-20**				
1.01	Earthwork	CY	1,000	$ 8	$ 8,000
1.02	Engineered Log Jams	EA	2	$ 40,000	$ 80,000
1.03	Large Woody Debris	EA	2	$ 1,000	$ 2,000
1.04	Riparian Revegetation	Acre	21	$ 21,000	$ 431,900
1.05	Invasive Species Removal	Acre	10	$ 9,000	$ 92,600
1.06	Land Acquisition/Easement	Acre	21	$ 10,000	$ 205,700
1.07	TESC & Care and diversion of water (1%)	LS	1	$ 8,210	$ 8,210
1.08	Mobilization, including demobilization (8%)	LS	1	$ 66,273	$ 66,273
2.00	**SUMMARY**				
2.01	Subtotal				$ 894,683
2.02	Lewis County sales tax (7.8%)				$ 69,785
2.03	Engineering, Permitting, Administraton (20%)				$ 178,937
2.04	Contingencies (30%)				$ 268,405
2.05	**Project Total**				**$ 1,411,809**

Line	Item	Unit	Quantity	Unit Cost	Cost
1.00	**CH-21**				
1.01	Earthwork	CY	3,773	$ 8	$ 30,200
1.02	Engineered Log Jams	EA	4	$ 40,000	$ 160,000
1.03	Large Woody Debris	EA	15	$ 1,000	$ 15,000
1.04	Riparian Revegetation	Acre	7	$ 21,000	$ 139,800
1.05	Invasive Species Removal	Acre	3	$ 9,000	$ 30,000
1.06	Land Acquisition/Easement	Acre	7	$ 10,000	$ 66,600
1.07	TESC & Care and diversion of water (1%)	LS	1	$ 4,420	$ 4,420
1.08	Mobilization, including demobilization (8%)	LS	1	$ 35,682	$ 35,682
2.00	**SUMMARY**				
2.01	Subtotal				$ 481,702
2.02	Lewis County sales tax (7.8%)				$ 37,573
2.03	Engineering, Permitting, Administraton (20%)				$ 96,340
2.04	Contingencies (30%)				$ 144,510
2.05	**Project Total**				**$ 760,125**

Line	Item	Unit	Quantity	Unit Cost	Cost
1.00	**CH-22**				
1.01	Earthwork	CY	6,110	$ 8	$ 48,900
1.02	Engineered Log Jams	EA	2	$ 40,000	$ 80,000
1.03	Large Woody Debris	EA	5	$ 1,000	$ 5,000
1.04	Riparian Revegetation	Acre	2	$ 21,000	$ 39,700
1.05	Invasive Species Removal	Acre	1	$ 9,000	$ 8,500
1.06	Land Acquisition/Easement	Acre	2	$ 10,000	$ 18,900
1.07	TESC & Care and diversion of water (1%)	LS	1	$ 2,010	$ 2,010
1.08	Mobilization, including demobilization (8%)	LS	1	$ 16,241	$ 16,241
2.00	**SUMMARY**				
2.01	Subtotal				$ 219,251
2.02	Lewis County sales tax (7.8%)				$ 17,102
2.03	Engineering, Permitting, Administraton (20%)				$ 43,850
2.04	Contingencies (30%)				$ 65,775
2.05	**Project Total**				**$ 345,978**

Line	Item	Unit	Quantity	Unit Cost	Cost
1.00	**CH-23**				
1.01	Earthwork	CY	5,427	$ 8	$ 43,500
1.02	Engineered Log Jams	EA	2	$ 40,000	$ 80,000
1.03	Large Woody Debris	EA	6	$ 1,000	$ 6,000
1.04	Riparian Revegetation	Acre	3	$ 21,000	$ 68,700
1.05	Invasive Species Removal	Acre	2	$ 9,000	$ 14,800
1.06	Land Acquisition/Easement	Acre	3	$ 10,000	$ 32,800
1.07	TESC & Care and diversion of water (1%)	LS	1	$ 2,460	$ 2,460
1.08	Mobilization, including demobilization (8%)	LS	1	$ 19,861	$ 19,861
2.00	**SUMMARY**				
2.01	Subtotal				$ 268,121
2.02	Lewis County sales tax (7.8%)				$ 20,913
2.03	Engineering, Permitting, Administraton (20%)				$ 53,624
2.04	Contingencies (30%)				$ 80,436
2.05	**Project Total**				**$ 423,095**

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Line	Item	Unit	Quantity	Unit Cost	Cost
1.00	**CH-24**				
1.01	Earthwork	CY	1,482	$ 8	$ 11,900
1.02	Engineered Log Jams	EA	2	$ 40,000	$ 80,000
1.03	Large Woody Debris	EA	4	$ 1,000	$ 4,000
1.04	Riparian Revegetation	Acre	18	$ 21,000	$ 378,700
1.05	Invasive Species Removal	Acre	9	$ 9,000	$ 81,200
1.06	Land Acquisition/Easement	Acre	18	$ 10,000	$ 180,300
1.07	TESC & Care and diversion of water (1%)	LS	1	$ 7,370	$ 7,370
1.08	Mobilization, including demobilization (8%)	LS	1	$ 59,478	$ 59,478
2.00	**SUMMARY**				
2.01	Subtotal				$ 802,948
2.02	Lewis County sales tax (7.8%)				$ 62,630
2.03	Engineering, Permitting, Administraton (20%)				$ 160,590
2.04	Contingencies (30%)				$ 240,884
2.05	**Project Total**				**$ 1,267,051**

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Line	Item	Unit	Quantity	Unit Cost	Cost
1.00	**CH-25**				
1.01	Earthwork	CY	9,245	$ 8	$ 74,000
1.02	Engineered Log Jams	EA	2	$ 40,000	$ 80,000
1.03	Large Woody Debris	EA	24	$ 1,000	$ 24,000
1.04	Riparian Revegetation	Acre	34	$ 21,000	$ 713,800
1.05	Invasive Species Removal	Acre	17	$ 9,000	$ 153,000
1.06	Land Acquisition/Easement	Acre	34	$ 10,000	$ 339,900
1.07	TESC & Care and diversion of water (1%)	LS	1	$ 13,850	$ 13,850
1.08	Mobilization, including demobilization (8%)	LS	1	$ 111,884	$ 111,884
2.00	**SUMMARY**				
2.01	Subtotal				$ 1,510,434
2.02	Lewis County sales tax (7.8%)				$ 117,814
2.03	Engineering, Permitting, Administraton (20%)				$ 302,087
2.04	Contingencies (30%)				$ 453,130
2.05	**Project Total**				**$ 2,383,465**

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Line	Item	Unit	Quantity	Unit Cost	Cost
1.00	**CH-26**				
1.01	Earthwork	CY	28,944	$ 8	$ 231,600
1.02	Engineered Log Jams	EA	4	$ 40,000	$ 160,000
1.03	Large Woody Debris	EA	36	$ 1,000	$ 36,000
1.04	Riparian Revegetation	Acre	16	$ 21,000	$ 339,000
1.05	Invasive Species Removal	Acre	8	$ 9,000	$ 72,700
1.06	Land Acquisition/Easement	Acre	16	$ 10,000	$ 161,500
1.07	TESC & Care and diversion of water (1%)	LS	1	$ 10,010	$ 10,010
1.08	Mobilization, including demobilization (8%)	LS	1	$ 80,865	$ 80,865
2.00	**SUMMARY**				
2.01	Subtotal				$ 1,091,675
2.02	Lewis County sales tax (7.8%)				$ 85,151
2.03	Engineering, Permitting, Administraton (20%)				$ 218,335
2.04	Contingencies (30%)				$ 327,502
2.05	**Project Total**				**$ 1,722,663**

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Line	Item	Unit	Quantity	Unit Cost	Cost
1.00	**SK-8a**				
1.01	Earthwork	CY	1,493	$ 8	$ 12,000
1.02	Engineered Log Jams	EA	2	$ 40,000	$ 80,000
1.03	Large Woody Debris	EA	3	$ 1,000	$ 3,000
1.04	Riparian Revegetation	Acre	1	$ 21,000	$ 26,700
1.05	Invasive Species Removal	Acre	1	$ 9,000	$ 5,800
1.06	Land Acquisition/Easement	Acre	1	$ 10,000	$ 12,700
1.07	TESC & Care and diversion of water (1%)	LS	1	$ 1,410	$ 1,410
1.08	Mobilization, including demobilization (8%)	LS	1	$ 11,329	$ 11,329
2.00	**SUMMARY**				
2.01	Subtotal				$ 152,939
2.02	Lewis County sales tax (7.8%)				$ 11,929
2.03	Engineering, Permitting, Administraton (20%)				$ 30,588
2.04	Contingencies (30%)				$ 45,882
2.05	**Project Total**				**$ 241,337**

Appendix C

Line	Item	Unit	Quantity	Unit Cost	Cost
1.00	**SK-8b**				
1.01	Earthwork	CY	2,003	$ 8	$ 16,100
1.02	Engineered Log Jams	EA	2	$ 40,000	$ 80,000
1.03	Large Woody Debris	EA	5	$ 1,000	$ 5,000
1.04	Riparian Revegetation	Acre	4	$ 21,000	$ 87,500
1.05	Invasive Species Removal	Acre	2	$ 9,000	$ 18,800
1.06	Land Acquisition/Easement	Acre	4	$ 10,000	$ 41,700
1.07	TESC & Care and diversion of water (1%)	LS	1	$ 2,500	$ 2,500
1.08	Mobilization, including demobilization (8%)	LS	1	$ 20,128	$ 20,128
2.00	**SUMMARY**				
2.01	Subtotal				$ 271,728
2.02	Lewis County sales tax (7.8%)				$ 21,195
2.03	Engineering, Permitting, Administraton (20%)				$ 54,346
2.04	Contingencies (30%)				$ 81,518
2.05	**Project Total**				**$ 428,787**

Appendix C

Line	Item	Unit	Quantity	Unit Cost	Cost
1.00	**SK-9**				
1.01	Earthwork	CY	1,909	$ 8	$ 15,300
1.02	Engineered Log Jams	EA	2	$ 40,000	$ 80,000
1.03	Large Woody Debris	EA	5	$ 1,000	$ 5,000
1.04	Riparian Revegetation	Acre	2	$ 21,000	$ 44,600
1.05	Invasive Species Removal	Acre	1	$ 9,000	$ 9,600
1.06	Land Acquisition/Easement	Acre	2	$ 10,000	$ 21,300
1.07	TESC & Care and diversion of water (1%)	LS	1	$ 1,760	$ 1,760
1.08	Mobilization, including demobilization (8%)	LS	1	$ 14,205	$ 14,205
2.00	**SUMMARY**				
2.01	Subtotal				$ 191,765
2.02	Lewis County sales tax (7.8%)				$ 14,958
2.03	Engineering, Permitting, Administraton (20%)				$ 38,353
2.04	Contingencies (30%)				$ 57,529
2.05	**Project Total**				**$ 302,605**

Appendix C

Line	Item	Unit	Quantity	Unit Cost	Cost
1.00	**SK-11**				
1.01	Earthwork	CY	3,874	$ 8	$ 31,000
1.02	Engineered Log Jams	EA	2	$ 40,000	$ 80,000
1.03	Large Woody Debris	EA	6	$ 1,000	$ 6,000
1.04	Riparian Revegetation	Acre	2	$ 21,000	$ 48,700
1.05	Invasive Species Removal	Acre	1	$ 9,000	$ 10,500
1.06	Land Acquisition/Easement	Acre	2	$ 10,000	$ 23,200
1.07	TESC & Care and diversion of water (1%)	LS	1	$ 2,000	$ 2,000
1.08	Mobilization, including demobilization (8%)	LS	1	$ 16,112	$ 16,112
2.00	**SUMMARY**				
2.01	Subtotal				$ 217,512
2.02	Lewis County sales tax (7.8%)				$ 16,966
2.03	Engineering, Permitting, Administraton (20%)				$ 43,502
2.04	Contingencies (30%)				$ 65,254
2.05	**Project Total**				**$ 343,234**

Appendix C

Line	Item	Unit	Quantity	Unit Cost	Cost
1.00	**SK-12**				
1.01	Earthwork	CY	2,668	$ 8	$ 21,400
1.02	Engineered Log Jams	EA	4	$ 40,000	$ 160,000
1.03	Large Woody Debris	EA	8	$ 1,000	$ 8,000
1.04	Riparian Revegetation	Acre	4	$ 21,000	$ 74,600
1.05	Invasive Species Removal	Acre	2	$ 9,000	$ 16,000
1.06	Land Acquisition/Easement	Acre	4	$ 10,000	$ 35,600
1.07	TESC & Care and diversion of water (1%)	LS	1	$ 3,160	$ 3,160
1.07	Mobilization, including demobilization (8%)	LS	1	$ 25,501	$ 25,501
2.00	**SUMMARY**				
2.01	Subtotal				$ 344,261
2.02	Lewis County sales tax (7.8%)				$ 26,852
2.03	Engineering, Permitting, Administraton (20%)				$ 68,852
2.04	Contingencies (30%)				$ 103,278
2.05	**Project Total**				**$ 543,244**

Appendix C

Line	Item	Unit	Quantity	Unit Cost	Cost
1.00	**SK-13**				
1.01	Earthwork	CY	4,030	$ 8	$ 32,300
1.02	Engineered Log Jams	EA	4	$ 40,000	$ 160,000
1.03	Large Woody Debris	EA	12	$ 1,000	$ 12,000
1.04	Riparian Revegetation	Acre	5	$ 21,000	$ 108,300
1.05	Invasive Species Removal	Acre	3	$ 9,000	$ 23,300
1.06	Land Acquisition/Easement	Acre	5	$ 10,000	$ 51,600
1.07	TESC & Care and diversion of water (1%)	LS	1	$ 3,880	$ 3,880
1.08	Mobilization, including demobilization (8%)	LS	1	$ 31,310	$ 31,310
2.00	**SUMMARY**				
2.01	Subtotal				$ 422,690
2.02	Lewis County sales tax (7.8%)				$ 32,970
2.03	Engineering, Permitting, Administraton (20%)				$ 84,538
2.04	Contingencies (30%)				$ 126,807
2.05	**Project Total**				**$ 667,005**

Appendix C

Line	Item	Unit	Quantity	Unit Cost	Cost
1.00	**SK-14**				
1.01	Earthwork	CY	2,927	$ 8	$ 23,500
1.02	Engineered Log Jams	EA	2	$ 40,000	$ 80,000
1.03	Large Woody Debris	EA	6	$ 1,000	$ 6,000
1.04	Riparian Revegetation	Acre	3	$ 21,000	$ 54,300
1.05	Invasive Species Removal	Acre	1	$ 9,000	$ 11,700
1.06	Land Acquisition/Easement	Acre	3	$ 10,000	$ 25,900
1.07	TESC & Care and diversion of water (1%)	LS	1	$ 2,020	$ 2,020
1.08	Mobilization, including demobilization (8%)	LS	1	$ 16,274	$ 16,274
2.00	**SUMMARY**				
2.01	Subtotal				$ 219,694
2.02	Lewis County sales tax (7.8%)				$ 17,136
2.03	Engineering, Permitting, Administraton (20%)				$ 43,939
2.04	Contingencies (30%)				$ 65,908
2.05	**Project Total**				**$ 346,677**

Appendix C

Line	Item	Unit	Quantity	Unit Cost	Cost
1.00	**SK-15**				
1.01	Earthwork	CY	2,079	$ 8	$ 16,700
1.02	Engineered Log Jams	EA	2	$ 40,000	$ 80,000
1.03	Large Woody Debris	EA	5	$ 1,000	$ 5,000
1.04	Riparian Revegetation	Acre	2	$ 21,000	$ 47,100
1.05	Invasive Species Removal	Acre	1	$ 9,000	$ 10,100
1.06	Land Acquisition/Easement	Acre	2	$ 10,000	$ 22,400
1.07	TESC & Care and diversion of water (1%)	LS	1	$ 1,820	$ 1,820
1.08	Mobilization, including demobilization (8%)	LS	1	$ 14,650	$ 14,650
2.00	**SUMMARY**				
2.01	Subtotal				$ 197,770
2.02	Lewis County sales tax (7.8%)				$ 15,426
2.03	Engineering, Permitting, Administraton (20%)				$ 39,554
2.04	Contingencies (30%)				$ 59,331
2.05	**Project Total**				**$ 312,080**

Appendix C

Line	Item	Unit	Quantity	Unit Cost	Cost
1.00	**NE-8**				
1.01	Earthwork	CY	2,153	$ 8	$ 17,300
1.02	Engineered Log Jams	EA	2	$ 40,000	$ 80,000
1.03	Large Woody Debris	EA	8	$ 1,000	$ 8,000
1.04	Riparian Revegetation	Acre	22	$ 21,000	$ 451,500
1.05	Land Acquisition/Easement	Acre	22	$ 10,000	$ 215,000
1.06	TESC & Care and diversion of water (1%)	LS	1	$ 7,720	$ 7,720
1.07	Mobilization, including demobilization (8%)	LS	1	$ 62,362	$ 62,362
2.00	**SUMMARY**				
2.01	Subtotal				$ 841,882
2.02	Lewis County sales tax (7.8%)				$ 65,667
2.03	Engineering, Permitting, Administraton (20%)				$ 168,376
2.04	Contingencies (30%)				$ 252,564
2.05	**Project Total**				**$ 1,328,489**

Appendix C

Line	Item	Unit	Quantity	Unit Cost	Cost
1.00	**NE-9**				
1.01	Riparian Revegetation	Acre	347	$ 21,000	$ 7,287,000
1.02	Invasive Species Removal	Acre	179	$ 9,000	$ 1,612,800
1.03	Land Acquisition/Easement	Acre	347	$ 10,000	$ 3,470,000
1.04	Mobilization, including demobilization (8%)	LS	1	$ 989,584	$ 989,584
2.00	**SUMMARY**				
2.01	Subtotal				$ 13,359,384
2.02	Lewis County sales tax (7.8%)				$ 1,042,032
2.03	Engineering, Permitting, Administraton (20%)				$ 2,671,877
2.04	Contingencies (30%)				$ 4,007,815
2.05	**Project Total**				**$ 21,081,108**

Appendix C

Line	Item	Unit	Quantity	Unit Cost	Cost
1.00	**NE-10a**				
1.01	Earthwork	CY	10,312	$ 8	$ 82,500
1.02	Engineered Log Jams	EA	2	$ 40,000	$ 80,000
1.03	Large Woody Debris	EA	5	$ 1,000	$ 5,000
1.04	Riparian Revegetation	Acre	27	$ 21,000	$ 569,100
1.05	Invasive Species Removal	Acre	6	$ 9,000	$ 49,500
1.06	Land Acquisition/Easement	Acre	27	$ 10,000	$ 271,000
1.07	Bridge	EA	1	$ 180,000	$ 180,000
1.08	TESC & Care and diversion of water (1%)	LS	1	$ 12,380	$ 12,380
1.09	Mobilization, including demobilization (8%)	LS	1	$ 99,958	$ 99,958
2.00	**SUMMARY**				
2.01	Subtotal				$ 1,349,438
2.02	Lewis County sales tax (7.8%)				$ 105,256
2.03	Engineering, Permitting, Administraton (20%)				$ 269,888
2.04	Contingencies (30%)				$ 404,832
2.05	**Project Total**				**$ 2,129,414**

Appendix C

Line	Item	Unit	Quantity	Unit Cost	Cost
1.00	**NE-10b**				
1.01	Large Woody Debris	EA	9	$ 1,000	$ 9,000
1.02	Riparian Revegetation	Acre	11	$ 21,000	$ 237,300
1.03	Invasive Species Removal	Acre	3	$ 9,000	$ 22,500
1.04	Land Acquisition/Easement	Acre	11	$ 10,000	$ 113,000
1.05	TESC & Care and diversion of water (1%)	LS	1	$ 3,820	$ 3,820
1.06	Mobilization, including demobilization (8%)	LS	1	$ 30,850	$ 30,850
2.00	**SUMMARY**				
2.01	Subtotal				$ 416,470
2.02	Lewis County sales tax (7.8%)				$ 32,485
2.03	Engineering, Permitting, Administraton (20%)				$ 83,294
2.04	Contingencies (30%)				$ 124,941
2.05	**Project Total**				**$ 657,189**

Appendix C

Line	Item	Unit	Quantity	Unit Cost	Cost
1.00	**NE-10c**				
1.01	Earthwork	CY	44,499	$ 8	$ 356,000
1.02	Engineered Log Jams	EA	2	$ 40,000	$ 80,000
1.03	Large Woody Debris	EA	7	$ 1,000	$ 7,000
1.04	Riparian Revegetation	Acre	59	$ 21,000	$ 1,247,400
1.05	Land Acquisition/Easement	Acre	59	$ 10,000	$ 594,000
1.06	Levee	CY	20,370	$ 20	$ 407,500
1.07	TESC & Care and diversion of water (1%)	LS	1	$ 26,920	$ 26,920
1.08	Mobilization, including demobilization (8%)	LS	1	$ 217,506	$ 217,506
2.00	**SUMMARY**				
2.01	Subtotal				$ 2,936,326
2.02	Lewis County sales tax (7.8%)				$ 229,033
2.03	Engineering, Permitting, Administraton (20%)				$ 587,265
2.04	Contingencies (30%)				$ 880,898
2.05	**Project Total**				**$ 4,633,522**

Appendix C

Line	Item	Unit	Quantity	Unit Cost	Cost
1.00	**NE-10d**				
1.01	Earthwork	CY	6,215	$ 8	$ 49,800
1.02	Engineered Log Jams	EA	2	$ 40,000	$ 80,000
1.03	Large Woody Debris	EA	12	$ 1,000	$ 12,000
1.04	Riparian Revegetation	Acre	16	$ 21,000	$ 329,700
1.05	Land Acquisition/Easement	Acre	16	$ 10,000	$ 157,000
1.06	TESC & Care and diversion of water (1%)	LS	1	$ 6,290	$ 6,290
1.07	Mobilization, including demobilization (8%)	LS	1	$ 50,783	$ 50,783
2.00	**SUMMARY**				
2.01	Subtotal				$ 685,573
2.02	Lewis County sales tax (7.8%)				$ 53,475
2.03	Engineering, Permitting, Administraton (20%)				$ 137,115
2.04	Contingencies (30%)				$ 205,672
2.05	**Project Total**				**$ 1,081,835**

Appendix C

Line	Item	Unit	Quantity	Unit Cost	Cost
1.00	**NE-10e**				
1.01	Earthwork	CY	2,315	$ 8	$ 18,600
1.02	Large Woody Debris	EA	9	$ 1,000	$ 9,000
1.03	Riparian Revegetation	Acre	15	$ 21,000	$ 323,400
1.04	Land Acquisition/Easement	Acre	15	$ 10,000	$ 154,000
1.05	TESC & Care and diversion of water (1%)	LS	1	$ 5,050	$ 5,050
1.06	Mobilization, including demobilization (8%)	LS	1	$ 40,804	$ 40,804
2.00	**SUMMARY**				
2.01	Subtotal				$ 550,854
2.02	Lewis County sales tax (7.8%)				$ 42,967
2.03	Engineering, Permitting, Administraton (20%)				$ 110,171
2.04	Contingencies (30%)				$ 165,256
2.05	**Project Total**				**$ 869,248**

Appendix C

Line	Item	Unit	Quantity	Unit Cost	Cost
1.00	**NE-15**				
1.01	Engineered Log Jams	EA	1	$ 40,000	$ 40,000
1.02	Riparian Revegetation	Acre	6	$ 21,000	$ 117,600
1.03	Invasive Species Removal	Acre	2	$ 9,000	$ 16,200
1.04	Land Acquisition/Easement	Acre	6	$ 10,000	$ 56,000
1.05	TESC & Care and diversion of water (1%)	LS	1	$ 2,300	$ 2,300
1.06	Mobilization, including demobilization (8%)	LS	1	$ 18,568	$ 18,568
2.00	**SUMMARY**				
2.01	Subtotal				$ 250,668
2.02	Lewis County sales tax (7.8%)				$ 19,552
2.03	Engineering, Permitting, Administraton (20%)				$ 50,134
2.04	Contingencies (30%)				$ 75,200
2.05	**Project Total**				**$ 395,554**

Appendix C

Line	Item	Unit	Quantity	Unit Cost	Cost
1.00	**NE-16**				
1.01	Earthwork	CY	1,392	$ 8	$ 11,200
1.02	Engineered Log Jams	EA	4	$ 40,000	$ 160,000
1.03	Riparian Revegetation	Acre	48	$ 21,000	$ 1,016,400
1.04	Invasive Species Removal	Acre	46	$ 9,000	$ 417,600
1.05	Land Acquisition/Easement	Acre	48	$ 10,000	$ 484,000
1.06	TESC & Care and diversion of water (1%)	LS	1	$ 20,900	$ 20,900
1.07	Mobilization, including demobilization (8%)	LS	1	$ 168,808	$ 168,808
2.00	**SUMMARY**				
2.01	Subtotal				$ 2,278,908
2.02	Lewis County sales tax (7.8%)				$ 177,755
2.03	Engineering, Permitting, Administraton (20%)				$ 455,782
2.04	Contingencies (30%)				$ 683,672
2.05	**Project Total**				**$ 3,596,117**

Appendix C

Line	Item	Unit	Quantity	Unit Cost	Cost
1.00	**NE-17**				
1.01	Engineered Log Jams	EA	1	$ 40,000	$ 40,000
1.02	Riparian Revegetation	Acre	15	$ 21,000	$ 306,600
1.03	Invasive Species Removal	Acre	15	$ 9,000	$ 131,400
1.04	Land Acquisition/Easement	Acre	15	$ 10,000	$ 146,000
1.05	TESC & Care and diversion of water (1%)	LS	1	$ 6,240	$ 6,240
1.06	Mobilization, including demobilization (8%)	LS	1	$ 50,419	$ 50,419
2.00	**SUMMARY**				
2.01	Subtotal				$ 680,659
2.02	Lewis County sales tax (7.8%)				$ 53,091
2.03	Engineering, Permitting, Administraton (20%)				$ 136,132
2.04	Contingencies (30%)				$ 204,198
2.05	**Project Total**				**$ 1,074,080**

Appendix C

Line	Item	Unit	Quantity	Unit Cost	Cost
1.00	**NE-18**				
1.01	Large Woody Debris	EA	2	$ 1,000	$ 2,000
1.02	Riparian Revegetation	Acre	30	$ 21,000	$ 619,500
1.03	Invasive Species Removal	Acre	4	$ 9,000	$ 39,600
1.04	Land Acquisition/Easement	Acre	30	$ 10,000	$ 295,000
1.05	TESC & Care and diversion of water (1%)	LS	1	$ 9,570	$ 9,570
1.06	Mobilization, including demobilization (8%)	LS	1	$ 77,254	$ 77,254
2.00	**SUMMARY**				
2.01	Subtotal				$ 1,042,924
2.02	Lewis County sales tax (7.8%)				$ 81,348
2.03	Engineering, Permitting, Administraton (20%)				$ 208,585
2.04	Contingencies (30%)				$ 312,877
2.05	**Project Total**				**$ 1,645,733**

Appendix C

Line	Item	Unit	Quantity	Unit Cost	Cost
1.00	**NE-19**				
1.01	Large Woody Debris	EA	2	$ 1,000	$ 2,000
1.02	Riparian Revegetation	Acre	8	$ 21,000	$ 176,400
1.03	Invasive Species Removal	Acre	6	$ 9,000	$ 54,000
1.04	Land Acquisition/Easement	Acre	8	$ 10,000	$ 84,000
1.05	TESC & Care and diversion of water (1%)	LS	1	$ 3,170	$ 3,170
1.06	Mobilization, including demobilization (8%)	LS	1	$ 25,566	$ 25,566
2.00	**SUMMARY**				
2.01	Subtotal				$ 345,136
2.02	Lewis County sales tax (7.8%)				$ 26,921
2.03	Engineering, Permitting, Administraton (20%)				$ 69,027
2.04	Contingencies (30%)				$ 103,541
2.05	**Project Total**				**$ 544,624**

Appendix C

Line	Item	Unit	Quantity	Unit Cost	Cost
1.00	**NE-20**				
1.01	Riparian Revegetation	Acre	16	$ 21,000	$ 338,100
1.02	Invasive Species Removal	Acre	16	$ 9,000	$ 144,900
1.03	Land Acquisition/Easement	Acre	16	$ 10,000	$ 161,000
1.04	Mobilization, including demobilization (8%)	LS	1	$ 51,520	$ 51,520
2.00	**SUMMARY**				
2.01	Subtotal				$ 695,520
2.02	Lewis County sales tax (7.8%)				$ 54,251
2.03	Engineering, Permitting, Administraton (20%)				$ 139,104
2.04	Contingencies (30%)				$ 208,656
2.05	**Project Total**				**$ 1,097,531**

Appendix C

Line	Item	Unit	Quantity	Unit Cost	Cost
1.00	**NE-21**				
1.01	Riparian Revegetation	Acre	0	$ 21,000	$ -
1.02	Invasive Species Removal	Acre	0	$ 9,000	$ -
1.03	Land Acquisition/Easement	Acre	200	$ 10,000	$ 200,000
1.04	Mobilization, including demobilization (8%)	LS	0	$ 16,000	$ -
2.00	**SUMMARY**				
2.01	Subtotal				$ 200,000
2.02	Lewis County sales tax (7.8%)				$ 15,600
2.03	Engineering, Permitting, Administraton (20%)				$ 40,000
2.04	Contingencies (30%)				$ 60,000
2.05	**Project Total**				**$ 315,600**