Chehalis Basin Strategy

Final EIS Executive Summary

Reducing Flood Damage and
Restoring Aquatic Species Habitat

DEPARTMENT OF ECOLOGY
State of Washington

June 2, 2017

TABLE OF CONTENTS

EXECUTIVE SUMMARY

The Chehalis Basin has experienced both devastating flood damage and extensive loss of aquatic species habitat

For more than 100 years, extreme flooding and the declining health of the Chehalis River and its aquatic species have continued without a comprehensive response. Since 1971, there have been 14 federally declared disasters in the Chehalis Basin from flooding. Flood damage reduction has been extensively examined in more than 830 studies since the 1930s; however, the efforts conducted to date have not resulted in appreciable reduction of flood damage.

Productivity for native aquatic species has also been reduced for decades, with current habitat degraded by as much as 87% for some species of salmon. This loss has harmed tribal and non-tribal fishers. The Governor and Washington State Legislature have made it a priority to develop a comprehensive strategy that integrates flood damage reduction and aquatic species habitat restoration within the Chehalis Basin, and have invested in identifying potential solutions. The Chehalis Basin Strategy is intended to be a program of integrated actions focused on maximizing the benefits of flood damage reduction and aquatic species habitat restoration over both the short and long term, while avoiding and minimizing adverse environmental, social, cultural, agricultural, and economic impacts.

The EIS states that to make a meaningful difference, the Chehalis Basin Strategy will need to provide a long-term, Basin-wide, integrated approach to substantially reduce damage from major floods and restore degraded aquatic species habitat in the Chehalis Basin. The two primary objectives of the strategy—flood damage reduction and aquatic species habitat restoration—are intended to address these needs.

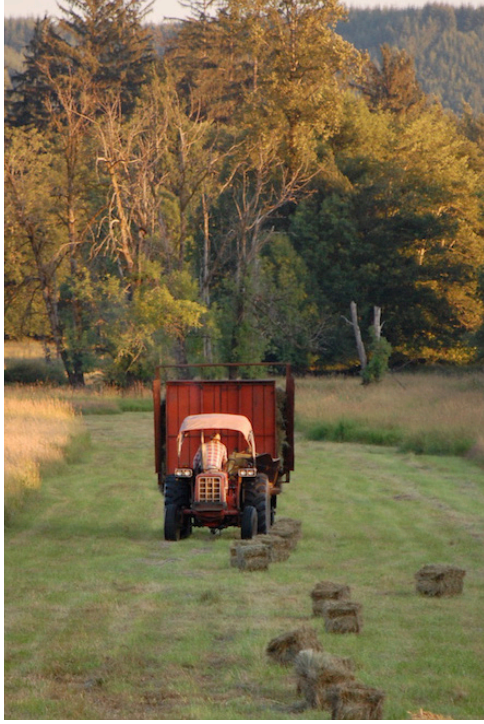

Major Roads
Rivers and Streams
Tribal Lands
Study Area
WA
OR
Olympic Mountains
Kalaloch
Queets
Quinault Indian Nation
Taholah
Moclips
Lake Quinault
Lake Cushman
Humptulips
West Fork Humptulips River
East Fork Humptulips River
Wynoochee River
West Fork Satsop River
Middle Fork Satsop River
East Fork Satsop River
Humptulips River
West Fork Hoquiam River
East Fork Hoquiam River
Wishkah River
Ocean Shores
Grays Harbor
Hoquiam
Aberdeen
Cosmopolis
Westport
John's River
Elk River
McCleary
Elma
Montesano
Chehalis River
Porter
Black Hills
Black River
Oakville
Confederated Tribes of the Chehalis Reservation
Olympia
Lacey
Nisqually River
Tenino
Bald Hills
Skookumchuck River
Grand Mound
Bucoda
Centralia
Chehalis
Bunker
Doty
Adna
Elk Creek
Willapa Hills
Raymond
Pe Ell
Boistfort
Chehalis River
South Fork Chehalis River
North Fork Newaukum River
South Fork Newaukum River
Cowlitz River
Pacific Ocean
Long Beach
Columbia River
Astoria
Kelso
Longview
101
8
12
107
6
5
510
507
Miles
0
5
10
N

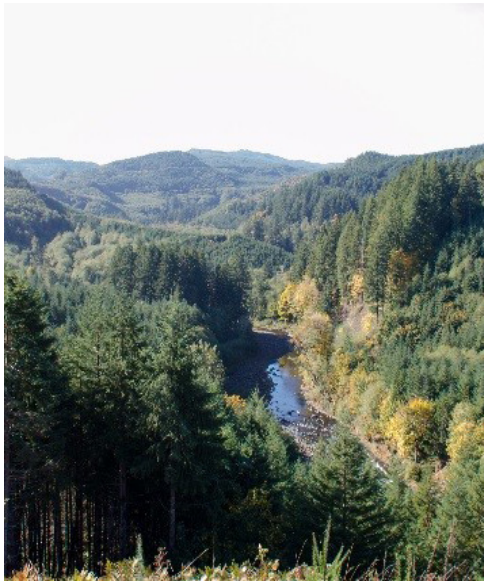
THE CHEHALIS BASIN

The EIS focuses on the Chehalis Basin in Southwestern Washington, which is the second largest river basin within the state. The Chehalis Basin extends over eight counties, encompassing large portions of Grays Harbor, Lewis, and Thurston counties, and small parts of Pacific, Cowlitz, Wahkiakum, Mason, and Jefferson counties. The Chehalis River flows approximately 125 miles north-northwesterly to Grays Harbor and the Pacific Ocean, and drains an area of approximately 2,700 square miles. Many species of fish are found in the Chehalis Basin, including salmonids such as steelhead and Chinook, coho, and chum salmon. Extensive and varied habitats within and adjacent to rivers and streams in the Chehalis Basin also support the most diverse amphibian population in Washington, an abundance of mudminnow, and numerous other native fish and wildlife species.

According to the U.S. Geological Survey, the Chehalis Basin has a high proportion of forested lands (80%), with 54% managed for timber production. Major infrastructure, including Interstate 5 (I-5) and the BNSF Railway and Union Pacific Railroad lines, cuts through the middle of the Chehalis Basin within the 100-year floodplain (floodplain). The most intensive commercial and residential development in the Basin is concentrated in the Chehalis-Centralia and Aberdeen areas. Commercial and residential development subject to flooding is also greatest in these two areas of the Basin. In the lower (northern) Chehalis Basin downstream of Centralia, the mainstem Chehalis River valley is much wider than in the upper Chehalis Basin, less populated, and predominantly agricultural, except for Aberdeen, Hoquiam, and Cosmopolis at the Grays Harbor estuary.

The Confederated Tribes of the Chehalis Reservation (Chehalis Tribe reservation) is situated near the mouth of the Black River on the mainstem Chehalis River. The Quinault Indian Nation reservation is located outside of the Chehalis Basin, on the southwestern corner of the Olympic Peninsula in Grays Harbor County. Quinault Indian Nation usual and accustomed fishing areas include Grays Harbor and its tributaries.





PROGRAMMATIC FINAL EIS OVERVIEW

The programmatic EIS evaluates long-term strategy options

The Washington State Department of Ecology (Ecology) prepared a State Environmental Policy Act (SEPA) Programmatic Environmental Impact Statement (EIS) at the request of the Governor's Chehalis Basin Work Group (Work Group), which has been tasked by the Governor with developing recommendations for an integrated strategy that includes measures to reduce flood damage and restore aquatic species habitat in the Chehalis Basin. The EIS evaluates a suite of actions to address these two challenges. The SEPA environmental review process provides a formal way to identify and assess the potential environmental effects of a proposal before deciding how to proceed. The process helps decision-makers and the public understand how implementing an integrated strategy could affect people and the environment.

For the Chehalis Basin Strategy, a broad analysis under a programmatic EIS (versus a site-specific, detailed analysis) is appropriate at this stage in the planning process. The programmatic EIS is intended to assess the potential range of impacts, so that the wide-ranging implications and tradeoffs associated with implementing the Chehalis Basin Strategy can be evaluated. Consistent with SEPA Rules, the EIS was prepared at the earliest possible point in the planning and decision-making process. Early environmental review helps identify those actions that may not be viable and do not warrant further study, versus actions that may require future environmental review or an evaluation of feasibility if an action is selected for implementation.

Public input was critical to EIS development

A scoping period was conducted from September 18 to October 19, 2015, for interested tribes, agencies, and the public to provide input on the content and scope of the EIS. Comments received during scoping helped shape the development and evaluation of action elements and combined alternatives for the EIS.

Ecology released the Draft EIS on September 29, 2016, and issued an addendum to the Draft EIS on October 17, 2016. The Draft EIS was originally available for public review and comment until October 31, 2016; however, an extension was granted to extend the review and comment period through November 14, 2016. Two public hearings were held during the Draft EIS public comment period, and clarifying information was also provided through meetings and a technical blog.

The Draft EIS was intended to provide an opportunity for interested tribes, agencies, and the public to consider the effects of implementing an integrated strategy at a broad, planning level. More than 500 comments were received during the Draft EIS public comment period. Ecology appreciates the time and attention that commenters committed to reviewing the draft, and the significant public response indicates the EIS was effective in its purpose.

The Final EIS

The Final EIS is being published in an addendum format, and consists of the comments received on the Draft EIS, Ecology's responses, an updated Fact Sheet, and this final Executive Summary. The entire Draft EIS will not be republished in final form for the following reasons:

- It would be difficult for readers to independently identify changes throughout the document due its size and complexity
- The results of ongoing and future assessments will be appropriately contained in future project- and site-specific environmental reviews
- The action elements, alternatives, and analyses in the EIS have not been changed

This final Executive Summary provides the next steps for development of the Chehalis Basin Strategy, a summary of EIS conclusions and comparisons of the four action alternatives and the No Action Alternative, and areas of controversy and uncertainty.

NEXT STEPS

The Work Group used the Draft EIS—and comments received on the draft—to develop its proposed 2017 to 2019 biennium budget recommendations for continued development and implementation of the Chehalis Basin Strategy (see page 8). The Governor included these budget recommendations in his budget proposal, which is currently under consideration by the Washington State Legislature. Funding for future years has not been determined.

This Final EIS responds to the comments received on the Draft EIS using information available at the time the draft was published, and identifies the analyses proposed to be conducted in the next biennium. Future analyses are intended to address significant issues raised by the public, agencies, and tribes during their review of the Draft EIS that are more specific than can be addressed in a broad, programmatic environmental review. More detailed environmental review will allow for identification of specific impacts and mitigation measures. For more information on additional analyses proposed for next biennium, refer to the Comment Response Report.

As described on the next page, the continuation of local flood damage reduction projects and development of the *Aquatic Species Restoration Plan* (ASRP) are underway, in response to comments received on the Draft EIS.

The Work Group will sunset in July 2017. The new Chehalis Board will be established, consistent with Revised Code of Washington (RCW) 43.21A.731, to evaluate the long-term strategy for the Chehalis Basin, including funding and timing of implementation of the various actions evaluated in the EIS.

The Office of Chehalis Basin, established within Ecology, is tasked to "aggressively pursue implementation of an integrated strategy…for long-term flood damage reduction and aquatic species restoration" in the Chehalis Basin (RCW 43.21A.730).

There has been progress for the people, communities, and natural resources in the Chehalis Basin, but several big decisions are still ahead

Since 2011, there have been significant investments by the Washington State Governor and Legislature in evaluating actions (through continued feasibility, design, and environmental review) that would reduce flood damage and restore aquatic species habitat in the Chehalis Basin (see EIS Section 1.1).

The Chehalis Board will engage in a public process with tribes, key stakeholders, and the broader Chehalis Basin community to develop recommendations for a long-term Chehalis Basin Strategy. Final Chehalis Board recommendations on a long-term strategy are anticipated in spring 2019, and will be based on the continued analysis proposed for the next biennium (see the Comment Response Report).

Local Flood Damage Reduction Projects

Many local flood damage reduction projects have been completed and others are underway in communities across the Chehalis Basin. These projects are designed to protect key infrastructure like roads and wastewater treatment plants from flood damage, and others aim to restore local floodplain areas. The Work Group's 2017 to 2019 biennium budget recommendations include funding for the first tier of local flood damage reduction projects developed by the Chehalis River Basin Flood Authority, as described in the Comment Response Report.

Aquatic Species Restoration Plan

Tribal and state officials are developing an unprecedented, Basin-wide ASRP to protect and restore potentially several hundred miles of riverside habitat. The ASRP is intended to do the following:

- Protect and preserve important habitats
- Restore degraded ecosystems
- Create self-maintaining environments
- Create flood and climate resilient systems

Comprehensive data collection on salmon and other aquatic species in the Chehalis Basin began 4 years ago. Continued data collection, research, and analyses for salmon and other aquatic species in the 2017 to 2019 biennium will be used to develop a more robust, science-based understanding of the habitat and aquatic species in the Chehalis Basin, and support development of the Basin-wide ASRP.

Governor's Work Group 2017 – 2019 Biennium Budget Recommendations

The Work Group recommended a $60 million 2017 to 2019 biennium budget appropriation to Governor Inslee, which was included in his budget proposal and is currently under consideration by the Legislature. The recommendations include the following:

- Completion of the *Aquatic Species Restoration Plan* (ASRP)
- Funding for construction of priority aquatic species habitat restoration projects, including barrier correction, early action reach restoration projects (such as floodplain and channel restoration and side-channel reconnections), and acquisition of critical habitats
- Funding for the first tier of local flood damage reduction projects developed by the Chehalis River Basin Flood Authority
- Initiation of a Basin-wide floodproofing program and continued work with local governments on improved floodplain management
- Detailed modeling and pre-permit design for one priority sub-basin for restorative flood protection, to evaluate landowner preferences and further understand if the approach is feasible in broader treatment areas
- Project-level environmental review for the dams being considered on the mainstem Chehalis River, to address questions raised during public review of the EIS and determine the feasibility of mitigating the impacts of the proposed dam
- Design and initial permit applications to evaluate the environmental impacts and determine the feasibility of the Aberdeen/Hoquiam North Shore Levee project
- Implementation of a public involvement and outreach strategy for all the actions and activities within the Chehalis Basin Strategy

PURPOSE AND NEED

To address key flooding and habitat challenges, the Chehalis Basin Strategy needs to include a suite of integrated actions to reduce flood damage and improve aquatic habitat

An integrated Basin-wide strategy should provide the following:

- A safer future for people
- A healthier, more resilient Chehalis Basin for aquatic species
- Reduced social and economic costs associated with floods and degraded aquatic species habitat
- Financially viable and sustainable solutions

If action is not taken, communities and resources will experience greater hardships and loss

Beginning in the 1850s, human-caused impacts on aquatic habitat have been extensive. Although there have been robust runs of most salmon species every year for the last 30 years, poor returns of one or more species of salmon have significantly limited tribal and non-tribal harvest. In recent years, summers have become drier with warmer stream temperatures and lower streamflows, and these conditions are predicted to get worse in the future.

The natural resources of the Chehalis Basin have supported native people for millennia and continue to provide value to both tribal and non-tribal people of the Basin. Farming, forestry, harvesting of shellfish, and fishing continue to be central to the area's economy. Salmon play a major cultural, recreational, and economic role, and the protection and restoration of salmon habitat is very important for many people in the Chehalis Basin. With no action, the future for flood damage and aquatic species is predicted to be significantly worse. People, communities, and natural resources could suffer at unprecedented levels. Further declines in habitat could result in future threatened or endangered species listings, causing federal government intervention into local actions and the harvesting of salmon.

Aquatic species habitat impairment

Fish harvest has been limited by poor runs over the last 30 years, and aquatic species habitat productivity has been degraded by up to 87%.

Estimate of Current Habitat Impairment

Potential Change in Salmon Abundance with Climate Change

Species	Current Potential Abundance in the Chehalis Basin	Change from Current Conditions with Climate Change (Number of Fish and Percentage)
Coho salmon	40,642	-22,390 | -55%
Fall-run Chinook salmon	25,844	-6,969 | -27%
Winter/fall-run chum salmon	190,550	-8,270 | -4%
Spring-run Chinook salmon	2,146	-1,869 | -87%
Winter-run steelhead	6,800	-3,741 | -55%

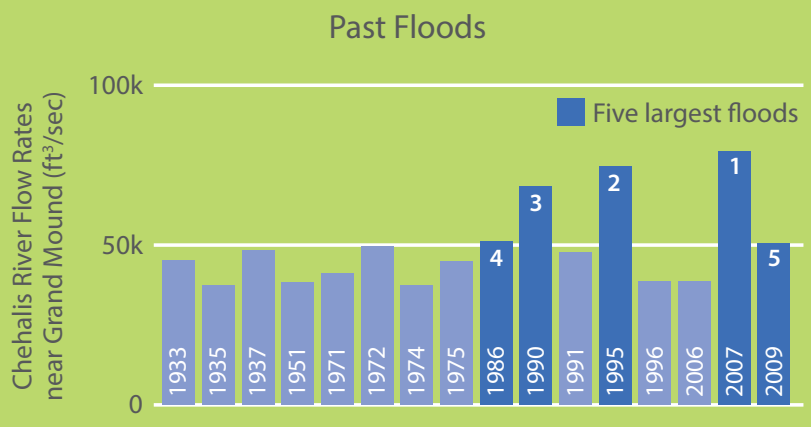
In addition to deteriorated aquatic species habitat, flood conditions have also worsened. Five of the largest floods in the history of the Chehalis Basin occurred in the last 30 years. In 2007 and 2009, two extreme floods occurred only 13 months apart. People lost their homes, businesses, agricultural equipment, and livestock. Roads and infrastructure were inundated with floodwaters, causing disruptions to emergency services.

Repeated flooding makes it difficult to attract new industry to the Chehalis Basin, and the emotional and psychological costs to communities are significant.

No action will stop all flooding. The strategy is intended to reduce the damages and adverse impacts of flooding and, at the same time, support the economic prosperity of communities, and restore fish populations and other natural resources in the Chehalis Basin.

Major floods

Flooding occurs on the Chehalis River and its tributaries in Lewis County, Thurston County, Grays Harbor County, and the Chehalis Tribe reservation. The threshold for a major flood, as described in the EIS, is 38,800 cubic feet per second (cfs) at the Grand Mound gage located along the Chehalis River (near Grand Mound) in Thurston County, which has a 15% probability of occurrence in any year (or a 7-year recurrence interval). Major floods include events greater than 38,800 cfs with a lower frequency of occurrence such as 10-year, 100-year, and 500-year floods (10%, 1%, and 0.02% probability of occurrence in any year). Major floods are more extensive and damaging than smaller, more frequently occurring floods. A major flood along the Chehalis River in Lewis County includes moderate flooding that results in road closures and floodwaters encroaching on some homes and businesses. Major flooding in Thurston County results in inundation of farmlands and roads, including US 12.



Temperatures, droughts, torrential rains, and severe floods are all increasing, and the trends are projected to continue as the earth warms. The increase in peak flows under climate change conditions is estimated to be 66% for a 100-year flood.

TIMELINE OF FLOODS AND ACTIVITIES

1887 Flood

1910 Flood

1933 Flood

1935 Flood

1937 Flood

1951 Flood

1971, 1972 Flood

1974, 1975 Flood

1986 Flood

1990, 1991 Flood

1995, 1996 Flood

2001
Grays Harbor County Comprehensive Flood Hazard Management Plan

2006 Flood

2007 Flood

2008
Chehalis Lead Entity Salmon Habitat Restoration and Preservation Work Plan for WRIAs 22 and 23

2009 Flood

2011
Washington State Legislature calls on Office of Financial Management to evaluate alternatives and recommend priority actions to reduce flood damage and improve conditions for aquatic species

2012
WSDOT I-5 Protection Alternatives Analysis

2012
Governor's Chehalis Basin Work Group formed

2012
Work Group recommends actions to reduce flood damage and restore aquatic species habitat

2013–2015
Work Group technical studies: aquatic species restoration, floodplain structures, hydrologic/hydraulic modeling, water retention and fish passage, water quality, economics, and geomorphology and sediment transport

2016–2017


Farm pad


Elevated home


Fish-passable culvert replacement

Implementation of early projects

1890s | 1900s | 1910s | 1930s | 1940s | 1950s | 1960s | 1970s | 1980s | 1990s | 2000s | 2010s

1998
Flood reduction studies including proposed modifications of the State Route 6 and Mellen Street bridges

2007
Chehalis River Basin Flood Authority formation and Lewis County Flood Disaster Recovery Strategy

2009
Confederated Tribes of the Chehalis Reservation Comprehensive Flood Hazard Management Plan

2012
Ruckelshaus Center releases Alternatives Report

2014
Work Group releases Recommendation Report

1930s–2007
Flood damage reduction extensively examined in more than 830 studies; however, the efforts conducted to date have not resulted in appreciable reduction of flood damage

2010
Flood Authority Comprehensive Flood Hazard Management Plan

2013
Washington Coast Sustainable Salmon Plan and Thurston County Flood Hazard Mitigation Plan

1980s–2011
U.S. Army Corps of Engineers Twin Cities Project Alternatives Evaluation

2013–2014
Work Group develops preliminary alternatives

2015–2017

Programmatic EIS and continuation of technical studies regarding aquatic species and water retention

Chehalis Basin Strategy Activities

Floods

Related Technical Studies

ACTION ELEMENTS

No single action alone will address all the problems—a combination of actions is needed

The EIS looks at four action alternatives and a No Action Alternative. Each action alternative combines flood damage reduction action elements (large-scale and local-scale) and the aquatic species habitat action element.

Public input shaped the action elements and alternatives

Ecology and the Work Group have worked closely with agencies, tribes, and local communities for the past several years to develop a comprehensive approach to addressing flood damage and aquatic species habitat concerns in the Chehalis Basin. In 2014, the Work Group published a Recommendation Report outlining a program of integrated, long-term, flood damage reduction and aquatic species habitat actions for further analysis. These actions were refined and evaluated within the EIS.

The process to develop the alternatives evaluated in the EIS is described further in EIS Section 2.3.1 and in the Comment Response Report.

Flood Damage Reduction

Large-scale

- Flood Retention Facility (Dam and Associated Reservoir)
- Airport Levee Improvements
- I-5 Projects
- Aberdeen/Hoquiam North Shore Levee
- Restorative Flood Protection

Local-scale

- Floodproofing
- Local Projects (Small Flood Reduction)
- Land Use Management
- Flood Warning System Improvements

Aquatic Species Habitat Actions

- Restore Riparian Habitat
- Correct Fish Passage Barriers
- Restore Off-channel Habitat
- Add Wood to Streams for Habitat
- Restore Bank Erosion to Naturally Occurring Rates
- Reconnect the Floodplain
- Create, Restore, and Enhance Wetlands

Actions to reduce flood damage

Flood damage reduction actions are intended to lessen the damage caused by major floods.

The same **Local-scale Flood Damage Reduction Actions** are included in all of the action alternatives evaluated in the EIS.

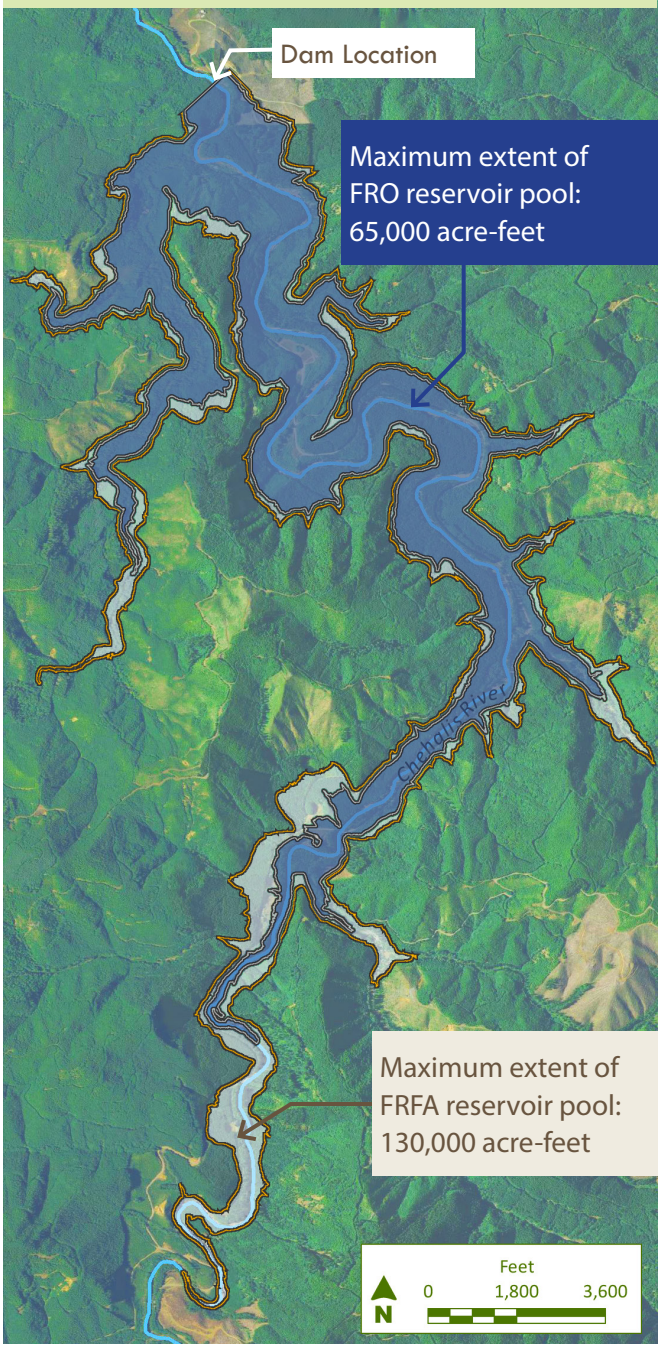
Local-scale Flood Damage Reduction Actions include *Floodproofing* buildings in the floodplain by elevating them or building floodwalls around them, or buying properties from willing landowners and removing structures that are repetitively damaged in floods and cannot be elevated or otherwise protected. Floodproofing also includes protecting livestock and farm investments by constructing farm pads (raised areas where farm animals and equipment will be safe during floods), and creating evacuation routes. Another element of the Local-scale Flood Damage Reduction Actions, *Local Projects,* is intended to protect key infrastructure like roads and wastewater treatment plants from flood damage, and restore local floodplain areas. Improvements to *Land Use Management* would include improving regulatory flood data, floodplain protection, and construction standards in local land use and floodplain regulations to protect remaining floodplain functions and prevent future flood damage to new uses or development in the floodplain. Finally, existing *Flood Warning Systems* would be improved as part of the Local-scale Flood Damage Reduction Actions.

Different combinations of **Large-scale Flood Damage Reduction Actions** are included in the alternatives evaluated in the EIS.

Five **Large-scale Flood Damage Reduction Actions** are evaluated in the EIS. These involve large-scale actions intended to alter the current extent and depth of flooding and reduce flood damage. Specific action elements include a *Flood Retention Facility* (dam and associated reservoir), *Restorative Flood Protection*, and three new or improved levee systems.

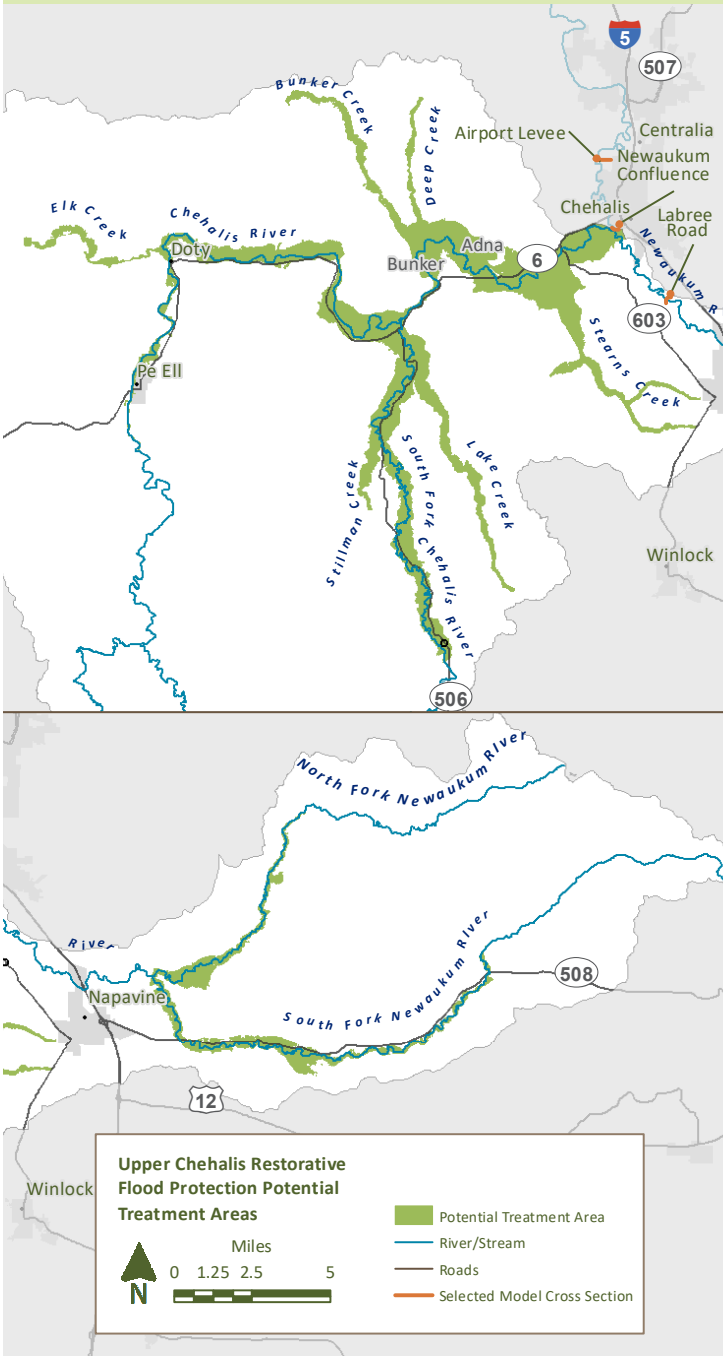
The first of the three action elements in the levee category, *I-5 Projects*, includes a series of new levees, floodwalls, and bridge replacements to help reduce flooding and closures of I-5 in the Chehalis and Centralia areas. Improvements to an existing levee are evaluated as the second action element, *Airport Levee Improvements*, which would provide additional flood protection to the Chehalis-Centralia Airport, local businesses, and a portion of I-5. The third levee action element, *Aberdeen/Hoquiam North Shore Levee,* includes a new levee to provide coastal flood protection for residents and business in low-lying areas within those two cities, both currently and when considering potential future sea level rise.

Flood Retention Facility



A *Flood Retention Facility,* or a dam, is also evaluated in the EIS. The dam is being considered for the mainstem Chehalis River, and would be located about 1 mile south of Pe Ell. Two types of dams are being considered. A dam with a temporary reservoir would be designed to temporarily hold back water during major floods. This is known as a Flood Retention Only (FRO) facility. The river would flow normally during regular conditions or smaller floods. A dam with a permanent reservoir would be designed to retain water all year (instead of only during major floods). This is known as a Flood Retention Flow Augmentation (FRFA) facility. In addition to reducing flood damage during the winter, the water from the reservoir would be released in late spring to early fall to provide more water and cooler water temperatures in reaches of the river downstream of the dam. Both dam options would be designed to accommodate fish passage through tunnels, ladders, or collection systems. The two Flood Retention Facility options are shown on this page.

Restorative Flood Protection



Restorative Flood Protection is intended to rebuild some of the lost natural flood storage capacity of the Chehalis Basin upstream of Chehalis. This would occur through adding engineered large wood structures and plantings to create "roughness" (or resistance to flow) in river and stream channels and the floodplain, and by reconnecting river channels to floodplain storage. There are about 140 river miles (RMs) within the Restorative Flood Protection treatment area, and the associated floodplain area that is engaged by these rivers during a 100-year flood is about 21,000 acres. The map on this page shows the potential treatment areas suitable for Restorative Flood Protection.

The same range of **Aquatic Species Habitat Actions** are included in all of the action alternatives in the EIS.

Actions to restore aquatic species habitat

Aquatic Species Habitat Actions include a number of measures to protect existing functional habitat and improve and create sustainable ecosystem processes and functions that support the long-term health of native aquatic and semi-aquatic species, and at much higher levels of abundance than current conditions support. "Low" and "high" restoration scenarios are evaluated in the EIS to bracket the potential range of results that could ensue from implementation of the ASRP, which is under development. The restoration actions identified in the final ASRP will be dependent upon site conditions and landowner willingness, and would likely be within the low and high restoration scenarios evaluated in the EIS.

Habitat would be improved by restoring areas along the mainstem Chehalis River and in tributaries, and adding native plants and vegetation. Habitat measures would also include correcting fish passage barriers to open up streams for migrating fish. Off-channel habitat on the mainstem Chehalis River would be restored, wood added in the mainstem and tributaries to trap sediment and improve habitat for salmon and other species, bank erosion restored in some locations to naturally occurring rates, and floodplains and oxbows reconnected in specific areas, allowing the river channel to migrate within the floodplain to help support habitat-forming processes. Wetlands would also be created, restored, or enhanced for use by aquatic and semi-aquatic species.

Aquatic Species Habitat Actions

Low scenario	High scenario
Restores 21 – 63 RMs, 1,150 – 2,900 acres	Restores 71 – 214 RMs, 3,900 – 9,750 acres
Focuses on spring-run Chinook salmon spawning reaches	Includes spawning reaches for spring- and fall-run Chinook salmon, coho salmon, chum, and steelhead with the highest restoration potential
Habitat potential primarily in the upper Chehalis Basin in managed forestland	Larger proportion of restoration benefit outside managed forestlands; wider array of reaches throughout the Chehalis Basin
Replacing or removing more than 400 culverts, opening up more than 295 miles of streams for migrating fish by removing barriers that partially or completely block fish passage	

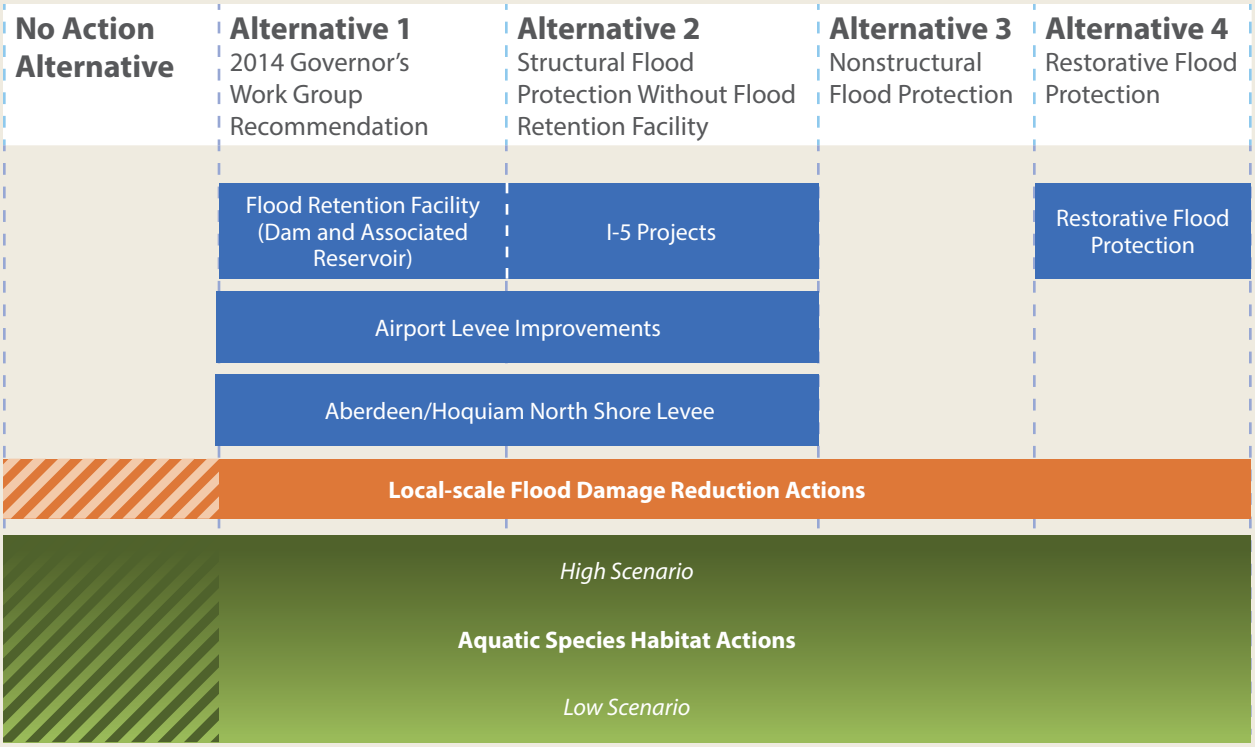
Aquatic Species Habitat Actions – High Scenario

Potential Restoration Reaches

The EIS alternatives

The four EIS action alternatives are characterized by different combinations of flood damage reduction action elements and the range of aquatic species habitat actions. The EIS evaluates how these action elements may function when combined, in terms of their impacts on people and the environment.

The chart below illustrates the action elements and how they are combined into the alternatives that are considered in the EIS. Large-scale Flood Damage Reduction Actions, which differ among the alternatives, are shown in **blue**. A No Action Alternative is included in the EIS for purposes of comparison, and represents the most likely future expected in the absence of implementing any of the action alternatives.



Over the years, many flood damage reduction approaches have been studied in the Chehalis Basin—from raising bridges and removing constrictions, to levees, dredging, and a series of smaller projects. Some approaches have been eliminated from further detailed study in the EIS for a variety of reasons; details are provided in EIS Chapter 2.

ANALYSIS OF IMPACTS

In the EIS, the analysis of impacts is conducted at a Basin-wide scale, for a programmatic evaluation of the alternatives. Localized impacts are noted, where known. Collaboration with tribes; federal, state, and local agencies; and technical reviewers has been an important part of identifying potential environmental impacts as described in the EIS.

There are similarities across the action alternatives

All of the action alternatives in the EIS include the same Local-scale Flood Damage Reduction Actions and the same range of Aquatic Species Habitat Action scenarios. Aquatic Species Habitat Actions would primarily result in beneficial effects, as they are designed to protect, improve, and create sustainable ecosystem processes and functions that support the long-term health of native aquatic and semi-aquatic species. The Local-scale Flood Damage Reduction Actions would also primarily result in beneficial effects due to increased safety from improvements to the flood warning system; a reduction in flood damage to structures, infrastructure, critical road segments, and some agricultural uses; potential limitations on future development within the 100-year floodplain; and the potential to maintain open space and functional floodplain habitat.

None of the Large-scale Flood Damage Reduction Actions would protect all existing development in the floodplain. Thus, floodproofing needs to be part of every alternative to reduce flood damage; although floodproofing is not feasible for every building. While protecting buildings from flooding effects would significantly reduce the economic impacts on buildings and their contents related to flood damage, floodproofing would not reduce damage and disruption to transportation systems, agricultural lands, and utilities during floods.

Actions would require a substantial number of willing landowners

Because several actions would affect or need to be implemented on private property, or would affect landowners once implemented, agreement of willing landowners and cooperation among Chehalis Basin communities and residents is essential before many of the actions can be implemented.

Information presented in this summary

The EIS details the potential adverse impacts and beneficial effects of the action elements and combined alternatives on the built and natural environment, during construction (short term) as well as during operation (long term), at a broad scale. Potential mitigation measures are identified that could be implemented or might be required to reduce potential adverse impacts; site- and project-specific mitigation measures would be identified and implemented during project design and environmental review. As detailed in the EIS, the type, location, and degree of the impacts vary. The alternatives were also evaluated in the EIS relative to the Chehalis Basin Strategy objectives to determine their effectiveness in reducing flood damage and improving aquatic species habitat.

In this final Executive Summary, a comparison of the alternatives relative to the Chehalis Basin Strategy objectives is presented. Following the Comparison of Alternatives section, the significant adverse impacts of each alternative are summarized. Note this final Executive Summary does not include a full explanation or context; for a detailed analysis, refer to the complete EIS.

Chehalis Basin Strategy Objectives

Reduce the damage caused by a major flood	
Threats to human health and safety, including access to critical medical facilities	Disruption in transportation systems, including closures of I-5 and local and regional transportation systems
Flood damage to commercial and residential properties	
Flood damage to agricultural properties, livestock, and crops	Disruption to industry, commercial businesses, and public services
Protect and restore aquatic species habitat function	
Improve resiliency of natural floodplain processes and ecosystems from the effects of climate change, including warming stream temperatures, low flows, and other effects	Increase abundance of native aquatic species, including increased populations of healthy and harvestable salmon and steelhead
Reduce the potential for future Endangered Species Act listings	Enhance tribal and non-tribal fisheries

COMPARISON OF ALTERNATIVES

The EIS looks at four action alternatives and a No Action Alternative

The **No Action Alternative** is intended to represent the most likely future expected in the absence of implementing an action alternative. As described in EIS Section 5.2, the No Action Alternative includes potential salmon habitat benefits from the maturation of riparian areas in managed forests compared to current conditions and predicted impacts of future climate conditions.

Alternative 1: 2014 Governor's Work Group Recommendation includes the Flood Retention Facility (FRO or FRFA dam), Airport Levee Improvements, and Aberdeen/Hoquiam North Shore Levee as the Large-scale Flood Damage Reduction Actions. Local-scale Flood Damage Reduction Actions and a range of Aquatic Species Habitat Actions are also included in Alternative 1.

Alternative 2: Structural Flood Protection Without a Flood Retention Facility includes the Airport Levee Improvements, I-5 Projects, and Aberdeen/Hoquiam North Shore Levee as the Large-scale Flood Damage Reduction Actions. Local-scale Flood Damage Reduction Actions and a range of Aquatic Species Habitat Actions are also included in Alternative 2.

Alternative 3: Nonstructural Flood Protection represents a "nonstructural" approach to reducing flood damage and restoring aquatic species habitat. In contrast to implementing Large-scale Flood Damage Reduction Actions, flood damage would be reduced through a programmatic effort to floodproof or remove existing structures. This alternative includes implementation of the Local-scale Flood Damage Reduction Actions and a range of Aquatic Species Habitat Actions, without any of the Large-scale Flood Damage Reduction Actions.

Alternative 4: Restorative Flood Protection includes Restorative Flood Protection as a Large-scale Flood Damage Reduction Action. This action is intended to increase the flood storage capacity of the Chehalis Basin watershed by reconnecting floodplain storage to the Chehalis River, and adding roughness to river and stream channels and floodplains to slow and store the flow of water. In some cases, this action would require relocation of at-risk landowners and uses out of the floodplain. The objective includes reducing flood peaks downstream of the Newaukum River confluence on the mainstem Chehalis River. This alternative also includes the implementation of the Local-scale Flood Damage Reduction Actions and a range of Aquatic Species Habitat Actions. The Restorative Flood Protection action element would be coordinated with and complement the Aquatic Species Habitat Actions within the treatment areas.

This section presents a comparison of the alternatives to the Chehalis Basin Strategy objectives of substantially reducing damage from major floods and restoring degraded aquatic species habitat function. In general, Alternative 1 and Alternative 4 would have the greatest Basin-wide effects of all of the alternatives. Therefore, much of the comparison in this section focuses on comparing these two alternatives. Potential benefits and significant adverse impacts resulting from each alternative are summarized in the next section.

Reduce the damage caused by a major flood

Reductions in flood depths and extents—and moving people, structures, and uses out of harm's way—would reduce threats to human health and safety, including improved access to critical medical facilities. Damage to commercial, residential, and agricultural properties, livestock, and crops would also be reduced, along with reduced disruption to transportation systems and to industry, commercial businesses, and public services. This section outlines the comparative differences (qualitative, and quantitative where available) among the alternatives during a 100-year flood with regard to: change in extent and depth of flood inundation, effects to agricultural land uses, reduction in structures damaged, and changes in disruption to transportation systems.

Change in extent and depth of inundation during a 100-year flood

Based on available data, Alternative 1 would reduce the areal extent and depth of 100-year floods to a greater extent than the No Action Alternative and the other action alternatives. Alternative 1 would not increase flooding; instead there would be a decrease in flood extent and depth in approximately 4,391 acres throughout Lewis, Thurston, and Grays Harbor counties. Alternative 2 would primarily reduce flooding in the Chehalis-Centralia area near the airport and I-5, and in the Aberdeen/Hoquiam area. However, raising the airport levee and constructing the I-5 Projects as part of Alternative 2 have the potential to increase flood extent and depth on approximately 14 acres of agricultural land and forestland on the west and east sides of the Chehalis River, as depicted in EIS Figure 5.4-1. Alternative 3 would not reduce flood extents. Alternative 4 would increase the areal extent and depth of 100-year floods upstream of the Newaukum River confluence by 4,590 acres in many valley-bottom areas. Downstream of the Newaukum River confluence, including in the Chehalis-Centralia area, Alternative 4 would reduce flood extents and depths, but to a lesser degree than Alternative 1. Alternative 4 would result in a reduction of approximately 815 acres of flooded area downstream of the Newaukum River confluence. However, because Alternative 4 would relocate 16,000 acres of land uses upstream of the Newaukum confluence to outside of the floodplain, including 8,500 acres of agriculture, it would result in greater flood damage reduction compared to the No Action Alternative and the other action alternatives.

Effects on agricultural land use

Alternative 1 would reduce impacts on agricultural land uses during a 100-year flood to a greater extent than the No Action Alternative and other action alternatives, due to reduced flooding on 1,956 acres of agricultural land and forestland. Alternative 4 would have the greatest effect on agricultural land uses because it could result in new or increased flooding to up to 21,000 acres in the future 100-year floodplain, including approximately 12,100 acres of active farmland, and would require relocation of 8,500 acres of agricultural land uses. The specific location, magnitude, and concentration of these effects under Alternative 4 were not identified for this programmatic evaluation.

Reduction in flood damage to high-value structures during a 100-year flood

The table below provides a comparison of the total number of high-value structures that models predict would be flooded or protected from damage during a 100-year flood under each alternative. The EIS delineates structures as either "high value" (e.g., schools, residences, businesses) or "limited value" (e.g., sheds, park shelters, carports). For all alternatives except Alternative 4, the structures in the table are located in the Chehalis River floodplain (see EIS Section 3.1.2.2). The number of structures flooded was determined based on the lowest floor elevation relative to the predicted flood depth that would result from each alternative. "Lowest floor elevation" refers to the height (off the ground) at which the first living or working floor of a home or building sits. If that elevation is lower than the depth of the flood, the structure was classified as flooded. The Aberdeen/Hoquiam North Shore Levee action element is included in Alternatives 1 and 2, and would result in the protection of 2,715 additional structures that are not shown on this table. It is anticipated that a comprehensive floodproofing program would extend to flood-prone buildings in the Chehalis Basin that are not protected by a Large-scale Flood Damage Reduction Action.

	No Action Alternative	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Structures no longer flooded	0	559	88	0	136
Structures relocated	0	0	0	0	462
Structures floodproofed	0	500	812	802	645
Total number of structures where damage would be reduced	**0**	**1,059**	**900**	**802**	**1,243**
Remaining structures flooded	1,379	320	479	577	598[1]

Note:

1. Relocated structures are not included in this total because it is currently unknown whether property owners would be willing to relocate.

Changes in disruption to transportation systems during a 100-year flood

	No Action Alternative	Alternative 1	Alternative 2	Alternative 3	Alternative 4
I-5 closures (closed 4 days during 100-year flood)	No reduction	Reduced by 3 days	Reduced up to 3 days	No reduction	No reduction
Flooding of SR 6, US 101, US 12, and local roads	No reduction	Reduced by 1 to 3 days	Reduced behind levee, increased on west side of I-5 (SR 6 and local roadways)	No reduction	Reduced in Chehalis-Centralia area by up to 1 day, could be increased on SR 6 (4 days), SR 506 (1 to 2 days), and SR 508 (2 days)

Protect and restore aquatic species habitat function

Implementation of the Aquatic Species Habitat Actions in all of the action alternatives would increase functioning habitat for salmon, resulting in a benefit to other aquatic species as well. Depending on the alternative, model results predict that the low Aquatic Species Habitat Action scenario would not always result in an increase in salmon abundance. For some species, the low scenario may not be enough to outpace the predicted adverse impacts on salmon habitat from climate change.

Model results predict that the Aquatic Species Habitat Actions would increase riparian area along 21 to 214 RMs (1,150 to 9,750 acres), depending on the restoration scenario, when compared to current conditions. Alternative 1 would decrease riparian area in the FRFA reservoir footprint by 241 acres, due to clear-cutting and permanent inundation. When considering the Aquatic Species Habitat Actions jointly with the FRFA reservoir, the combined Alternative 1 would increase riparian habitat by 909 to 9,509 acres, depending on the restoration scenario. Alternative 4 would increase the riparian area by between 562 and 6,552 acres by adding large wood in the treatment areas. When combined with the Aquatic Species Habitat Actions, the total increase in riparian habitat would be 1,712 to 16,302 acres.

All of the action alternatives would increase salmon abundance; however, there is very limited improvement to abundance when the low restoration scenario is combined with climate change. Alternative 4 would result in the greatest increase in salmon abundance, while Alternative 1 would result in the least increase in salmon abundance. The increase in salmon abundance for Alternatives 2 and 3 would be very similar to the increase predicted from implementing the Aquatic Species Habitat Actions alone.

A major difference between Alternative 1 and the other alternatives is the effect on salmon and other aquatic species that use the mainstem Chehalis River upstream and immediately downstream of the dam. The dam would have a significant adverse impact on the native species that use this area of the river. Although the FRO dam would allow passage of species, changes to habitat in the reservoir area would decrease the survival of salmon and other species. The FRFA dam would more severely reduce upstream and downstream passage of aquatic species, resulting in significant reductions of salmon, lamprey, and other species in that portion of the Chehalis Basin.

Climate change impacts are predicted to reduce overall salmon abundance when compared to current conditions. The low restoration scenario would, at best, maintain the status quo. When the high restoration scenario is included, all the alternatives increase salmon abundance, even when factoring in climate change. When implemented as a combined alternative, Alternative 4 is predicted to result in the greatest benefit to aquatic species compared to the No Action Alternative and other action alternatives. Alternative 1 would substantially restore habitat for aquatic species, but would result in the least benefit as a result of permanent and large-scale changes to the Chehalis River and floodplain caused by a Flood Retention Facility.

Potential response in salmon abundance to habitat change in the Chehalis Basin with different action alternatives

	Change in Abundance for Chum, Spring-run and Fall-run Chinook, and Coho Salmon, and Winter-run Steelhead (Number; Percentage)			
Action	**Low Restoration 20% Reaches (Current Conditions)**	**Low Restoration 20% Reaches (with Climate Change)**	**High Restoration 60% Reaches (Current Conditions)**	**High Restoration 60% Reaches (with Climate Change)**
Aquatic Species Habitat Actions (Alternatives 2 and 3 would be similar)	48,843 **(18%)**	5,019 **(2%)**	194,383 **(73%)**	141,135 **(53%)**
Alternative 1 (FRO)	46,602 **(18%)**	7,925 **(3%)**	192,560 **(72%)**	127,848 **(48%)**
Alternative 1 (FRFA)	38,215 **(14%)**	4,707 **(2%)**	143,975 **(54%)**	123,564 **(46%)**
Alternative 4 (Restorative Flood Protection and Aquatic Species Habitat Actions)	120,514 **(45%)**	40,017 **(15%)**	249,345 **(94%)**	179,847 **(68%)**

SUMMARY OF SIGNIFICANT ADVERSE IMPACTS

No Action Alternative

The No Action Alternative would include the continuation of certain ongoing efforts aimed at reducing flood damage and restoring aquatic species habitat. However, it would not meet the Chehalis Basin Strategy objectives because it would result in limited reduction of flood damage and continued degradation of aquatic species habitat over both the short and long terms. In managed forestlands, the No Action Alternative assumes salmon habitat potential benefits from the maturation of riparian areas compared to current conditions. In contrast, the action alternatives include benefits from managed forestland along with active restoration in the lowlands (included within Aquatic Species Habitat Actions) compared to current conditions.

Flood damage reduction and habitat restoration projects would be completed in a piecemeal fashion, with associated impacts and mitigation measures identified on a site-specific, project-level basis. Because the No Action Alternative would not involve a coordinated and integrated approach, benefits are likely to be localized and minimal. The No Action Alternative would have limited local benefits and would allow continued flood damage and degradation of habitat.

Potential long-term, significant adverse impacts related to the No Action Alternative are summarized as follows.

- **Land Use:** Structures within the floodplain would remain vulnerable and could incur substantial damages during major floods. After reoccurring floods, the cost of relief and recovery—and associated psychological effects—could hinder economic growth and development in the Chehalis Basin. Agricultural losses would be lessened to some degree by farm pads that have been constructed, but flooding would continue to cause substantial damage to agricultural lands and infrastructure, potentially including the loss of crops and livestock.
- **Recreation:** Recreational fishing opportunities would continue to decline, and recreation areas and the access roads and bridges to recreational facilities would remain at risk of damage from major floods.
- **Transportation:** During major floods, transportation impacts would continue to occur and could increase. This includes impacts related to I-5 closures, other flooded highways and local roads, flooding within the Chehalis-Centralia Airport, and flooded rail lines.

- **Public Services and Utilities:** Public service facilities and utilities located within the floodplain would continue to be adversely affected by floods, including damaged infrastructure, interrupted services, and temporary service outages.

- **Environmental Health and Safety:** Without a coordinated strategy, there would continue to be delays in emergency response, complications from critical facilities located in the floodplain, and continued potential for contamination of wells and surface water during major floods.

- **Climate Change:** By mid-century, rainfall events are projected to become more severe, and summer streamflows are projected to decrease. Anticipated effects of climate change could result in increased flooding, channel erosion and incision, bank instability and erosion, lateral bank migration, and saltwater intrusion into freshwater areas. Other anticipated effects include shifts in forest composition, reduced air quality from more forest fires, higher temperatures in rivers and streams, and changes in fish and wildlife species composition. Notably, depending on the increases in summer water temperature, spring-run Chinook salmon and other species of salmon and trout could be eliminated from the Chehalis Basin. Without an integrated strategy, flood damage reduction and habitat restoration projects would be completed in a piecemeal fashion, which could reduce the potential of formulating and adapting strategies capable of adjusting to changing climatic conditions.

- **Tribal Resources:** Impacts on tribal resources would continue to occur, primarily related to impacts on fish resources.

- **Cultural Resources (Historic and Archaeological):** Potential adverse impacts on cultural resources would continue to occur. Continued flooding would result in ground disturbance, channel mobility and erosion, increased or changed vehicular and foot traffic patterns, and changing flooding and sedimentation patterns that could potentially expose cultural resources, resulting in damage. Ongoing floodproofing or habitat restoration efforts could also affect cultural resources.

1 Alternative 1:
2014 Governor's Work Group Recommendation

Alternative 1 was designed as an integrated approach to incorporate flood damage reduction and aquatic species restoration into one strategy. Alternative 1 would achieve flood damage reduction through the construction of a dam with a temporary (FRO) or permanent (FRFA) reservoir, Airport Levee Improvements, the Aberdeen/Hoquiam North Shore Levee, and Local-scale Flood Damage Reduction Actions. Aquatic Species Habitat Actions would accomplish the restoration objectives outlined in the Work Group's recommendations.

Compared to the other alternatives, Alternative 1 would result in the greatest reduction in flood depth and extent in the Chehalis River floodplain during a major flood, as detailed in the Comparison of Alternatives section. Flood depths and extents would be reduced most in the upper and middle Chehalis Basin, depending on the location, as well as in Aberdeen and Hoquiam. Some areas would no longer be inundated, some would experience a 10-foot reduction, and most areas would experience a 0.1- to 5-foot reduction in inundation. In the lower Chehalis Basin downstream of Grand Mound, most reductions in inundation would be about 0.5 foot. Even with reduced flood depths and extents in specific areas, some structures would continue to be damaged by floods.

It is anticipated that the Aberdeen/Hoquiam North Shore Levee would protect the areas behind the levee in Aberdeen and Hoquiam from coastal flooding.

Alternative 1 would provide a benefit to aquatic species. The potential response in salmon abundance ranges from an increase of 14% to 54% for the alternative combination with the FRFA facility, or 18% to 72% with the FRO facility, when compared to current conditions.

Aside from the benefits described previously, potentially significant, long-term adverse impacts related to Alternative 1 are summarized below. Compared to the dam, most of the other actions in this alternative would have minor to moderate impacts; thus much of the following discussion focuses on impacts related to the dam.

- **Water Resources:** The Flood Retention Facility has the potential to adversely affect water quality with regard to temperature, dissolved oxygen, and turbidity conditions. A comparison of the potentially significant impacts of the FRO and FRFA facility types, including details and locations for these impacts is provided on page 35. The other action elements in this alternative would have minor impacts on water resources.

- **Geology:** Landslides along the perimeter of the proposed reservoir have the potential to increase as a result of fluctuating water levels. Although the likelihood of an earthquake occurring over the life of the Flood Retention Facility when the reservoir is full, during flood operations, is low, the dam and appurtenant structures would be designed to withstand this potential situation. If a major earthquake occurs when the reservoir is full, and the dam is damaged despite being designed for this situation, it could have an adverse impact on downstream communities.

- **Geomorphology:** Geomorphic functions would be affected by the change in the delivery and distribution of sediment and woody material downstream of the dam to approximately the Chehalis River's confluence with the Skookumchuck River.

- **Wetlands and Vegetation:** Permanent losses of wetlands and forested vegetation would occur with the construction and operation of the action elements associated with Alternative 1, primarily the Flood Retention Facility. Alternative 1 would have the most unavoidable adverse impacts on wetlands and vegetation as compared to the No Action Alternative and other action alternatives. Within the Flood Retention Facility footprint, between 68 (FRO) and 89 (FRFA) acres of wetlands would be affected under Alternative 1.

- **Fish and Wildlife:** The dam would temporarily or permanently inundate fish and wildlife habitat and decrease the current flood regimes that affect some amphibians, which could result in benefits or impacts, depending on the species. Over time, potential changes to habitat could change the composition of species that occur. The long-term impacts on wildlife vary, because different classes of wildlife species (such as amphibians, reptiles, and some mammal and bird species) have different habitat needs and home ranges, with different potential responses to the disturbance and conversion of their habitat.

  Alternative 1 could substantially increase abundance of native aquatic species through implementation of the Aquatic Species Habitat Actions, which would result in beneficial effects to native aquatic and semi-aquatic species and salmon at a Basin-wide scale. However, Alternative 1 would result in impacts on native salmon and aquatic species because of permanent and large-scale changes to the Chehalis River and its floodplain caused by the dam. There would be impacts on fish and amphibians resulting in the potential decline of some species, particularly when considering climate change predictions over the next 100 years. Impacts on fish were modeled for the combination of the Flood Retention Facility and Aquatic Species Habitat Actions, paired

with climate change predictions. The dam associated with Alternative 1 would potentially significantly adversely affect some populations, species, or life stages of salmon and lamprey.

- **Tribal Resources:** Impacts on tribal resources would occur, primarily related to impacts on treaty-reserved fish resources, although disruption to plant and wildlife resources and traditional cultural practices such as hunting and gathering could also occur. The determination of the extent of potential impacts on tribal resources is pending additional coordination with tribes and continued government-to-government consultations.

- **Cultural Resources (Historic and Archaeological):** Impacts on cultural resources following construction of the action elements in Alternative 1 could include sedimentation of any submerged resources, changes in erosion and potential exposure of resources, and increased or changed vehicular and foot traffic patterns that could affect resources. There is a high to moderate potential for archaeological deposits to exist within the vicinity of some of the action elements that are part of Alternative 1, based on the Washington Statewide Archaeological Predictive Model. Impacts on cultural resources may occur due to the predicted archaeological potential in several areas of proposed construction. Potential impacts on tribal cultural resources or graves, Indian human remains, or traditional cultural properties would be determined in coordination with tribes and continued government-to-government consultations.

Comparison of impacts of the Flood Retention Facility types for Alternative 1

	FRO	FRFA
Water Resources	River generally free-flowing; use of reservoir would be temporary with transition to flood retention operations only during major floods (average once in 7 years for up to 32 days) Violation of state water quality criterion for turbidity Up to 4°C increase in summer water temperatures, with a reduction to background temperatures at approximately the confluence of the South Fork Chehalis River; where temperatures are increased, there would be a decrease in dissolved oxygen	6.3 miles of Chehalis River converted from free-flowing to a permanent reservoir Increased thermal stratification (i.e., temperature layers) and decrease in dissolved oxygen within the permanent reservoir during summer and fall Benefits to river flows and temperatures through cool-water flow augmentation downstream of the dam to approximately the confluence of the Skookumchuck River during late spring to early fall
Geology and Geomorphology	Temporary disruption of sediment transport (when operational) including deposition and erosion of sediment in reservoir (up to 5 miles), with up to 50% of bedload retained Approximately 6,000 to 7,000 cubic yards of wood trapped (when operational)	Increased landslide potential in reservoir area Permanent disruption of sediment transport, including deposition and erosion of sediment at upstream end of reservoir (up to 1.5 miles), with all bedload retained All large wood trapped
Wetlands and Vegetation	Potential loss of up to 68 acres of wetlands and 6 acres of vegetation, and impacts from changes in vegetative species composition	Potential loss of up to 98 acres of wetlands and 720 acres of vegetation, and impacts from changes in vegetative species composition
Fish and Wildlife	Reduced habitat function for fish and wildlife species upstream of the dam Reduced fish survival and potential interruptions to salmon spawning due to fish passage impediments during flood operations	Greater reduced habitat function for fish and wildlife species, including loss of stream habitat and salmon spawning and rearing habitat, in the permanent reservoir Greater reduced fish survival; fish passage impediments resulting in almost total elimination of passage for some species Pacific lamprey could be eliminated from the upper Chehalis Basin above the dam, but would continue to occur in the rest of the Basin Fish downstream of dam, such as spring-run Chinook salmon that require cool-water refuge during peak summer months, may benefit from flow augmentation and decreased water temperatures Creation of reservoir habitat that some species and life stages that currently exist in the area would use for rearing or foraging, such as coho salmon, steelhead, largescale sucker, mountain whitefish, or sculpin

2 Alternative 2:
Structural Flood Protection Without Flood Retention Facility

Alternative 2 would achieve flood damage reduction through improving the Airport Levee, constructing the I-5 Projects and Aberdeen/Hoquiam North Shore Levee, and implementing Local-scale Flood Damage Reduction Actions. This alternative does not include the Flood Retention Facility.

Alternative 2 would reduce flood damage during a major flood and benefit aquatic species habitat function when compared to the No Action Alternative. As compared to the other action alternatives, Alternative 2 would reduce flood depths and extents, and therefore flood damage, in a smaller geographic area than Alternatives 1 and 4, but in a larger geographic area than Alternative 3, which would not reduce flood depths and extents. Details are provided in the Comparison of Alternatives section. Flood damage would be reduced because some areas would no longer be inundated, primarily behind the Airport Levee. In parts of the Chehalis/Centralia area, floodwater depths would be reduced by between 0.1 and 1 foot, depending on the location. In locations where flood elevations are reduced, some structures would still be damaged by floods.

Alternative 2 would increase floodwater depths upstream of the levees and walls in some areas, by between 0.1 and 0.9 foot. It is anticipated that the Aberdeen/Hoquiam North Shore Levee would protect the areas behind the levee in Aberdeen and Hoquiam from coastal flooding.

Implementation of the Aquatic Species Habitat Actions in Alternative 2 would substantially increase the abundance of native aquatic species—thereby reducing the potential of future Endangered Species Act (ESA) listings—and substantially enhance tribal and non-tribal fisheries as compared to the No Action Alternative. Alternative 2 is anticipated to result in greater benefits to aquatic species habitat function than Alternative 1, because it would exclude the permanent and large-scale changes to the Chehalis River and floodplain resulting from the Flood Retention Facility. Alternative 2 is anticipated to result in a similar benefit to aquatic species habitat as Alternative 3 and less benefit than Alternative 4.

Aside from the benefits described previously, potentially significant, long-term adverse impacts related to Alternative 2 are summarized as follows.

- **Wetlands:** The permanent loss of up to 7 acres of wetlands would be required to construct the levees and I-5 Projects included in Alternative 2. The alternative would have fewer unavoidable adverse impacts on wetlands than Alternative 1 because it would include limited structural actions in comparison. Alternative 2 would have greater adverse impacts than Alternatives 3 and 4 due to the potential construction-related impacts and floodplain habitat connectivity constraints associated with the levee projects, which are not a part of those alternatives.

- **Tribal Resources:** Impacts on tribal resources would likely occur, primarily related to impacts on fisheries. Impacts on plants and wildlife and disruption of traditional cultural practices such as hunting and gathering could also occur. The potential long-term impacts on fish in Alternative 2 are primarily related to a change in flood extents and elevations upstream and downstream of the levee during major floods. The extent of potential impacts on tribal resources is pending additional coordination with tribes and continued government-to-government consultations.

- **Cultural Resources (Historic and Archaeological):** Impacts on cultural resources may occur due to the potential for archaeological deposits to exist within the vicinity of proposed areas of construction, although the degree or severity of the impacts would depend on the nature of the cultural resources that would be disturbed. Potential impacts on tribal cultural resources or graves, Indian human remains, or traditional cultural properties would be determined in coordination with tribes and continued government-to-government consultations.

3 Alternative 3:
Nonstructural Flood Protection

Alternative 3 would reduce flood damage in the Chehalis Basin through significant investments in floodproofing, local-scale flood damage reduction projects, and improved land use management. The implementation of Local-scale Flood Damage Reduction Actions would protect key properties and infrastructure in specific locations from flood damage and a substantial portion of the structures in the Chehalis River floodplain through elevation, other floodproofing measures, and buy-outs.

This alternative would significantly reduce the pattern of damage and recovery to structures and their contents associated with major floods, but would not reduce flood damage or disruption to transportation systems, public services, and agricultural properties or crops. Livestock could be protected where farm pads are constructed as part of the Local-scale Flood Damage Reduction Actions. Low-lying areas in Aberdeen and Hoquiam would continue to be at risk of coastal flooding. During major floods, I-5 closures, flooding of the Chehalis-Centralia Airport, and flooding of rail lines would continue to occur. Local roadways that currently flood during major floods would continue to do so, except where smaller-scale flood reduction projects reduce flooding of local roadways.

Alternative 3 has the potential to reduce threats to human health and safety when compared to the No Action Alternative, because Alternative 3 would protect structures in the floodplain and allow people the option of safely waiting out many floods in their homes.

However, Alternative 3 would not improve the ability to access critical medical facilities as compared to the No Action Alternative, and would not reduce disruptions to industry, commercial businesses, and public services—with the exception of protecting the structures that house them in the event those structures have been floodproofed. Additional details are provided in the Comparison of Alternatives section.

This alternative would have fewer adverse effects to aquatic species habitat function than Alternatives 1 and 2, because it does not include Large-scale Flood Damage Reduction Actions. When implemented as a comprehensive strategy, Alternative 3 would substantially increase the abundance of native aquatic species, reduce the potential for future ESA listings, and enhance tribal and non-tribal fisheries as compared to the No Action Alternative. Alternative 3 would have less benefit to aquatic species habitat function than Alternative 4 because of the treatments associated with the Restorative Flood Protection action element, including placement of engineered wood structures, implemented as part of that alternative.

Alternative 3 would not result in significant adverse impacts on any elements of the built or natural environment; however, bank stabilization impacts on fish habitat cumulatively could be significant, depending on the project setting.

- **Tribal Resources:** The extent of potential impacts on tribal resources is pending additional coordination with tribes and continued government-to-government consultations.

- **Cultural Resources (Historic and Archaeological):** Impacts on cultural resources may occur due to the potential for archaeological deposits to exist within the vicinity of proposed areas of construction, although the degree or severity of the impacts would depend on the nature of the cultural resources that would be disturbed. Potential impacts on tribal cultural resources or graves, Indian human remains, or traditional cultural properties would be determined in coordination with tribes and continued government-to-government consultations.

4 Alternative 4:
Restorative Flood Protection

Alternative 4 includes the implementation of Restorative Flood Protection as a Large-scale Flood Damage Reduction Action. This action element would result in flood damage reduction through the relocation of at-risk landowners and uses out of the floodplain, and some reduction in flood peaks downstream of the Newaukum River confluence on the mainstem Chehalis River. This alternative also includes implementation of all the Local-scale Flood Damage Reduction Actions and range of Aquatic Species Habitat Actions. The Restorative Flood Protection action element would be coordinated with and complement the Aquatic Species Habitat Actions within the treatment areas.

Alternative 4 addresses flooding in tributary areas of the Chehalis River—North and South Fork Newaukum River, South Fork Chehalis River, Stearns Creek, Bunker Creek, Lake Creek, Stillman Creek, and Elk Creek—largely through supporting relocation and adaptation of at-risk land uses under existing conditions. Alternative 4 would increase the extent and depth of flooding above the Chehalis River confluence with the Newaukum River, and reduce the extent and depth of flooding in the Chehalis-Centralia area by 0.1 to 1 foot. However, because Alternative 4 includes the relocation of 16,000 acres of current land uses upstream of the Newaukum confluence out of the floodplain, it would result in a greater reduction of flood damage than Alternative 1. Additional details are provided in the Comparison of Alternatives section.

When implemented as a comprehensive strategy, Alternative 4 would substantially increase the abundance of native aquatic species, reduce the potential for future ESA listings, and substantially enhance tribal and non-tribal fisheries as compared to the No Action Alternative. Alternative 4 would increase wetland areas, improve riparian vegetation communities, and improve connectivity to floodplain habitat. These treatment actions would provide the most benefits to fish and wildlife, both in the channels and within connected floodplain habitats. The potential response in salmon abundance ranges from an increase of 45% to 94% when compared to current conditions, depending on species.

Restorative Flood Protection treatment areas would cover up to 21,000 acres within the channels and floodplains of the Newaukum, South Fork Chehalis, and mainstem Chehalis rivers, and Stearns, Stillman, Elk, Bunker, and Lake creeks. Within these treatment areas, increased flooding would occur, which would be addressed through buy-outs, floodproofing, and easements. Much of this area is subject to current flood and erosion risks, which are predicted to worsen under climate change forecasts. With the

removal of existing structures and conversion of land uses within the newly created greenway, future flooding and damage to these properties would be eliminated.

Aside from the benefits described previously, the potentially significant, long-term adverse impacts related to Alternative 4 are summarized as follows.

- **Vegetation:** Within areas where current floodplain land uses are relocated, long-term impacts on vegetation could include converting up to 16,000 acres of managed forestland to other uses (e.g., agricultural, residential, and commercial development). This conversion may be offset by restorative treatments that include planting riparian vegetation in equivalent valley-bottom areas.

- **Land Use:** Restorative Flood Protection treatments would be incompatible with many existing land uses. Based on the preliminary analysis conducted, the area within the 10-year floodplain where the restorative treatment is implemented would be largely unsuitable for people to reside. This zone, described in the Restorative Flood Protection description as the "river management zone" or "greenway," is expected to experience active channel migration, engagement of floodplain wetlands, and frequent flooding such that structures would be at risk of severe flood and erosion damage. There are currently approximately 16,000 acres within this zone, including 8,500 acres of active farmland. New or increased flooding to an area potentially reaching 21,000 acres in the future 100-year floodplain could occur, which would include a total of 12,100 acres of active farmland.

  Willing landowners would be offered a suite of compensation options, which could include relocating to suitable upland areas that would not be affected by the Restorative Flood Protection treatments.

- **Cultural Resources (Historic and Archaeological):** Although the degree or severity of the impact on cultural resources would depend on the nature of the disturbance, moderate to significant adverse impacts on cultural resources could occur due to the predicted archaeological potential. Potential impacts on tribal cultural resources or graves, Indian human remains, or traditional cultural properties would be determined in coordination with tribes and continued government-to-government consultations.

- **Transportation:** Upstream of the Newaukum River confluence during a 100-year flood, the duration of closure of SR 6 would increase by approximately 4 days, SR 506 by approximately 1 to 2 days, and SR 508 by approximately 2 days. Closures of I-5 and flooding of local roads and the Chehalis Centralia Airport would continue during 100-year floods.

- **Public Services and Utilities:** Relocation of agricultural, residential, and commercial land uses out of the future Restorative Flood Protection 10-year floodplain would require disconnection and decommissioning of existing public utilities and relocation of services and utilities to the upland areas where the displaced land uses would be relocated. This could require extension of utilities including electricity, water supplies, and sewer services.

- **Environmental Health and Safety:** Increased flooding could affect emergency response services in the areas upstream of the Newaukum River confluence with the Chehalis River. Higher flood levels and increased duration of road and airport closures could prevent or delay emergency service access.

AREAS OF UNCERTAINTY AND CONTROVERSY

Potential impacts of the Chehalis Basin Strategy have been evaluated at a broad, programmatic level, with the action elements assessed in different combinations. With this broad scope and evaluation comes a degree of uncertainty. There are also areas of controversy associated with implementing some of the action elements and alternatives. The information in the EIS is based on the information and data available for each action element and combined alternative. More quantitative evaluations would occur through future project-level environmental review to identify the site- and project-specific impacts associated with implementation of given actions, and to reduce the uncertainty and controversy associated with actions that may move forward.

Areas of Uncertainty

- **Ownership, Costs, and Funding:** Funding levels and sources for the action alternatives have not been determined. Details regarding who will be responsible for implementing, maintaining, and operating some of the action elements included in the combined alternatives have not been identified. The information that is currently available on ownership, costs, and funding is provided in Section 3.5 of the Comment Response Report. A timeline or sequence for implementation of the action alternatives has not been determined, and would be contingent upon available funding. To evaluate the impacts of implementing a selected course of action, the EIS and its supporting analyses assume that the effect of an action, positive or negative, would be fully in place in year 1 of the 100-year study period.

- **Effects of Climate Change:** Another area of uncertainty is the magnitude of the effects of climate change on the Chehalis Basin (such as increased sea levels, reduced snowpack, changes in water availability, changes in streamflow timing, increased forest fires, and more extreme precipitation events and flooding). Adverse impacts that currently affect water resources and aquatic habitat are anticipated to worsen as a result of climate change. The effects of climate change may reduce the effectiveness of the projects implemented in association with Aquatic Species Habitat Actions. Research has shown that atmospheric rivers are projected to increase across the region, resulting in higher rainfall associated with these storms. The risk of winter flooding is also anticipated to increase, and summer low flows are anticipated to further decrease.

- **Effectiveness of Restoration:** There is uncertainty as to the effectiveness of restoration from the maturation of riparian buffers in managed forestlands over time. There is also uncertainty associated with site-specific conditions and landowner willingness to allow restoration of habitat on private property. The "effectiveness" of restoration was modeled at ranges of 20% and 60% to account for this uncertainty.

- **Forest Practices:** Uncertainties connected to forest practices relate to summer low flows, channel-forming flows, and peak flows. There is agreement in the literature that in small drainages, summer low flows temporarily increase after forest harvesting, but uncertainty about how long those effects persist. There is also agreement that in small basins, forest harvesting results in an increased magnitude of channel-forming flows, which could potentially be detrimental to fish habitat, but the details of these changes depend on local conditions such as geology, topography, and sediment supply. There is also mixed evidence about the effect of forest harvesting on large floods in rain- and rain-on-snow-dominated systems.

- **Fish Responses:** It is uncertain how different fish species would respond to the effects of climate change, and how they would respond if a Flood Retention Facility was constructed. In general, climate change would likely benefit warm-water species and negatively affect cold-water species such as salmon, but it is possible that both types of fish species may adapt their behavior to a warmer system over time. This potential adaptation to climate change creates uncertainty on how fish species would respond to the decreases in water temperature that would be provided with the FRFA facility. For a programmatic analysis of the potential effects of the FRFA dam on fish, please see the Comment Response Report, EIS Section 4.2.4.2.1, and the additional technical analysis in EIS Appendix K.

- **Fish Passage:** An additional area of uncertainty is related to fish passage if a Flood Retention Facility was constructed. A great deal of information was developed regarding fish abundance and the conceptual design of the passage facilities. In addition, fish survival through the facilities was estimated based on similar designs used at other dams in the Pacific Northwest. However, there is uncertainty associated with each of the fish passage concepts since the design effort was focused at the conceptual level and not all design details were fully developed. The passage options are described in the Comment Response Report and EIS Section 2.3.3.1, and total fish passage survival through the facilities evaluated during conceptual design is presented in EIS Section 4.2, Table 4.2-5. Engineering design is a step-wise process, and additional evaluations would be needed during project-level environmental review to further inform the effectiveness of the fish passage options and effects of the FRO and FRFA facility on the fish species present in the upper Chehalis River.

- **Causes of Flooding:** Historically, extreme rainfall from atmospheric rivers has been the primary contributor to major floods in Western Washington. Some people question whether increased land development will contribute more to the causes of flooding.

- **Landowner Willingness:** Finally, several action elements and combined action alternatives would be constructed on private property or affect landowners during operation or implementation. Agreement from willing landowners and cooperation amongst Chehalis Basin communities would be required before implementing the flood damage reduction and aquatic species habitat actions evaluated in this EIS. Ongoing engagement with Chehalis Basin communities, agencies, and tribes will be vital to help reduce this area of uncertainty.

Areas of Controversy

- **Large-scale Flood Damage Reduction Actions:** Several of the alternatives include dams, levees, and restorative flood protection actions that are controversial. Alternative 1 includes the Flood Retention Facility (e.g., a dam) action element. Historically, dams have had significant adverse impacts on aquatic systems and species. Consequently, construction of either the FRO or FRFA dam is controversial. Alternatives 1 and 2 include improvements to existing or construction of new levees and floodwalls. Due to the potential for cumulative impacts on fish, fish habitat, and land use from changes in hydrologic flow and extent, these types of flood protection structures are also controversial.

  For Alternative 4 to effectively reduce flood damage, landowners along key corridors in the upper Chehalis Basin would need to voluntarily allow parts or all of their existing floodplain property to be flooded longer and for floodplain land in valley bottoms to be reforested. In some locations, increased inundation would significantly affect existing structures and land uses, and would require the relocation of these residents and their properties or land uses to adjacent or nearby uplands. The effect on existing communities from additional flooding and relocation is controversial.

- **Land Use in the Floodplain:** The Land Use Management actions involve recommendations for local governments to improve and revise land use regulations and practices to protect remaining floodplain functions and prevent future flood damage by minimizing floodplain development. There is some controversy related to existing patterns of development in the Chehalis River floodplain and how potential regulatory modifications would be implemented in the floodplain.

More detailed environmental review, including identification of specific impacts and mitigation measures for any controversial actions, would be conducted during project-specific review or before implementation.

Photography Credits:

Front Cover
Left: The Chronicle, Centralia, Washington
Center right: Caitlin McIntyre, Lacey, Washington
Bottom right: Caitlin McIntyre, Lacey, Washington

Page 1
Bottom: The Chronicle, Centralia, Washington

Page 3
Top: Jessica Roberts, Montesano, Washington
Bottom: Junior Goodell; Ecology has a nonexclusive copyright to use this photo solely for publication in the EIS

Page 4
The Chronicle, Centralia, Washington

Page 5
Left: The Chronicle, Centralia, Washington

Page 12
Right: The Chronicle, Centralia, Washington

Page 13
Top right: French Whetmore
Center left and right: RCO
Bottom: Junior Goodell; Ecology has a nonexclusive copyright to use this photo solely for publication in the EIS

Page 22
Junior Goodell; Ecology has a non-exclusive copyright to use this photo solely for publication in the EIS

Page 27
The Chronicle, Centralia, Washington

Back Cover
Top left: The Chronicle, Centralia, Washington
Center left: Jeffry Seldomridge, Curtis, Washington
Bottom left: The Chronicle, Centralia, Washington


CASINO