Chehalis River Basin

Comprehensive Flood Hazard Management Plan

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Chehalis River Basin Flood Authority

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CHEHALIS
RIVER BASIN
FLOOD AUTHORITY

ACRONYMS

AF	acre feet
BA	Biological Assessment
BE	Biological Evaluation
BMC	Bucoda Municipal Code
BMP	Best Management Practice
CEQ	Council on Environmental Quality
CFHMP	Comprehensive Flood Hazard Management Plan
CFR	Code of Federal Regulations
CFRP	Centralia Flood Reduction Project
cfs	cubic feet per second
CMC	Chehalis Municipal Code
COE	U.S. Army Corps of Engineers
Corps	U.S. Army Corps of Engineers
CMZ	Channel Migration Zone
CRS	Community Rating System
CTED	Community, Trade, and Economic Development
CWA	Clean Water Act
CWPO	Closed Without Payment
DOE	Department of Ecology
DST	Decision Support Tool
Ecology	Washington State Department of Ecology
EIS	Environmental Impact Statement
EO	Executive Order
EPA	Environmental Protection Agency
ER	Emergency Response
ESA	Endangered Species Act
ESSB	Engrossed Substitute Senate Bill
FCAAP	Flood Control Assistance Account Program
FEMA	Federal Emergency Management Association
FERC	Federal Energy Regulatory Commission
FHWA	Federal Highway Administration
FIA	Federal Insurance Administration
FIRM	Flood Insurance Rate Map
FMA	Flood Mitigation Assistant grant program
FONSI	Finding of No Significant Impact
GI	General Investigation
GIS	Geographic Information System
GMA	Growth Management Act
GO	General Obligation
HEC-RAS	Hydrologic Engineering Centers River Analysis System
HHS	Human Health & Safety
HPA	Hydraulic Project Approval
LCC	Lewis County Code

LID	local improvement district
LiDAR	Light Detection and Ranging
LLC	Limited Liability Company
LWD	large woody debris
MI	Major Infrastructure
NEPA	National Environmental Policy Act
NF	North Fork
NFIP	National Flood Insurance Program
nhc	Northwest Hydraulics Consultants
NHMP	Natural Hazards Mitigation Plan
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resource Conservation Service
NSIP	National Streamflow Information Program
NWS	National Weather Service
O&M	operation and maintenance
OHWM	ordinary high water mark
OMC	Oakville Municipal Code
PCB	polychlorinated biphenyl
PL	Public Law
PUD	Lewis County Public Utility District
RCW	Revised Code of Washington
RM	River Mile
SaSI	Salmonid Stock Inventory
SBA	Small Business Administration
SEPA	State Environmental Policy Act
SFHA	Special Flood Hazard Area
SMA	Shoreline Management Act
SMP	Shoreline Master Program
SR	State Route
SRF	State Revolving Fund
TCC	Thurston County Code
TMDL	Total Maximum Daily Load
USACE	U.S. Army Corps of Engineers
USC	U.S. Code
USDA	U.S. Department of Agriculture
USFSW	U.S. Fish and Wildlife Services
USGS	United States Geological Survey
WDFW	Washington Department of Fish and Wildlife
WRDA	Water Resources Development Act
WRIA	Water Resource Inventory Area
WSDOT	Washington State Department of Transportation
WWTP	Wastewater Treatment Plant

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CHAPTER 1 INTRODUCTION AND GOALS

Background

The Chehalis River Basin Flood Authority (Flood Authority) has prepared this Comprehensive Flood Hazard Management Plan (CFHMP) for the Chehalis River basin to define flood problems in the basin and to propose solutions for those problems. The CFHMP will remain a work in progress and will be revised as the Flood Authority continues its efforts to develop solutions to flooding problems.

Major Flooding Issues in the Basin

Flooding is a common, historical occurrence in the Chehalis River basin. Major flood events on the Chehalis River have affected Lewis, Thurston, and Grays Harbor Counties in the years 1972, 1975, 1986, 1990, 1996, 2007, and 2009. Flooding has caused millions of dollars of flood damage and the disruption of lives and commerce. Flooding closed Interstate 5 through Chehalis and Centralia for multiple days during the 1996, 2007, and 2009 floods.

Authority and Scope for the Chehalis River Basin CFHMP

The Flood Authority was formed in response to the 2007 flooding event throughout Lewis, Grays Harbor, and Thurston Counties and on the Chehalis Reservation. The Flood Authority was formed by an Interlocal Agreement between 11 jurisdictions in the river basin in April 2008, to evaluate flooding issues throughout the basin. Through House Bills 3374 and 3375, the Legislature appropriated $2.5 million for the Flood Authority to develop or participate in the development of flood hazard mitigation measures throughout the basin. The House Bills appropriated an additional $47.5 million in state general obligation bonds to the Office of Financial Management, working with and through other state agencies, the Flood Authority, and other local governments, to participate in flood hazard mitigation projects for the Chehalis River basin.

The Flood Authority consists of 11 jurisdictions: Grays Harbor, Lewis, and Thurston Counties; the Confederated Tribes of the Chehalis Reservation; the cities of Aberdeen, Centralia, Chehalis, Montesano, and Oakville; and the towns of Bucoda and Pe Ell.

The purpose of the Flood Authority, according to the Interlocal Agreement, is to develop and participate in the development of flood hazard mitigation measures throughout the basin, and provide a formal and organized process to ensure:

- That flood control projects are identified and implemented that address the flood problems in the basin;
- That good public policy supports environmentally sensitive responses to protect communities and their residents from flooding, if the responses provide benefits which exceed costs, including costs associated with a no action response;
- That state and federal funding sources are well-informed of Basin Government options and needs;

- That the design for basin flood control projects incorporates options, features and betterments that may benefit the basin communities and the basin governments; and
- That the Flood Authority will oversee moving current and future Chehalis River basin flood reduction projects forward until such time as a Flood Control District is formed and adopted by the stakeholders' legislative authorities.

The Flood Authority also agreed to the following goals in the Interlocal Agreement:

- To create a Basin Flood Control District as soon as is practicable.
- To inform state and federal funding sources of project options and the needs of the basin communities.
- To work with the State of Washington to develop appropriate policy for a basin-wide flood control project.
- To seek adequate funding for the Basin Governments to identify, study and permit projects for localized problems.
- To disseminate information to residents about options and alternatives.
- To coordinate flood control activities, actions and responses.

The Flood Authority decided in November 2008 to develop a basin-wide CFHMP as a means to document flood conditions in the basin and to identify projects for funding in the future.

Plan Development Process

The Flood Authority began preparing the CFHMP in January 2009. Existing CFHMPs for basin jurisdictions formed the basis for the CFHMP. The Flood Authority also conducted a monthly series of work sessions from January through June 2009 to develop the plan.

This CFHMP follows the guidelines of the State of Washington Flood Control Assistance Account Program (FCAAP) and the Federal Emergency Management Agency's Community Rating System (CRS).

Summary of Public Involvement and Agency Coordination

The Flood Authority held two public workshops in February 2009, one in Chehalis on February 11 and one in Montesano on February 12. Approximately 200 people attended the workshop in Chehalis and approximately 40 people attended in Montesano. At the workshops, the Flood Authority introduced the planning process to members of the public then asked for feedback specifically on goals, flood problem areas, and recommended actions.

In March 2009, the Flood Authority commissioned Stuart Elway of Elway Research to perform a public values telephone survey of basin residents. The Flood Authority used the results of the survey to revise its goals at its work session on April 2, 2009.

Defining Goals

The Flood Authority began its CFHMP process with a workshop on goals held on January 15, 2009. For the purpose of the workshop, the Flood Authority agreed to the following definitions of "goal," "objective," and "task":

- **Goal** – A statement that provides clear direction and purpose but may not be fully attainable
- **Objective** – A product or effort that moves toward the goal, is attainable and is measurable, and has various discrete products
- **Task** – A discrete product or effort that is possible, measurable, and contributes to the objective

At the January 15 workshop, the Flood Authority agreed upon eight initial goals. After the workshop, the Board Advisory Committee further developed the language of the goals. In February 2009 the Flood Authority conducted public workshops to gather citizen feedback on goals. In March 2009 the Flood Authority conducted a public values telephone survey. The Flood Authority held a goal revision workshop on April 2, 2009, to reconsider its goals in light of public feedback from the public workshops and the survey. The Flood Authority agreed to revise one existing goal and add a new goal.

The nine goals adopted by the Flood Authority are:

- Protect life and property basin-wide, including tributaries, by developing a mix of strategies that reduce flood damage.
- Promote the wise use of public and private resources.
- Enhance understanding of the hydrologic processes in the Chehalis River system.
- Ensure that land use plans and regulations protect floodplain functions.
- Ensure that flood reduction strategies protect, or enhance, the basin's natural resources.
- Increase public awareness and understanding of flooding.
- Assure that there are mechanisms in place to implement the recommendations in this plan.
- Protect the communities' interest in growth and economic sustainability.
- Protect property rights.

Related Plans

This CFHMP is based on existing CFHMPs developed by jurisdictions within the Chehalis River basin. Table 1-1 lists the existing CFHMPs that were used.

Table 1-1. Existing Comprehensive Flood Hazard Management Plans

Jurisdiction	Title	Year	Notes
Bucoda	Town of Bucoda Comprehensive Flood Hazard Management Plan	2009	Plan prepared as an "Annex" to the Thurston County plan.
Centralia	City of Centralia Comprehensive Flood Management and Natural Hazards Mitigation Plan	2008	Flooding issues are the same as presented in the Lewis County CFHMP.
Chehalis Tribe	Comprehensive Flood Hazard Management Plan for Confederated Tribes of the Chehalis Reservation	2009	
Montesano	All Hazard Mitigation Plan Addendum 2	2007	Addendum to Natural Hazards Mitigation Plan for the Grays Harbor Region
Lewis County	Lewis County Comprehensive Flood Hazard Management Plan	2008	
Grays Harbor County	Grays Harbor County Comprehensive Flood Hazard Management Plan	2001	
Thurston County	Natural Hazards Mitigation Plan for the Thurston Region	2009	

CHAPTER 2 STUDY AREA CHARACTERISTICS

The study area for the Draft Comprehensive Flood Hazard Management Plan (CFHMP) includes the entire Chehalis River basin (Figure 2-1). The basin is located in western Washington, mostly in Grays Harbor, Lewis, and Thurston Counties. Small portions of the basin are located in Cowlitz, Jefferson, Mason, Pacific, and Wahkiakum Counties. The headwaters of the Chehalis River are in the southwest corner of the basin. The river flows generally north-northwest, discharging into the Pacific Ocean through Grays Harbor.

This chapter provides a general description of the physical, land use, and population characteristics of the Chehalis River basin.

Study Area Description

The mainstem Chehalis River and its tributaries form the Chehalis River basin, which drains approximately 2,700 square miles. The basin is bounded by the Pacific Ocean to the west, the Deschutes River basin to the east, the Olympic Mountains to the north, and the Willapa Hills and Cowlitz River basin to the south. Elevations within the basin range from sea level at Grays Harbor to over 3,000 feet in the Coast Range.

Four population centers are located within the basin—Chehalis, Centralia, Aberdeen, and Hoquiam. The Confederated Tribes of the Chehalis Reservation is located within the basin. In the year 2000, total population in the Chehalis River basin was approximately 141,000 (U.S. Census, 2000). The river is paralleled by major transportation routes including State Route (SR) 6 from Pe Ell to Chehalis, Interstate 5 from Chehalis to north of Centralia, Highway 12 from Interstate 5 to near Elma, and U.S. Highway 101 from Elma to the river mouth.

The Chehalis River basin is the second largest basin by area in Washington, next to the Columbia River basin. The basin is divided into two Water Resource Inventory Areas (WRIAs). WRIA 22 contains the upper Chehalis basin upstream from the town of Porter. The lower Chehalis basin is located in WRIA 23 and is downstream from the town of Porter. In 2004, the Chehalis Basin Partnership completed a Watershed Management Plan for the basin under the authority of the state Watershed Management Act (RCW 90.82) (Chehalis Basin Partnership, 2004). That plan and its supporting documents provided much of the information used in this chapter.

Forest and shrub cover dominate the Chehalis River basin. Other land use includes agriculture, urban and industrial uses. The Chehalis River basin contains 180 lakes, ponds, and reservoirs and covers approximately 3,350 linear stream miles. A variety of fish and wildlife species are supported by streams, lakes, ponds, and reservoirs in the basin (Envirovision, 2000).

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CREATED BY: JAB / DATE LAST UPDATED: 06/30/09

SOURCE: USGS, 2008; ESRI, 2008; National Weather Service (NWS), 2008; WA Dept. of Ecology, 2000; WDNR, 2008.

Chehalis River Basin Facilitation . 208379

Figure 2-1
Chehalis River Basin
Washington

The Chehalis River flows for approximately 125 miles north-northwest through the Chehalis River basin and discharges into the Grays Harbor Estuary. The river originates in the Coast range in the southwest corner of the basin and flows east to Chehalis, north to Grand Mound, and west to its mouth. Several tributaries drain into the Chehalis River in the study area. The main tributary rivers starting upstream are the Newaukum River, Skookumchuck River, Black River, Satsop River, Wishkah River, and Wynoochee River. In addition, the Hoquiam and Humptulips Rivers flow directly into Grays Harbor. A number of creeks also contribute to the Chehalis River. The major creeks include Salzer Creek, Dillenbaugh Creek, China Creek, Scatter Creek, Porter Creek, and Cloquallum Creek.

Physical Characteristics

Climate

The climate in the Chehalis River basin is temperate throughout the year, with wet winter and dry summer months. Most precipitation occurs in the fall and winter when frequent passage of low pressure systems pass through the area (Lewis County, 2008). High pressure systems dominate the area in warmer months which have significantly less rainfall. In addition to seasonal fluctuations, climate in the Chehalis basin is influenced by mountain range and proximity to the Pacific Ocean. Temperatures are more moderate near the coast than in the interior and more precipitation occurs on the windward side of mountain ranges.

The majority of precipitation within the basin falls as rain. The surrounding mountain ranges receive snow accumulation during winter months, although snow generally does not accumulate for long periods. Most precipitation accumulates between the months of October and May. Peak river discharges generally occur between December and March. The highest precipitation in the basin is received in the headwaters of the Wynootchee River in the Olympic Mountains with an annual average of 220 inches.

Table 2-1 summarizes temperature and precipitation averages for Aberdeen near the coast and Centralia in the interior.

Table 2-1. Precipitation and Temperature Recordings for Aberdeen and Centralia

	January Temperature Range	July Temperature Range	October to March Precipitation Range	July Average Precipitation	Annual Precipitation
Aberdeen	35-46°	52-69°	5- 8 inches	1.35 inches	83.7 inches
Centralia	35-47°	54-79°	7-13 inches	0.8 inches	47.4 inches

Source: CityTownInfo.com, 2010

The warmest temperatures in the basin occur during July and the coldest during January. The average frost-free period ranges from 163 days to more than 190 days (Envirovision, 2000).

Geology

The Chehalis Basin has several distinct geologic regions with unique geologic history. For example, the headwaters arise out of the Willapa Hills, which are primarily comprised of marine volcanic and sedimentary rocks, while some other regions are primarily glacially influenced (Envirovision, 2000). Much of the basin is underlain by old ocean floor that was dragged up when the Olympic Mountains were uplifted. The hills and valleys were carved into these slabs of oceanic rock by erosion, resulting in low rounded hills and ravines. At the end of the ice ages, meltwater from the Puget Sound glaciers flowed down the Black River and lower Chehalis River. After the ice ages ended, sea levels rose by several hundred feet and flooded the mouth of the Chehalis. This created Grays Harbor, and caused the river valleys to fill in with sediment.

The complex geologic history of the Chehalis River basin dictates to a large degree the distribution, quantity, and movement of groundwater. Primary geologic units include bedrock of volcanic and sedimentary origin, as well as glacial deposits and alluvial material. Volcanic rocks (primarily basalt flows) underlie most of the basin, but have been overlain by sedimentary deposits of marine and non-marine origin or glacial material. Near surface volcanic deposits dominate the Black Hills west of the Black River, as well as the southern Olympic Mountains. Scattered volcanics occur throughout the remainder of the Chehalis River basin.

Sedimentary rocks include those of the Eocene/Oligocene epoch (55 to 24 million years ago) and younger rocks of the Miocene epoch (24 to 5 million years ago). The older sedimentary rocks dominate the Lincoln Creek and South Fork Chehalis basins, in addition to terraces along the mainstem Chehalis River. The younger rocks are found primarily between the Satsop and Wynoochee River valleys.

Much of the basin possesses glacial deposits from at least four different glaciations. The Black River/Scatter Creek area is underlain by approximately 100 feet of deposits from the southern terminus of the Vashon stade of the Fraser glaciation (21,000 to 19,000 years ago), which inundated Puget Sound. In addition, alpine glaciers have flowed south from the Olympic Mountains, shaping the surface features of much of the lower Chehalis Basin. Finally, the major river valleys contain significant deposits of alluvial material. This material is often mixed with glacial deposits, forming a complex mosaic of unsorted material (Envirovision, 2000).

Topography

The Chehalis River originates in the Willapa Hills, part of the Coastal Range. Elevations range from below 2,400 feet to 3,110 feet. The mainstem Chehalis River flattens into an open river valley below Pe Ell. The South Fork Chehalis River opens to a low-gradient river valley at the Lewis County/Cowlitz County line.

The middle portion of the Chehalis River meanders through a flat river valley. The west side of the river is used primarily for agricultural purposes. The east side of the river has been developed into the Centralia and Chehalis urban areas. The river channel narrows to approximately 150 feet wide and flows through a channel dominated by pool habitat with occasional riffle habitat. South of Grand Mound, the river flows through the coastal hills, and the river valley separates the Doty and Willapa Hills to the south from the Black Hills located to the north. Elevations range from approximately 100 feet to 2,700 feet at Larch Mountain, the tallest of the Black Hills.

Areas located north of the lower Chehalis River are characterized by open river valley. The south side of the river contains steeply rising hills. A portion of the open river valley to the north transitions into tributary river valleys; other areas transition into sloping hillsides.

Soils

The Chehalis River basin floodplain contains five major soil associations (Table 2-2) (Envirovision, 2000). These soils occur in flat or gently sloping terrain and include the major tributary systems within the basin. In floodplain fringes, cropland, and pasture areas, dominant vegetation includes western red cedar, red alder, black cottonwood, and willow species. Areas of moderate to well-drained soils contain some Douglas-fir trees.

Table 2-2. Major Soil Groups in the Chehalis River Basin

Soil Group	Percent Land	Location	Geographic Description
Group A	6	Southern Olympic slope in the northern basin	Steep and very steep well-drained soils
Group B	1	Coast from Grayland-Westport and north beach area; Copalis	Deep sandy, poorly-drained deposits; tidal estuaries
Group C	27	Eastern third of the basin, Chehalis-Centralia urban area	Steep glacial plains and rolling grassy prairie terrain
Group D	19	Chehalis floodplain and major tributaries	Level and gently sloping alluvial soils
Group E	47	Western two-thirds of the basin between Thurston County line and coast	Forested foothills and steep slopes

Source: Envirovision, 2000

Hydrology

Groundwater Hydrology

Groundwater movement in the Chehalis River basin is determined by the complex geologic formations that shape the basin (Ecology, 1998a). The primary surficial aquifers within the basin are contained in the unconsolidated glacial and alluvial deposits, located in the river valleys and upland prairies. Bedrock formations provide low yields

of local groundwater and are not generally associated with surficial aquifers within the basin. Surficial aquifers generally occur between several feet below ground surface and can extend to approximately 100 feet deep. Wells associated with the primary surficial aquifers can generate between 200 gallons and 3,000 gallons per minute. Groundwater flow generally spreads from upland recharge areas along aquifer perimeters toward natural discharge points along streams and tributaries. Groundwater movement also occurs downward in elevation to recharge regional aquifers.

Alluvial aquifers in the tributary system of the Chehalis River are much shallower, with a depth generally occurring within 20 feet of the ground surface (Ecology, 1998a). These aquifers provide a local water source for farms, private residences, and public water systems. Because of the shallow water table and hydraulic connection to other waterbodies, these aquifers are susceptible to groundwater contamination.

Surface Water Hydrology

Rainfall is a primary water source for the Chehalis River basin. The majority of precipitation in the basin accumulates as rain. The surrounding mountains also receive snow accumulations during winter months. Discharge levels within the basin peak between December and March. Average annual discharge within the basin is approximately 11,210 cfs. Delayed runoff from snowmelt primarily impacts the Wynoochee and Satsop Rivers. Tables 2-3 through 2-7 illustrate average flow patterns at the main gauges on the Chehalis River and on the Newaukum and Skookumchuck Rivers. Flood flows are described in Chapter 5.

Table 2-3. Average flow at Chehalis River near Doty, WA (cfs).

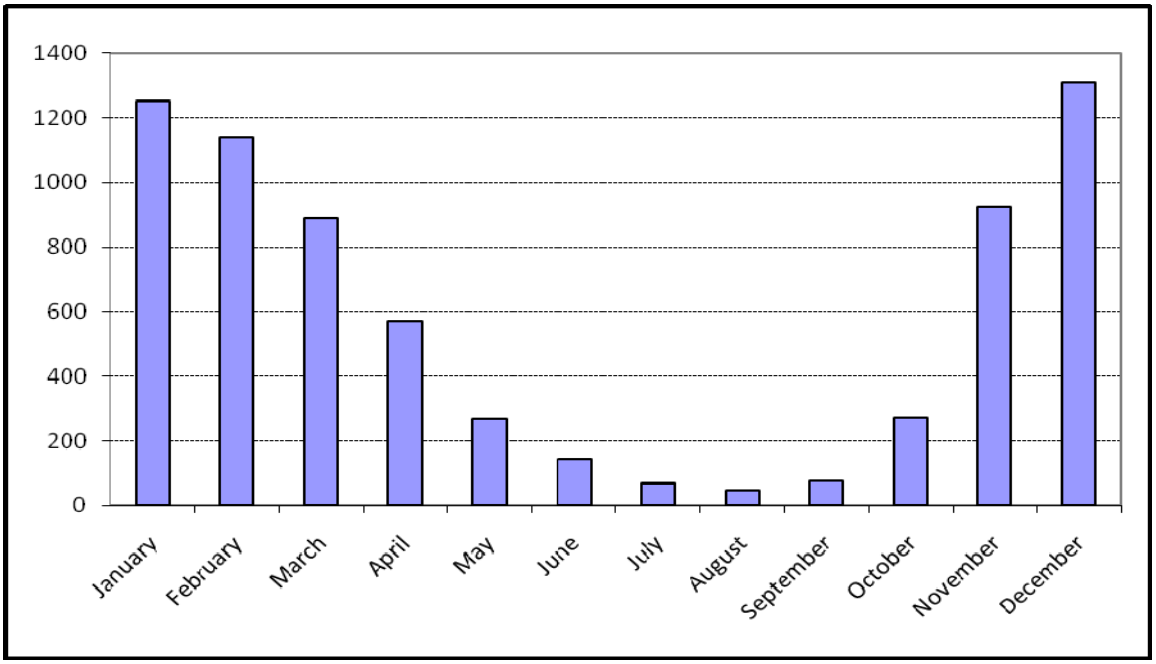


Table 2-4. Average flow at Newaukum River near Chehalis, WA (cfs).

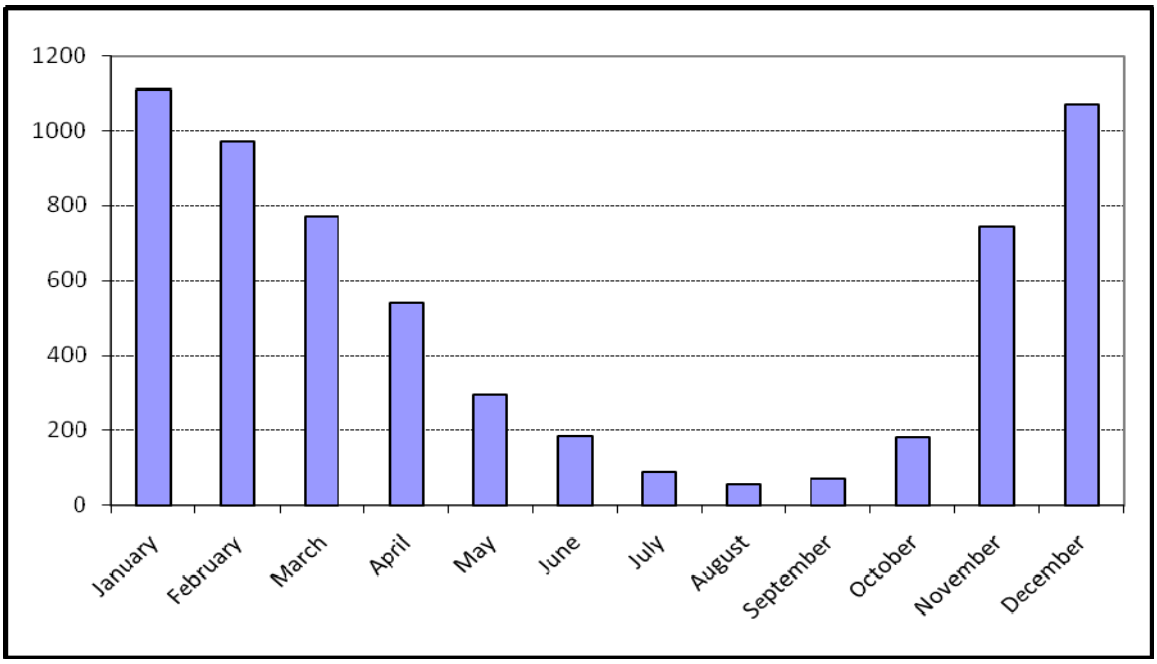


Table 2-5. Average flow at Skookumchuck River near Bucoda, WA (cfs).

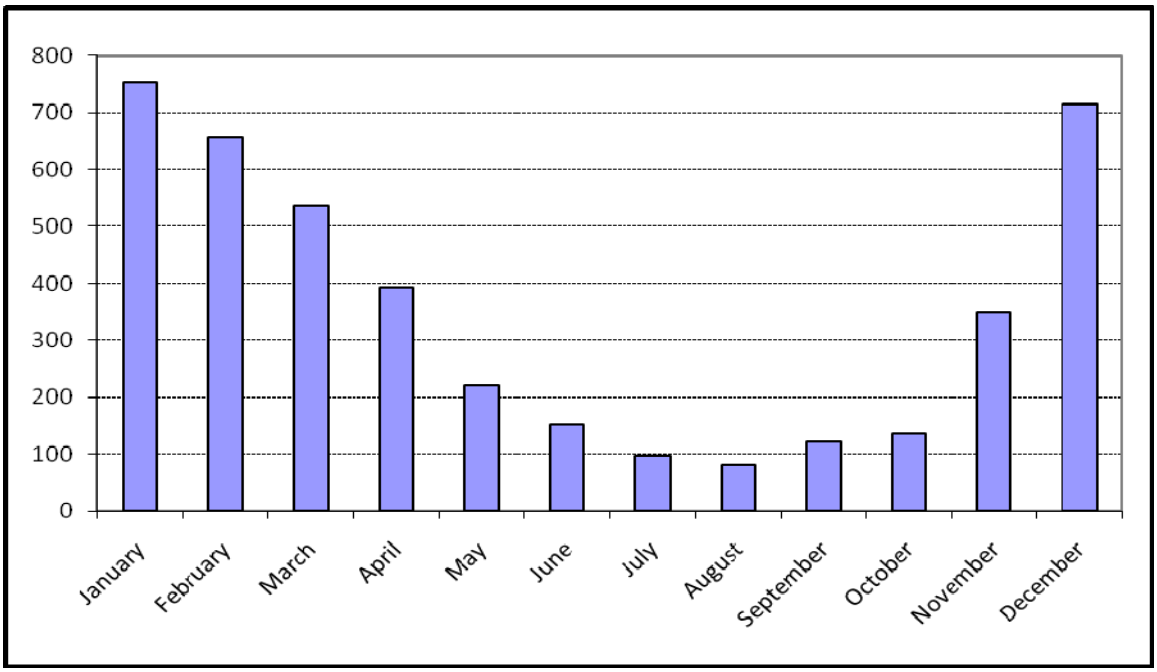


Table 2-6. Average flow at Chehalis River at Porter, WA (cfs).

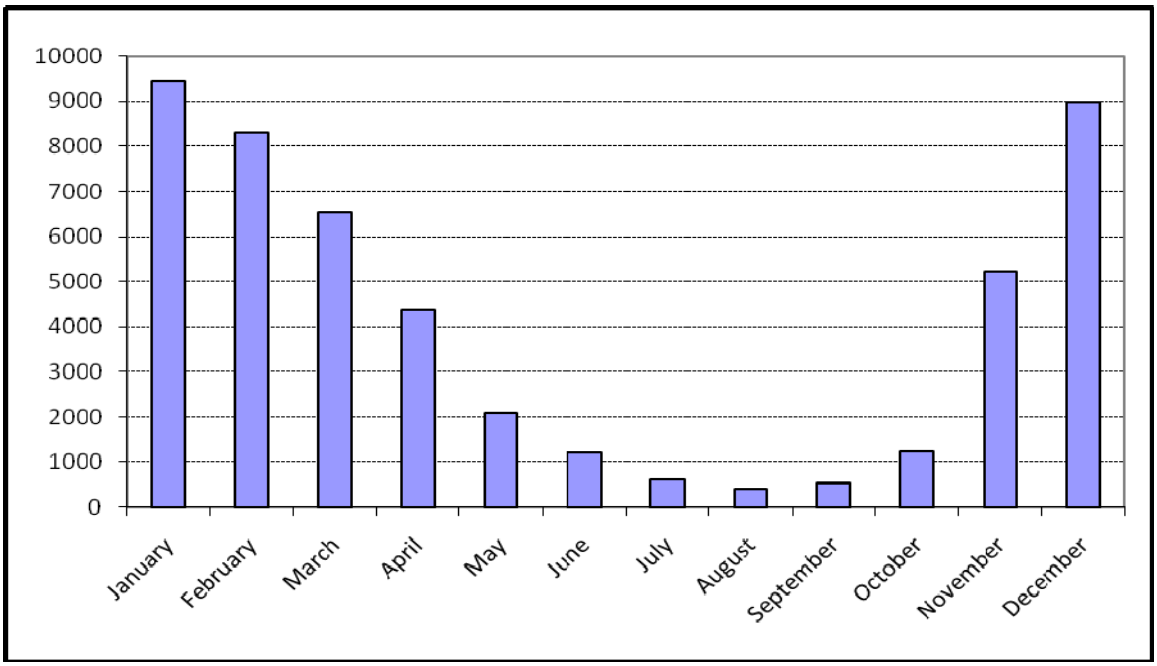
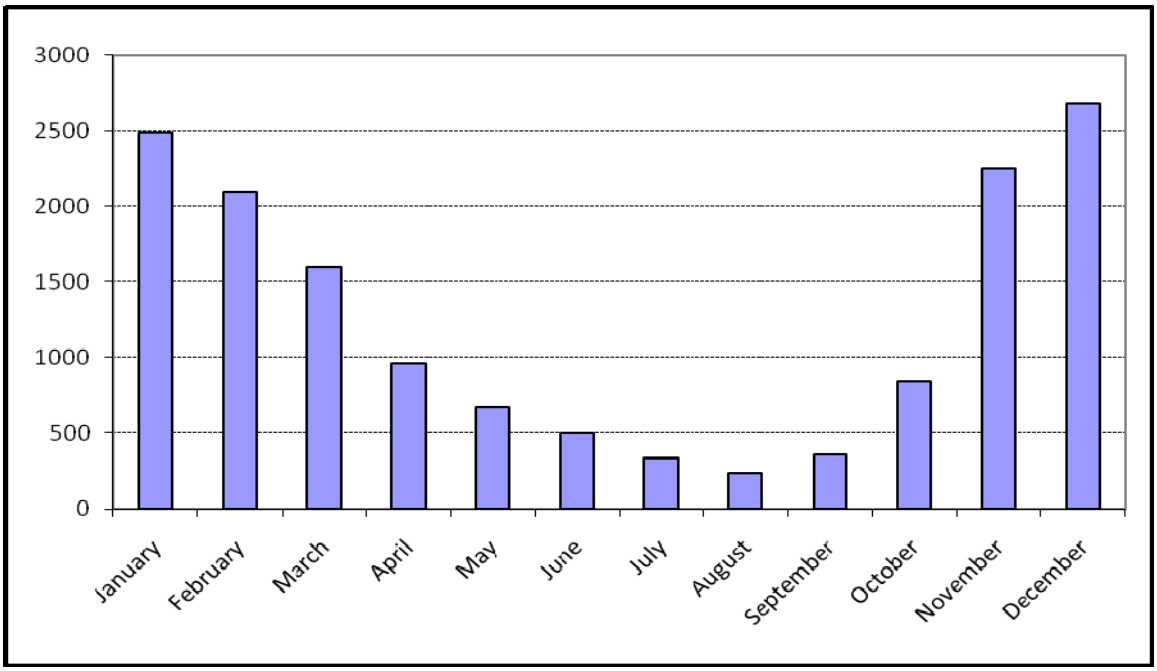


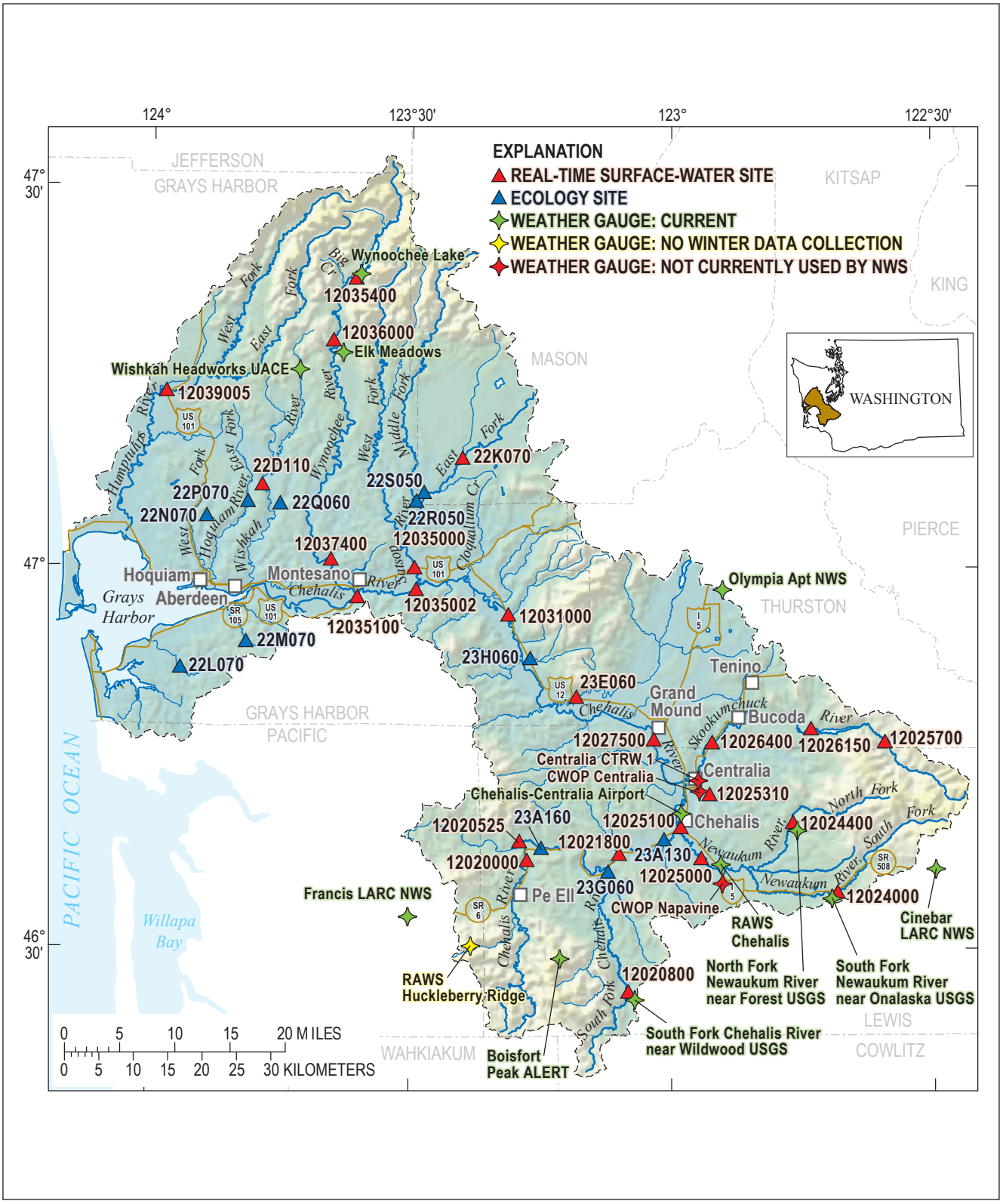
Table 2-7. Average flow at Wynooche River above Black Creek near Montesano, WA (cfs).



Few dams or diversion structures are located in the basin. The only reservoir in the basin with the authorized purpose of flood control is Wynoochee Dam. Diversion structures are located on the Hoquiam and Wishkah Rivers to provide municipal and industrial water to the Hoquiam/Aberdeen area. These structures consistently divert approximately 2.5 cfs from the Hoquiam River and 10 cfs from the Wishkah River. The Wynoochee Dam, located on the Wynoochee River, provides a variety of opportunities for the City of Aberdeen. These include fish and wildlife habitat, irrigation, recreation, flood control, and a municipal and industrial water supply. Wynoochee Lake, which serves as the reservoir for the dam, has a maximum capacity of 70,000 acre-feet. The Skookumchuck Dam is located on the Skookumchuck River, just upstream of Bloody Run Creek, and primarily serves the Centralia Steam Electric Plant, with a maximum discharge of 54 cfs. The reservoir has provided limited flood storage in the past, especially in the 2007 flood. The North Fork of the Newaukum River is dammed to provide up to 7 cfs of municipal and industrial water supply to the nearby cities of Centralia and Chehalis. Several other, small dams are interspersed throughout the basin. These provide local water sources to rural areas.

Stream Gauges

Figure 2-2 illustrates the location of precipitation and stream gauges in the Chehalis River basin. These gauges are managed by a variety of agencies as indicated in Tables 2-4 and 2-5. There are 37 active stream gauges in the Chehalis River basin. The U.S. Geological Survey manages 21 gauges; the National Weather Service manages 2 gauges; and Ecology manages 14 gauges in the basin. Data from all of the gauges managed by the USGS are reported in realtime and included in the USGS Flood Watch system. The National Weather Service reports some data in near realtime at the Newaukum River near Chehalis, the Chehalis River at Centralia, and the Skookumchuck River near Chehalis. All but three of the Ecology gauges are manual staff height gauges and are not appropriate for flood monitoring. The Ecology gauges that provide telemetry data are located at the Black River at Highway 12, Bingham Creek at Hatchery, and Wishkah River near Nisson.



FILE NAME: Fig02-2_StreamGaugesBasin.ai / Comp FloodHazMngt Plan
CREATED BY: JAB / DATE LAST UPDATED: 03/10/10

SOURCE: USGS, 2008; ESRI, 2008; National Weather Service (NWS), 2008; WA Dept. of Ecology, 2000; WDNR, 2008.

Chehalis River Basin Facilitation . 208379

Figure 2-2

Chehalis River Basin Stream and Precipitation Gauges
Washington

Table 2-9. Chehalis River Basin Stream Gauges

Gauge Number	Location	River Mile	Drainage Area (square miles)	Date of Record	Managing/Funding Agency	Notes
12020000	Chehalis River near Doty	101.8	113	1939-present	USGS/Lewis County Public Works Department	Realtime data
12020525	Elk Creek below Deer Creek near Doty	Not avail-able	58	2010-present	USGS/Army Corps of Engineers	Realtime data
12020800	South Fork Chehalis River near Wildwood	16.2	27	1998-present	USGS/Lewis County Public Works Department	Seasonal gage Realtime data
12021800	Chehalis River near Adna	86	340	1998-present	USGS/Lewis County Public Works Department	Seasonal gage Elevation/stage only station Realtime data
12024000	South Fork Newaukum River near Onalaska	22.8	42.4	1944-present	USGS/Lewis County Public Works Department	Seasonal gage Realtime data
12024400	NF Newaukum River above Bear Creek	7.7	29.6	1998-present	USGS/Lewis County Public Works Department	Seasonal gage Realtime data
12025000	Newaukum River near Chehalis	4.1	155	1929-present	USGS/Lewis County Public Works Department	Realtime data
12025100	Chehalis River at WWTP at Chehalis	74.3	618	2000-present	USGS/Lewis County Public Works Department	Realtime data Seasonal gage Elevation/stage only station
12025310	Salzer Creek at Centralia Alpha Road near Centralia	Not avail-able	58	2010-present	USGS/Army Corps of Engineers	Realtime data
12025500	Chehalis River at Centralia	67.5	653	Pre-2000-present	National Weather Service	Realtime data
12025700	Skookumchuck River near Vail	28.8	40.0	1967-present	USGS/Skookumchuck Dam, LLC.	Realtime data
12026150	Skookumchuck River at Bloody Run Creek near Centralia	20.7	65.9	1969-present	USGS/Skookumchuck Dam, LLC.	Realtime data

Gauge Number	Location	River Mile	Drainage Area (square miles)	Date of Record	Managing/Funding Agency	Notes
12026400	Skookumchuck River near Bucoda	6.4	112	1967-present	USGS/Skookumchuck Dam, LLC. and Thurston County	Realtime data
12026600	Skookumchuck River at Centralia	2.5	170	Pre-2000-present	National Weather Service	Realtime data
12027500	Chehalis River near Grand Mound	59.9	895	1928-present	USGS/Ecology	Realtime data
12031000	Chehalis River at Porter	33.3	1,294	1952-present	USGS/Ecology	Realtime data
12035000	Satsop River near Satsop	2.3	299	1929-present	USGS/Ecology and USGS NSIP	Realtime data
12035002	Chehalis River near Satsop	18	1,760	1979-present	USGS/Energy Northwest	Realtime data Stage velocity readings Affected by tides and debris
12035100	Chehalis River near Montesano	13.2	1,780	2001-present	USGS/USGS NSIP	Realtime data Affected by tides
12035400	Wynoochee River near Grisdale	51.3	41.3	1965-present	USGS/City of Tacoma, Tacoma Public Utilities	Realtime data
12036000	Wynoochee River above Save Creek near Aberdeen	40.6	71.4	1925-present	USGS/City of Tacoma, Tacoma Public Utilities	Realtime data
12037400	Wynoochee River above Black Creek near Montesano	5.9	155.2	1956-present	USGS/City of Tacoma, Tacoma Public Utilities	Realtime data
12039005	Humptulips River below Highway 101 bridge near Humptulips	22.9	132	1933-present (most 2002-present)	USGS/Grays Harbor County	Realtime data
22R050	North Fork Satsop River at the Mouth	0.3	Not available	2005 to present	Ecology	Manual staff height
22D110	Wishkah River near Nisson	15.3	Not available	2005-present	Ecology	Telemetry

Gauge Number	Location	River Mile	Drainage Area (square miles)	Date of Record	Managing/Funding Agency	Notes
22K070	Bingham Creek at Hatchery	0.1	Not available	2000-present	Ecology	Telemetry
22L070	Johns River at Western	5.5	Not available	2005-present	Ecology	Manual staff height
22M070	Newskah Creek below Falls	4.1	Not available	2005-present	Ecology	Manual staff height
22N070	Middle Fork Hoquiam River near New London	Not avail-able	Not available	2005-present	Ecology	Manual staff height
22P080	East Fork Hoquiam River near Nisson	10.0	Not available	2005-present	Ecology	Manual staff height
22Q060	East Fork Wishkah River near mouth	0.9	Not available	2005-present	Ecology	Manual staff height
22S050	Decker Creek at mouth	0.1	Not available	2005-present	Ecology	Manual staff height
23A130	Chehalis River at Claquato	77.7	Not available	2005-present	Ecology	Manual staff height
23A160	Chehalis River at Dryad	96.9	Not available	1996-present	Ecology	Manual staff height
23E060	Black River at Highway 12	2.0	Not available	2005-present	Ecology	Telemetry
23G060	South Fork Chehalis River near mouth	0.6	Not available	2005-present	Ecology	Manual staff height
23H 070	Cedar Creek at Highway 12	1.3	Not available	2005-present	Ecology	Manual staff height
None	Black River at 128th Avenue Littlerock	Not avail-able	Not available	1992-1999, 2006-present	Thurston County	
None	Scatter Creek at James Road	Not avail-able	Not available	1995-1998, 2007-present	Thurston County	

Table 2-10. Precipitation Gauges in the Chehalis River basin

Gauge Name/Location	Managing Agency	Notes
Huckleberry Ridge	RAWS	Does not operate during the winter at this time
Chehalis	RAWS	
Chehalis-Centralia Airport	National Weather Service	
Francis	LARC National Weather Service	Near the Chehalis River basin
Boisfort Peak	ALERT	
South Fork Chehalis River near Wildwood	USGS	
Cinebar	LARC National Weather Service	
South Fork Newaukum River near Onalaska	USGS	
North Fork Newaukum River near Forest	USGS	
Olympia Airport	National Weather Service	Near the Chehalis River basin
Wynoochee Lake		
Elk Meadows		
Wishkah Headworks	Corps of Engineers	
Citizen Weather Observer station Napavine[1]	APRS/CWOP[2]	
Citizen Weather Observer station Centralia[1]	APRS/CWOP[2]	
Hydrologic Remote Sensing Center Centralia[1]	USGS	At the Centralia stream gauge 12025500
WDFW Skookumchuck Dam Hatchery[1]	Thurston County	Under construction
Black River at 128th Ave, Littlerock[1]	Thurston County	At the Black River stream gauge (1989-present)
Scatter Creek at James Road[1]	Thurston County	At the Scatter Creek stream gauge (2006-present)

[1] Not used by the National Weather Service for forecasting
[2] Automated Position Reporting System/Citizen Weather Observer Position

Wetlands

Wetlands, as defined in RCW 36.070A.030, are those areas inundated or saturated by surface water or groundwater at a frequency and duration to support vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas. Wetlands are important to flood hazard management because they provide natural retention and detention functions. They store water above

and below the ground surface, reducing the volume and velocity of floodwaters downstream and thus decreasing downstream erosion. Wetlands also improve water quality and provide habitat for a wide range of plants and animals.

The Chehalis River basin contains a diverse wetland mosaic. Estuarine and tidal wetlands combine with forested, scrub-shrub, emergent, and riverine wetlands to create a complex wetland ecosystem at the mouth of the river in Grays Harbor. Although the Grays Harbor area still contains an extensive wetland system, approximately one-third of the historic wetlands in this area have been lost to development and agricultural activities. Between Montesano and Porter, most wetlands are restricted to the riparian areas and floodplain between the river and U.S. Highway 12 to the north. These also include a variety of emergent, forested, and scrub-shrub wetlands. At Porter, floodplain wetlands generally shift to the south and west side of the riverbed. These include forested, scrub-shrub, emergent, and riparian wetlands. Upstream from Porter to the headwaters, the floodplain is laced with forested, emergent, scrub-shrub, and riparian wetlands. These wetlands range from temporarily flooded to seasonally and permanently flooded. Most of the wetland vegetation is considered broad-leaved deciduous.

Fish and Wildlife

Fish and wildlife presence in the Chehalis River basin has been addressed in recent watershed planning documents (Chehalis Basin Partnership, 2008; Washington State Conservation Commission, 2001; Washington Department of Fish and Wildlife, 2008). These issues have recently focused on the health of fish species that inhabit the river basin, due to their cultural, recreational, and economic importance.

The water bodies in the Chehalis River basin provide a variety of habitats for fish species. Upland tributaries are generally cold, high-elevation, and high-velocity streams. These waterbodies transition into warmer, low-elevation streams that meander through river valleys. The basin is host to significant tribal, sport, and commercial fisheries. Documented salmonid species in the basin include fall, spring, and summer Chinook; coho; fall chum; cutthroat trout; and summer and winter steelhead. Bull trout/Dolly Varden presence is documented from the mouth of the Chehalis River downstream of Centralia. Historic presence is documented on tributaries near the mouth of the river (Envirovision, 2000).

Cutthroat trout presence is documented in most perennial tributaries and mainstem reaches of the Chehalis River basin in one or more life history forms. Anadromous and fluvial cutthroat trout inhabit mainstem and accessible tributary reaches, and the resident form is found above and below anadromous barriers. In areas below fish barriers, this species mixes with anadromous fish. Adfluvial cutthroat trout (fish that live in lakes and migrate into rivers or streams to spawn) inhabit many lakes in the Chehalis River system. Current status is unknown, but cutthroat trout are considered abundant and widely distributed throughout the basin.

Table 2-11 summarizes salmonid fish populations in the Chehalis River basin. Table 2-12 summarizes the non-salmonid fish that occur in the basin.

Table 2-11 Stock origins, status and production type for anadromous fish in the Chehalis River basin

Stock Name	Stock Origin	Production Type	Stock Status	Population Trend
Spring Chinook				
Chehalis	Native	Wild	Healthy	Stable or positive
Wynoochee	Native	Wild	Disputed	Unknown
Summer Chinook				
Satsop	Mixed	Wild	Depressed	Negative
Fall Chinook				
Humptulips	Mixed	Wild	Healthy	Positive
Hoquiam	Native	Wild	Healthy	
Wishkah	Native	Composite	Healthy	
Wynoochee	Native	Wild	Healthy	
Satsop	Mixed	Composite	Healthy	
Chehalis	Mixed	Wild	Healthy	
Johns/Elk and South Bay tributaries	Mixed	Wild	Unknown	Unknown
Fall Chum				
Humptulips	Native	Wild	Healthy	
Chehalis	Native	Wild	Health	
Coho				
Humptulips	Mixed	Composite	Healthy	
Hoquiam	Mixed	Composite	Healthy	
Wishkah	Mixed	Composite	Healthy	
Wynoochee	Mixed	Composite	Healthy	
Satsop	Mixed	Composite	Healthy	
Chehalis	Mixed	Composite	Healthy	
Johns/Elk and South Bay tributaries	Mixed	Composite	Healthy	
Summer Steelhead				
Humptulips	Native	Wild	Unknown	Unknown
Chehalis	Unknown	Wild	Unknown	Unknown
Winter Steelhead				
Humptulips	Native	Wild	Healthy	
Hoquiam	Native	Wild	Healthy	
Wishkah	Native	Wild	Healthy	
Wynoochee	Mixed	Composite	Healthy	
Satsop	Native	Wild	Depressed	Negative
Chehalis	Native	Wild	Healthy	

Stock Name	Stock Origin	Production Type	Stock Status	Population Trend
Skookumchuck/Newaukum	Mixed	Composite	Depressed	Negative
South Harbor	Native	Wild	Unknown	Unknown
Bull trout / Dolly Varden				
Chehalis / Grays Harbor	Native	Wild	Unknown	Unknown
Coastal Cutthroat Trout				
Humptulips	Native	Wild	Unknown	Unknown
Chehalis	Native	Wild	Unknown	Unknown

Source: Envirovision, 2000.

Table 2-12. Non-salmonid fish species known or suspected to be present in the Chehalis River basin

Native Fish Species	Introduced Fish Species
White sturgeon	Brook trout
Green sturgeon	Rainbow trout
American shad	Largemouth bass
Northern pikeminnow	
Largescale sucker	
Redside shiner	
Whitefish	
Reticulate sculpin	
Coast range sculpin	
Torrent sculpin	
Riffle sculpin	
Prickly sculpin	
Pacific lamprey	
River lamprey	
Western brook lamprey	
Longnose dace	
Speckled dace	
Redside shiner	
Olympic mudminnow	

Source: Envirovision, 2000.

The varied habitats in the Chehalis River basin support a wide range of wildlife. Higher elevation and forested areas support big game such as deer, elk, and black bear and upland birds such as grouse and quail. Seasonally flooded areas along the Chehalis River and its tributaries provide winter habitat for waterfowl. The Chehalis River basin is along the Pacific Flyway migratory bird corridor. The Grays Harbor Estuary is a noted

stopover on that corridor for shorebirds. Riparian areas on the Chehalis River and its tributaries provide important habitat for a variety of birds and small mammals.

Endangered Species Act Issues

Bull trout/Dolly Varden is the only listed fish species under the Endangered Species Act in WRIAs 22 and 23. The Olympic Peninsula bull trout/Dolly Varden population was listed as federally threatened by the U.S. Fish and Wildlife Service (USFWS) in November 1999.

Analysis of the limiting factors affecting bull trout has been performed for the Chehalis River and the four major subbasins (Chehalis Basin Partnership Habitat Working Group, 2008). Grays Harbor, the Chehalis River upstream to and including the Satsop River, and portions of the Wishkah, Wynoochee, and Humptulips Rivers have been identified as current or potential habitat for bull trout foraging, migration, and overwintering. This habitat is important for bull trout recovery in the Olympic Peninsula. Limiting factors identified within the basin include:

- degraded riparian conditions;
- degraded water quality;
- reduced stream flow;
- elevated water temperature; and
- low dissolved oxygen levels.

Non-fish federally listed species in the basin are the loggerhead sea turtle, marbled murrelet, northern spotted owl, western snowy plover, and golden paintbrush. Most of these species are unlikely to be found in the floodplain area.

Water Quality

Section 303(d) of the CWA requires Ecology to identify the state's polluted waterbodies and submit a list of these waterbodies to Environmental Protection Agency every two years. The list is known as the 303(d) list. For each of those water bodies, the law requires states to develop Water Quality Improvement Projects or Total Maximum Daily Loads (TMDLs). A TMDL is the maximum amount of pollutant loading that can occur in a given waterbody without impairing beneficial uses and still meet water quality standards. The 2008 303(d) list, Washington's most recent list, was approved in January 2009.

Water quality impairment in the Chehalis River and its tributaries has been recognized in studies since the early 1980s (Envirovision, 2000). The most common water quality issues are temperature, water quality, and fecal coliform exceedances of water quality standards. The major causes of these water quality problems are degraded riparian conditions including lack of riparian vegetation, livestock waste, failing septic systems, urban stormwater runoff, and sewage discharge. Total Maximum Dissolved Loads (TMDLs) have been developed to address these problems in the mainstem Chehalis River

and its tributaries. The Chehalis Basin Partnership is responsible for developing the details of implementing projects such as those for temperature reduction.

A number of stream segments and lakes in the Chehalis River basin do not meet Washington State surface water quality standards. These are summarized in Table 2-13. A complete listing can be found on Ecology's web site at http://www.ecy.wa.gov/programs/wq/303d/2008/index.html.

Table 2-13. Waterbody segments not meeting water quality standards

Waterbody Name	Parameter Exceeding Standards
Chehalis River	mercury, PCB[1], dioxin
Black Creek	temperature
Humptulips River	pH, dissolved oxygen
Black Lake	total phosphorous
Carlisle Lake	total phosphorous, fecal coliform
Stillman Creek	temperature
Mill Creek	temperature
Dillenbaugh Creek	dioxin
Newaukum River (Middle Fork)	dissolved oxygen
Elk Creek	dissolved oxygen

[1]Polychlorinated biphenyl, a toxic organic compound banned in the United States since 1979

Land Use Characteristics

The majority of land in the Chehalis basin (87 percent) is forestland (Chehalis Basin Partnership, 2004). Most forested acres are both private and government-owned lands. Government-owned lands include the Capital State Forest and portions of the Mt. Baker-Snoqualmie National Forest and Olympic National Forest.

Agriculture makes up 7 percent of land use in the basin. Dairy, livestock, and crop farms are located mainly in the low-lying valleys adjacent to the Chehalis River and its major tributaries. Most common crops include hay and silage, vegetables and small grains, as well as pasture (Chehalis Basin Partnership, 2004).

Development is primarily clustered within floodplains and valleys. Only 11 percent of the basin as a whole is in agricultural, urban, or industrial uses. However, for the land within 1 mile of major rivers in the basin, 42 percent of the land is in agricultural, urban, or industrial use. Industrial development is focused around the Chehalis/Centralia and Aberdeen/Hoquiam areas as well as the coal mine/power plant site south of Bucoda. The

main use of industrial water is in the manufacturing of wood, pulp, and paper (Chehalis Basin Partnership, 2004).

Population

The most populated portions of the basin are located in the lower Chehalis River basin. Major population centers are Chehalis and Centralia in the upper basin and Aberdeen and Hoquiam near the mouth of the river. Table 2-14 summarizes the population of jurisdictions within the Chehalis River basin. It shows population from the 2000 U.S. Census and 2009 population estimates provided by the Washington Office of Financial Management (OFM). The table does not include population numbers for the three counties in the basin because portions of counties are outside the Chehalis River basin and no accurate estimate of county populations within the basin exists.

Table 2-14. Population of Basin Jurisdictions

Jurisdiction	2000 Census	2009 OFM Estimate
Grays Harbor Communities		
Aberdeen	16,461	16,440
Cosmopolis	1,595	1,640
Elma	3,049	3,110
Hoquiam	9,097	8,765
McCleary	1,484	1,555
Montesano	3,312	3,565
Oakville	675	715
Ocean Shores	3,836	4,860
Westport	2,137	2,345
Lewis County Communities		
Centralia	14,742	15,570
Chehalis	7,057	7,185
Napavine	1,383	1,690
Pe Ell	657	670
Thurston County Communities		
Bucoda	628	665
Tenino	1,447	1,535

Sources: Office of Financial Management, 2010

CHAPTER 3 REGULATORY OVERVIEW

This chapter provides an overview of existing federal, state, and local regulatory and permitting requirements that relate to flood hazard management, surface water management, water quality, and wetlands protection.

Summary of Existing Regulations

Many laws that directly or indirectly address flood hazard management have been enacted at the federal, state, and local levels. Table 3-1 lists federal and state laws in the categories of flood hazard management, stormwater management, and sensitive areas.

Most federal laws are implemented at the state and local levels. For example, the federal Clean Water Act regulates stormwater discharge, but the U.S. Environmental Protection Agency (EPA) has delegated the responsibility of administering the program to the Washington State Department of Ecology (Ecology). The National Flood Insurance Program, which offers affordable flood insurance to private property owners, is a national program administered by the Federal Emergency Management Agency (FEMA), but it requires cities and counties to adopt floodplain regulations.

With the exception of the National Flood Insurance Program and the Endangered Species Act, the laws most relevant to flood hazard management originate at the state level. Most of these begin with state legislation that enables local governments to adopt regulations promoting public health, safety, and general welfare. Environmental laws that affect flood hazard management through habitat, shoreline, and other critical-area protection measures also exist at the state level, but enforcement is increasingly becoming the responsibility of local governments. State growth management requirements contain additional recommendations regarding land use and development near wetlands and in frequently flooded areas, with regulatory implementation largely in the hands of local jurisdictions.

Key Federal Regulations

National Flood Insurance Program

In 1968, the U.S. Congress initiated the National Flood Insurance Program (NFIP) (Chapter 44 CFR) under the National Flood Insurance Act to relieve the burden of disaster relief on the national treasury, state and local tax bases. The NFIP is administered by the Federal Insurance Administration (FIA), which is part of FEMA. The NFIP makes available affordable flood insurance to communities that adopt approved community-wide floodplain management regulations. Communities that do not participate in the NFIP do not qualify for certain flood disaster relief.

Table 3-1. Overview of Major Federal and State Surface Water Management Regulations

Regulation	Implementing Agency	Purpose	Jurisdiction	Required Approval, Permit, or Plan	Applicability to Flood Hazard Management
FEDERAL					
Clean Water Act, Section 401	State agencies empowered by EPA (i.e., Ecology)	Ensures that federally permitted activities comply with the Clean Water Act, state water quality laws, discharge limitations, and other state regulations	Waters of the U.S.	Water Quality Certification or Modification	Structural measures affecting surface water will require Water Quality Certification or Modification
Clean Water Act, Section 402	State agencies empowered by EPA (i.e., Ecology)	Establishes permit application requirements for stormwater discharges under National Pollutant Discharge Elimination System (NPDES)	All stormwater discharge associated with industrial activity and from municipal storm sewer systems	Stormwater Discharge Permits	NPDES stormwater permit is required for jurisdictions applying for an individual NPDES permit
Clean Water Act, 404	COE	Regulates the discharge of dredged or fill material in rivers, streams, and wetlands	Waters of the U.S. including wetlands	Individual or Nationwide Permits	Dredging or filling in wetlands or the Yakima River will require permit
National Flood Insurance Act	FEMA	Offers affordable flood insurance to communities that adopt approved floodplain management regulations	Floodplains of the U.S.	Flood Insurance Study and approval letter from FEMA	Participation in NFIP requires minimum floodplain management regulations
Flood Disaster Protection Act	FEMA	Provides incentive to communities to join the NFIP by increasing amounts of flood insurance available and providing penalties for communities and individuals that do not join the NFIP and are subsequently flooded	Floodplains of the U.S.	Approval by FEMA	Requires purchase of flood insurance for funding by federally backed lending institutions for purchase of property in floodplains
National Environmental Policy Act	Varies (usually the federal agency issuing the permit)	Requires full disclosure of potential impacts associated with proposed actions and mitigative measures	All federal actions	Environmental Assessment and EIS	Regulates actions that may result in significant adverse environmental impacts
River and Harbor Act, Section 10	COE	Preserves the navigability of the nation's waterways	U.S. navigable waters	Section 10 permit	Regulates activities within the ordinary high water mark (OHWM) on navigable waters
Executive Order 11988	Federal Agencies	Protects floodplain from development by federal agencies	Federal projects	None	Enhances existing floodplain management regulations
Endangered Species Act	Federal Agencies	Protection of fish and wildlife habitat and evaluation of species health	Nationwide	Approval	Regulates activities in endangered species habitat
Executive Order 11990	Federal Agencies	Protects wetlands and evaluates impacts of proposed actions on wetlands	Federal projects, federally funded activities, or other activities licensed or regulated by federal agencies	None	Enhances existing wetland protection regulations
STATE					
SEPA	Varies (usually the local agency issuing the permit); circulation to state and federal agencies for review	Requires full disclosure of the likely significant adverse impacts associated with a proposed action and identification of mitigative measures	All proposed actions that require permits	Environmental Checklist or EIS	Requires environmental review of any project with potential adverse environmental impacts
Shoreline Management Act	Ecology; local jurisdictions when state approved	Manages uses of the shorelines of the state for protection of public interests and natural environment	All shorelines of the state (including all marine waters, lakes >20 acres, reservoirs, streams and rivers >20 cfs mean annual flow, and associated wetlands)	State or state-approved local shoreline permit	Applies to activities within the Chehalis River system, adjacent lands within 200 feet of the floodway or within the 100-year floodplain (whichever is less) and all associated wetlands
Senate Bill 5411 (ESSB 5411); Flood Control by Counties (RCW 86.12)	Counties	RCW 86.12 gives county governments the power to levy taxes, exercise eminent domain and take action to control and prevent flood damage. ESSB 5411 provides a greatly expanded role for counties in formulating and adopting drainage basin plans to address flooding and land use regulations	All drainage basins located wholly or partially within the County	Comprehensive Flood Hazard Management Plan	Allows for development of CFHMPs
Floodplain Management Program (RCW 86.16)	Ecology	Reduces flood damages and protects human health and safety. Department oversees local implementation of floodplain regulations required for participation in the NFIP.	All floodplains within the state	State approval of floodplain management programs and regulations	Provides eligibility for national flood insurance and for state matching funds to construct flood control facilities
State Participation in Flood Control Maintenance	Ecology	Assists local jurisdictions in comprehensive planning and flood control maintenance efforts	All flood hazard management activities of local jurisdictions as approved by Ecology	FCAAP grant application, approved CFHMP for maintenance grants	FCAAP funds available for preparation of CFHMPs, flood control maintenance projects, and emergency flood control projects
Water Pollution Control Act	Ecology	Empowers the state to develop, maintain, and administer the federal statutes and programs required by the federal Clean Water Act	All receiving waters of the state	Water Quality Certification/Modification	Regualtes activities that violate state water quality standards per the Clean Water Act
Hydraulic Code	WDFW	Protects fish, fish habitat, and wildlife habitat from damage by construction and other activities	All marine and fresh waters of the state and drainage corridors	Hydraulic Project Approval (HPA)	HPA is required for all activities within the OHWM of streams and along natural drainage corridors
Growth Management Act (GMA) (RCW 36.70A)	Commerce	Requires comprehensive plans to include surface water considerations and facilities (quantity and quality).	Selected high-growth counties and their cities.	Comprehensive Plan	Requires adoption of development regulations and comprehensive plans
		Requires designation and regulation of critical areas, including wetlands and frequently flooded areas.	All Washington counties and cities.	Critical areas and resource lands designation.	Requires adoption of critical areas and resource lands ordinances regulating development in designated areas
Executive Order 90-04, Protection of Wetlands/Model Wetlands Protection Ordinance	Ecology	Provides guidance to local governments to achieve no net loss of wetland functions and values	State wetland buffers	None	Provides voluntary technical assistance to the local jurisdiction to regulate activities that affect wetlands

Congress added several provisions to the NFIP under the Flood Disaster Protection Act of 1973 in order to strengthen the program. The 1973 act provided additional incentives to communities to join the NFIP by substantially increasing the amount of flood insurance coverage available and providing penalties for communities and individuals that choose not to join the NFIP. Specific new requirements include the following:

- Any acquisition or construction undertaken in identified special flood hazard areas requires purchase of federal flood insurance, if available.
- Purchase of properties in the floodplain to be secured under mortgages from a federally related lender requires purchase of federal flood insurance, if available.
- Communities identified by FEMA as flood-prone have one year from the time of designation to enroll in the NFIP; otherwise disaster-assistance funds and federal financial assistance for acquisition or construction of property in flood hazard areas will be denied.

A community enters the regular NFIP program upon adoption of an ordinance approved by FEMA. A detailed flood insurance study that involves hydrologic and hydraulic analyses is normally performed and is referenced in the ordinance as the basis for the regulatory program. The products of the study are the Flood Insurance Rate Map (FIRM) and the Flood Insurance Study.

The Flood Insurance Study provides data on the width of the floodway and floodplain, the cross-sectional area, and the floodwater velocity at given points in the stream. FIRMs delineate areas adjacent to rivers and coastlines that are subjected to flood risks, and an insurance rate is determined for each area. New FIRMs delineate flood insurance rate zones, as well as limits of the 100-year floodway, 100-year floodplain, and 500-year floodplain. FIRMS also delineate areas of coastline flooding. FIRMs and associated insurance studies are available online and from FEMA.

The 100-year flood determines the geographic jurisdiction of NFIP-related programs. The 100-year flood is frequently called the “base flood” and is defined as the discharge that has a 1 percent chance of occurring or being exceeded in a given year. The 100-year floodplain is the area that would become inundated by water during the 100-year flood.

The floodway is an engineering concept incorporated into the NFIP floodplain management criteria. A floodway is the channel of a river or other watercourse and the adjacent land areas that must be reserved in order to convey the base flood without cumulatively increasing the water surface elevation more than a certain amount (1 foot for NFIP). Floodways are calculated by FEMA for the 100-year base flood for major rivers and streams as part of the flood insurance study undertaken for a community.

Since 1990, communities that have adopted programs or regulations to reduce flood-related damages have been eligible to receive reduced insurance rates under the Community Rating System (CRS). The CRS is a voluntary incentive program that recognizes and encourages community floodplain management activities that exceed the

minimum NFIP requirements. Communities must apply to FEMA to be certified for a rate reduction before policy holders within the community can receive a rate reduction. Flood insurance premium rates are discounted to reflect the reduced flood risk resulting from community actions.

For CRS participating communities, flood insurance premium rates are discounted in increments of 5 percent. A Class 1 community would receive a 45 percent premium discount, while a Class 9 community would receive a 5 percent discount (a Class 10 is not participating in the CRS and receives no discount). The CRS classes for local communities are based on 18 creditable activities, organized under four categories:

- Public Information,
- Mapping and Regulations,
- Flood Damage Reduction, and
- Flood Preparedness.

Currently, Centralia, Centralia and Lewis and Thurston Counties participate in the CRS program. Table 3-2 summarizes the status of those jurisdictions. Centralia and Thurston County are in the process of having their status reviewed and anticipate receiving a reduced class.

Table 3-2. Current CRS Status of Participating Jurisdictions

	CRS Entry Date	Current Effective Date	Current Class
Centralia	10/1/94	10/1/99	7
Chehalis	10/1/94	5/1/04	6
Lewis County	10/1/94	10/1/99	8
Thurston County	10/1/00	10/1/00	5

Clean Water Act

The Clean Water Act (CWA) of 1977 and the Water Quality Act of 1987 (amendments to the Federal Water Pollution Control Act) provide the backbone for national water quality policy and action. The goal is to eliminate pollutant discharges into “waters of the United States”. Sections 401, 402, and 404 of the CWA (33 USC 1251 et seq., as amended by Public Law 92-500) are pertinent to surface water management activities.

CWA Section 401 - Water Quality Certification

Section 401 (40 CFR 121) ensures that activities requiring a federal permit (such as a U.S. Army Corps of Engineers Section 404 permit for filling of a wetland) comply with

the CWA, state water quality laws, and other appropriate state regulations (e.g., the Hydraulic Code, Water Pollution Act). Compliance with Section 401 is required for any structural measures resulting in a discharge of dredge or fill material to all waters of the U.S. or non-isolated wetlands.

Section 401 is implemented through a certification process implemented by each state and some approved Native American tribes, including the Chehalis Tribe. Section 401 approvals are granted through a Water Quality Certification issued by a state agency. The certification ensures that federally permitted activities comply with water quality standards and discharge limitations. The implementing state agency has final authority on approval, denial, or development of special conditions for certification. The certification is similar to a permit and is a prerequisite requirement for obtaining a Corps permit, a Federal Energy Regulatory Commission (FERC) license, or other federal permit.

CWA Section 402 - National Pollutant Discharge Elimination System

Section 402 of the CWA established the system for permitting wastewater discharges, known as the National Pollutant Discharge Elimination System (NPDES). Under NPDES, all facilities which discharge pollutants from any point source into waters of the United States are required to obtain a permit. NPDES permits are issued by states that have obtained EPA approval to issue permits or by EPA Regions in states without such approval. The Water Quality Act of 1987 amended Section 402 with a new subsection regulating stormwater discharges. In Washington, Ecology issues NPDES permits.

There are two basic types of NPDES permits, individual and general permits. An individual permit is specifically tailored to an individual facility. Once a facility submits the appropriate application(s), the permitting authority develops a permit for that particular facility based on the information contained in the permit application (e.g., type of activity, nature of discharge, receiving water quality). The authority issues the permit to the facility for a specific time period (not to exceed five years) with a requirement that the facility reapply prior to the expiration date.

A general permit covers multiple facilities within a specific category. A general NPDES stormwater permit is called a municipal permit. Under the 1987 revisions, NPDES permits were required for municipal stormwater discharges to surface waters. EPA developed rules to implement the new stormwater requirements in two phases. In Phase I, NPDES permits were required for stormwater discharges from cities and counties with populations greater than 100,000. In Phase II, communities with populations of at least 10,000 or designated as an “urbanized area” by the U.S. Census Bureau are also required to obtain permits.

For both Phase I and Phase II jurisdictions, the EPA rules require operators of municipal separate storm sewer systems to develop and implement a stormwater management program that: (1) reduces the discharge of pollutants to the “maximum extent

practicable"; (2) protects water quality; and (3) satisfies appropriate requirements of the CWA.

EPA's rules identify six minimum control measures which must be included in a Phase II stormwater program to protect water quality:

1. Public Education and Outreach;
2. Public Participation/Involvement;
3. Illicit Discharge Detection and Elimination;
4. Construction Site Runoff Control;
5. Post-Construction Runoff Control; and
6. Pollution Prevention/Good Housekeeping.

The federal rules identify two additional standards with which an operator of a regulated municipal separate storm sewer system must comply:

7. Fulfillment of requirements of an approved TMDL (water-cleanup plan), and
8. Record keeping, evaluation and reporting the progress of the program.

CWA Section 404 - Dredge and Fill Requirements

Section 404 of the CWA (USC 1394) regulates the discharge of dredged or fill material into waters of the United States. Any project that proposes discharging dredged or fill material into the waters of the United States, including special aquatic sites such as wetlands (non-isolated), must get a Section 404 permit. The U.S. Army Corps of Engineers (Corps) can authorize activities through an Individual Permit, Letter of Permission, Nationwide Permit, or Regional General Permit. The Corps determines what type of permit is needed.

Nationwide Permits are a type of general permit issued by the Corps on a nationwide basis for smaller projects or activities that will have minimal impacts. The Nationwide Permits authorize specific categories of work, such as stormwater management facilities, bank stabilizations, mooring buoys, or maintenance of flood control facilities. An activity may be authorized under a Nationwide Permit only if it satisfies all of the Nationwide Permit terms and conditions. If the Corps finds that the proposed activity would have more than minimal individual or cumulative net adverse impacts on the environment, or may be contrary to the public interest, an applicant will be required to modify the proposal or apply for an Individual Permit.

Individual Permits are required for proposals that do not fit within the specific criteria of a Nationwide Permit. The Individual Permit review process includes an analysis by the Corps of whether the project's benefits outweigh predicted environmental impact. Completion of an Environmental Impact Statement (EIS) may be necessary for some projects. In addition, there is a 30-day period during which the proposal is available for review by federal, state, and local agencies, Native American groups, interest groups, and the general public. On average, Individual Permit decisions are made within two to six months from receipt of a completed application. Applications requiring an EIS (less than

1 percent) average about three years to process. In emergencies, decisions can be made in a matter of hours.

Letters of Permission are a type of permit normally used for activities in navigable waters where objections are unlikely, and the activity does not qualify for a Nationwide Permit. The letters are issued through an abbreviated processing procedure that includes coordination with federal and state environmental agencies and a public interest evaluation. They do not require the publishing of an individual public notice.

Regional General Permits are issued on a regional basis (limited geographic scope) for a category of activities that are substantially similar in nature and cause only minimal individual and cumulative impacts on the aquatic environment. Each Regional General Permit has a number of terms and conditions that must be met.

Proposed wetland activities may be subject to other laws in addition to or in association with a Section 404 permit. For example, in Washington, Ecology has the right to place conditions on or request denial of a Section 404 permit if a proposed project does not comply with state water quality laws. The Corps cannot issue a Section 404 permit if the state has denied water quality certification. Furthermore, if any local agency permit is denied, the Corps will deny the 404 permit.

Rivers and Harbors Act, Section 10

The Rivers and Harbors Act was enacted in 1899 to preserve the navigability of the nation's waterways. Section 10 (33 USC 403) prohibits the unauthorized obstruction or alteration of any navigable water of the United States. Section 10 requires approval prior to any work in, over, under or near waters of the United States or special aquatic sites, including wetlands. Typical activities requiring Section 10 permits are:

- Construction or installation of piers, wharves, bulkheads, dolphins, marinas, ramps, floats, overhanging decks, buoys, boat lifts, jet ski lifts, intake structures, outfall pipes, marine waterways, overhead transmission lines, and cable or pipeline crossings, etc.; or
- Dredging and excavation.

Provisions of Section 10 are implemented by the Corps through a permit process that includes consideration of navigation, flood control, fish and wildlife management, and environmental impact. Compliance with the National Environmental Policy Act (NEPA) is required. Section 10 reviews often occur simultaneously with Section 404 permit processing. Under Section 10, activities receive an Individual Permit, a Letter of Permission, a Nationwide Permit, or a Regional General Permit.

Executive Order 11988 - Floodplains

Executive Order 11988, issued in 1977, directs federal agencies to avoid, to the extent possible, the long- and short-term adverse impacts associated with the occupancy and

modification of floodplains and to avoid direct or indirect support of floodplain development wherever there is a practicable alternative. The Order directs each agency to "provide leadership and take action to reduce the risk of flood loss, to minimize the impact of floods on human safety, health and welfare, and to restore and preserve the natural and beneficial values served by floodplains in carrying out its responsibilities for (1) acquiring, managing, and disposing of federal lands and facilities; (2) providing federally undertaken, financed, or assisted construction and improvements; and (3) conducting federal activities and programs affecting land use, including but not limited to water and related land resources planning, regulating, and licensing activities."

The guidelines address an eight-step process that agencies should carry out as part of their decision-making on projects that have potential impacts to or within the floodplain. The eight steps, which are summarized below, reflect the decision-making process required in Section 2(a) of the Order:

1. Determine if a proposed action is in the base floodplain (that area which has a 1 percent or greater chance of flooding in any given year).
2. Conduct early public review, including public notice.
3. Identify and evaluate practicable alternatives to locating in the base floodplain, including alterative sites outside of the floodplain.
4. Identify impacts of the proposed action.
5. If impacts cannot be avoided, develop measures to minimize the impacts and restore and preserve the floodplain, as appropriate.
6. Reevaluate alternatives.
7. Present the findings and a public explanation.
8. Implement the action.

Executive Order 11990 - Wetlands

In 1977, Executive Order 11990 directed federal agencies to avoid the unnecessary alteration or destruction of wetlands. The purpose of Executive Order 11990 is to "minimize the destruction, loss or degradation of wetlands and to preserve and enhance the natural and beneficial values of wetlands." To meet these objectives, the Order requires federal agencies, in planning their actions, to consider alternatives to wetland sites and limit potential damage if an activity affecting a wetland cannot be avoided. The Order applies to:

- Acquisition, management, and disposition of federal lands and facilities construction and improvement projects which are undertaken, financed or assisted by federal agencies; and
- Federal activities and programs affecting land use, including but not limited to water and related land resources planning, regulation, and licensing activities.

Each federal agency is responsible for preparing and implementing procedures for carrying out the provisions of the Order. The Order requires federal agencies to provide leadership and take action to minimize the destruction, loss, or degradation of wetlands

affected by any federal project or project that receives federal funding. Federal agencies must also address and mitigate any unavoidable wetland impact. The Order establishes wetland protection as the official policy of all federal agencies.

While the Order does not regulate wetlands per se, it does establish wetland protection as the official policy of all federal agencies. Many state policies and regulations reflect this federal policy.

Endangered Species Act

The Endangered Species Act (ESA), passed in 1973, provides for the conservation of species that are endangered or threatened and the conservation of the ecosystems on which they depend. A species is considered endangered if it is in danger of extinction throughout all or a significant portion of its range. A species is considered threatened if it is likely to become an endangered species within the foreseeable future. There are approximately 1,880 species listed under the ESA.

All projects that have the potential to directly or indirectly impact wildlife species listed as endangered or threatened under ESA are subject to environmental review by the U.S. Fish and Wildlife Service (USFWS) or the National Marine Fisheries Service (NMFS). The USFWS oversees terrestrial and freshwater fish species, and NMFS oversees marine and anadromous species. These agencies review projects to determine the extent of the impacts and the proper mitigation and conservation measures to be implemented to eliminate or limit these impacts. The ESA applies to all projects that meet any of the following criteria:

- Projects requiring a permit from a federal agency;
- Projects on federal lands;
- Federally funded projects; or
- Projects that may cause either direct injury to the listed species, alteration of habitat, or significant disturbance to the habitat.

The first three types of projects listed above are covered under Section 7 of the ESA, which requires agency consultation. The last category is covered under Section 9, which defines prohibited acts. Under both categories, applicants must show either that the project would have negligible impact on any listed species, or that the project includes mitigation or conservation measures to sufficiently negate any potential impacts.

Agency consultation involves working with the federal authority (USFWS or NMFS) to determine which species reside in the project area and the probable extent of the impact. If the impacts are determined to be negligible, then the federal agency issues a letter or notification of “no effect” and the project may proceed without additional permitting from USFWS or NMFS. If potential significant impacts on the listed species or its habitat are identified, a Biological Assessment is prepared and submitted to the federal agency, along with a request for a formal consultation. The Biological Assessment will

result in one of two determinations—"may affect, not likely to adversely affect" or "may affect, likely to adversely affect." If the determination is "may affect, not likely to adversely affect," the project can proceed as long as it complies with mitigation measures outlined in the Biological Assessment. If a projected is determined to "may affect, likely to adversely affect," triggers formal consultation and the federal agency must prepare a Biological Opinion. The Biological Opinion states the opinion of the federal agency on whether the project will result in adverse impact to a listed species.

Another way that the Section 7 ESA consultation may be triggered in the future is if a recent Biological Opinion regarding the NFIP is extended outside of the Puget Sound to include the Chehalis basin. In September 2008, NMFS released a Biological Opinion that found that the NFIP in Puget Sound is likely to jeopardize the continued existence of federally listed salmon species and Southern Resident killer whales. One outcome of this Biological Opinion is that a Section 7 consultation will be required if a floodplain development permit is issued by one of FEMA's partner communities or if a map revision is requested. FEMA is currently adjusting policy guidance, and providing partner communities within the Puget Sound with regulatory mechanisms that comply with the Biological Opinion. These mechanisms focus on the community adopting specific elements in their local floodplain ordinance to qualify for a programmatic approval under the NFIP. These mechanisms include a Model Ordinance that communities can adopt or adapt, and a checklist that communities can use to assess their existing ordinance.

National Environmental Policy Act

The National Environmental Policy Act (NEPA) (42 USC 4321 et seq.) requires federal agencies to review the potential environmental impact of all federal actions (including agency-sponsored development projects and agency decisions on permits and approvals for privately-sponsored development projects). The NEPA process requires evaluation of probable environmental consequences of a proposal before decisions are made by a federal agency. NEPA also requires identification of alternatives and mitigation that avoids or minimizes environmental impacts.

Guidance for implementation of NEPA is provided by the Council on Environmental Quality (CEQ). The CEQ Regulations (40 CFR 1500-1508) place significant emphasis on the consideration of alternatives, including ways to mitigate harmful environmental effects. Most federal agencies have adopted their own regulations for implementing NEPA requirements.

NEPA requires the preparation of an environmental impact statement (EIS) for any federal action that would have significant adverse environmental impact. The EIS must thoroughly evaluate any adverse environmental impact of the proposed action and its alternatives. Permits issued by a federal agency (such as Section 404 permits) are among the federal actions that may require an EIS.

To determine whether a proposal would have significant adverse environmental impact, the agency may prepare an environmental assessment (EA). A permit applicant often provides much of the information and analysis used to prepare the EA. The EA contains sufficient evidence and analysis to determine whether an EIS is required. If an EIS is not required, a Finding of No Significant Impact (FONSI) document is prepared by the federal agency to explain why an EIS is not required. Compliance with NEPA is achieved upon completion of the FONSI or EIS.

Key State Regulations

Floodplain Management Program

Washington State's Floodplain Management Program (RCW 86.16) requires that local flood-prone jurisdictions adopt a flood damage prevention ordinance based on federal standards contained in the NFIP. However, state regulations go beyond federal standards in prohibiting new or substantially improved residential construction in designated floodways.

The state Floodplain Management Program also provides technical and financial assistance to local communities. The CFHMPs for Thurston County and for the Chehalis Tribe were partially funded by the State Floodplain Management Program through the Flood Control Assistance Account Program (FCAAP).

Hydraulic Code

The Washington State Hydraulic Code (RCW 75.20.100-140) regulates activities affecting the state's salt and fresh waters. The purpose of the Hydraulic Code is to reserve fish and wildlife habitat in and around the waters of the state. The Washington State Department of Fish and Wildlife (WDFW) administers the Hydraulic Code.

Any work that falls within the definition of a hydraulic project requires a Hydraulic Project Approval (HPA) from WDFW. Hydraulic projects are defined as work that will use, divert, obstruct, or change the natural flow or bed of any waters of the state. Most structural flood hazard reduction projects require an HPA.

Other State Programs Implemented at the Local level

The following state laws relevant to flood hazard management are implemented at the county or city level:

- Shoreline Management Act (SMA),
- Growth Management Act (GMA), and
- State Environmental Policy Act (SEPA).

State involvement in these programs is limited to oversight and technical assistance.

The Shoreline Management Act requires local jurisdictions to develop Shoreline Master Programs to regulate activities in the shoreline zone (within 200 feet) of streams or rivers with flows greater than 20 cfs and lakes greater than 20 acres. The Shoreline Master Program regulations are intended to protect the shoreline by limiting what can be constructed on the shoreline and in the shoreline zone. Regulations typically cover shoreline armoring, docks, vegetation removal, construction of roads and structures, and utility installation. The Shoreline Management Act is also intended to provide public access to areas of the shoreline. The Shoreline Management Act has no specific flood protection role, but indirectly helps reduce flood damages by regulating what can be constructed within the shoreline zone.

The Growth Management Act regulates development in cities and counties of the state. The Growth Management Act includes a requirement for jurisdictions to adopt critical (or sensitive) areas regulations to protect wetlands, fish and wildlife habitat, geologic hazard areas, critical aquifer recharge areas, and flood hazard areas. In addition to the direct flood regulations in flood hazard areas, protection of wetlands and streams helps protect the floodplain. The general protection mechanism is the requirement for buffers around wetlands (often located in the floodplain) and streams. These buffers restrict construction in those areas.

The State Environmental Policy Act does not include any specific regulations, but is a procedural requirement that jurisdictions conduct an environmental analysis of the potential impacts of developments that meet certain requirements. The environmental analysis can help identify potential impacts of developing in a floodplain and can identify ways to mitigate development.

Flood Authority Regulatory Summary

All of the member jurisdictions of the Chehalis River Basin Flood Authority have adopted floodplain regulations that have been approved by the state. Although all the regulations meet the state's minimum requirements, there is no standard regulation. There is considerable variability between jurisdictions in the level of protection provided.

Most jurisdictions in the Chehalis River basin have adopted critical or sensitive areas regulations, although some are still in the process of adoption. Although there is some variability in the regulations, most provide sizable buffers around wetlands and streams. Jurisdictions in the Chehalis River basin adopted their Shoreline Master Programs in the 1970s shortly after the Shoreline Management Act passed. Those programs have not been updated since the 1970s, but will be required to be revised within the next five years under amendments to the Shoreline Management Act.

CHAPTER 4 PREVIOUS STUDIES

Many different entities have studied flood problems in the Chehalis River basin. These include the U.S. Army Corps of Engineers (Corps), Federal Emergency Management Agency (FEMA), Natural Resources Conservation Service (formerly Soil Conservation Service), and the U.S. Bureau of Reclamation (Reclamation). The Corps has been conducting studies of the basin intermittently since the 1930s. The early studies did not identify projects that justified the expense of flood improvements under benefit-cost analysis guidelines. The Corps is currently conducting new studies in response to recent flood events. Reclamation investigated multipurpose land and water resource development potentials of the upper Chehalis River basin in the 1960s. The Natural Resources Conservation Service (NRCS) conducted flood analyses for tributaries in the basin in the 1970s.

These projects are described in more detail below. This chapter also includes a brief description of the existing flood hazard management plans developed by jurisdictions in the Chehalis River basin and the Chehalis Watershed Management Plan.

U.S. Army Corps of Engineers Activities

This section describes projects undertaken by the Corps since the early 1930s as well as the current Corps projects. This section is based largely on information provided in the 2008 Lewis County Comprehensive Flood Hazard Management Plan (CFHMP) and therefore, focuses on activities in Lewis County. Detailed information on studies in other parts of the basin is not readily available.

1930-1976

- In 1931, the Corps investigated improvements on the Chehalis River for navigation, flood control, power development, and irrigation, but concluded that no improvements were justified at that time.
- In 1935, a Preliminary Examination (not published as a congressional document) by the Corps concluded that a flood control reservoir or channel improvements at Centralia, Galvin, Oakville, Malone, and Porter were not economically justified.
- In 1944 House Document 494 discussed a Preliminary Examination and survey for flood control on the Chehalis River and its tributaries. The Corps considered construction of a levee system to protect Aberdeen, Cosmopolis, and Hoquiam, but concluded that any additional flood control in the basin was not economically feasible. Despite this conclusion, a levee system was subsequently authorized by Congress in 1944. However, the authorization expired in 1952 and no levees have been constructed.
- Between 1946 and 1949, the Corps analyzed the concept of multiple reservoirs on the upper Chehalis River, but determined that they were not feasible at that time. Later, the Corps conducted a more localized evaluation of the flood problems along Lum Road in Centralia and recommended channel clearing on 1,660 feet of Coffee Creek. This evaluation was completed in March 1966.

- Between 1966 and 1971, the Corps study efforts concentrated on identifying flood problem areas and possible solutions. Flood damage was occurring in the urban areas of the Aberdeen/ Hoquiam/ Cosmopolis region, Oakville, and Centralia-Chehalis region, and in rural areas along the Chehalis, Skookumchuck, and Newaukum Rivers. These studies indicated that large multiple-purpose storage projects in the Chehalis River basin were not economically justified and that levee and/or channel modifications, along with small headwater dams, should be studied further. Enlargement of Skookumchuck Dam to provide flood control storage was considered and found not to be economically justified at that time.
- In 1968, the Corps published two informational documents.
    - *Flood Plain Information-- Skookumchuck River, Bucoda, Washington* (Corps, 1968a) delineated the floodplain along the Skookumchuck River, from the Lewis/Thurston County line to about 1 mile upstream of Bucoda.
    - *Flood Plain Information-- Chehalis and Skookumchuck Rivers, Centralia Chehalis, Washington* (Corps, 1968b) delineated the floodplain along the Chehalis River from the Lewis/Thurston County line to Chehalis and along the Skookumchuck River from the mouth to the Lewis/Thurston County line.
- A 1974 report, *Special Study, Suggested Hydraulic Floodway-- Chehalis and Skookumchuck Rivers* (Corps, 1974), delineated the suggested hydraulic floodway for the area covered by the 1968 floodplain information report. The Corps published another report in this series in 1976, *Special Study-- Suggested Hydraulic Floodway, Chehalis and Newaukum Rivers*, that delineated the floodplain and suggested a hydraulic floodway for the Chehalis River from Chehalis to Adna, and for the Newaukum River from its mouth to the Interstate 5 bridge.

1972-1982

During the period from 1972 to 1982, the basin study was divided into four interim reports, each covering a specific area. These areas included the following locations on the Chehalis River: (1) at South Aberdeen and Cosmopolis; (2) near Centralia; (3) at the Wynoochee Hydropower/Fish Hatchery facility; and (4) surrounding Aberdeen and Hoquiam.

Centralia, Washington, Flood Damage Reduction Interim Feasibility Report and Environmental Impact Statement

The objective of the planning effort in Lewis County was to reduce flood damages within both the flood problem area near the Cities of Centralia and Chehalis and throughout the planning area covering the Skookumchuck valley. Preliminary evaluation of potential flood damage reduction measures considered multiple-purpose storage dams, small headwater dams, watershed management, channel clearing, channel excavation, urban levees, and non-structural measures. The urban levee system was the only alternative that initially appeared to be economically justified.

Subsequent feasibility studies focused on the urban levee alternative. These studies resulted in a tentative recommendation for a levee system providing a 200-year level of protection for 2,080 acres in Centralia. Levees to protect Fords Prairie, Galvin, and Chehalis were determined not to be economically justified. On August 5, 1980, Centralia expressed support for the levee system and agreed to serve as local sponsor, but recommended that prior to proceeding with the levee, the Corps review the potential for modifying the private Skookumchuck Dam to provide flood control. Based on its subsequent analysis, the Corps recommended modification of Skookumchuck Dam as the preferred flood control alternative in the *Centralia, Washington, Flood Damage Reduction Interim Feasibility Report and Environmental Impact Statement* (Corps, 1982). The Corps prepared basic hydrologic, hydraulic, and economic studies that were updated from the previous reports and preliminary spillway design layouts and cost estimates. The Corps suspended design work after studies indicated that the recommended plan lacked economic justification.

Modification of Skookumchuck Dam, 1982

Prompted by the City of Centralia's 1980 request, the Corps initiated feasibility studies for modifying the existing private water supply dam on the Skookumchuck River, about 20 miles upstream from Centralia. The Corps' study results indicated that it would be a better solution, both economically and environmentally, than an urban levee system. Although a 1968 Corps analysis had shown that using the dam for flood control was not feasible, subsequent coordination with the dam owner, Pacific Power and Light, indicated that flood control could be feasible. Based on the experience it had gained in a decade of dam operation, Pacific Power and Light believed that it would be possible to use part of its existing water supply storage for flood control storage during winter months. Hydrologic studies by the Corps showed that 17,000 acre-feet of flood control storage could be provided at the dam. This storage would reduce the 100-year flood on the Skookumchuck River in Centralia from 13,300 to 6,700 cubic feet per second (cfs), a reduction of 2 to 5 feet in flood height. The reliability of the existing and future water supply would also be maintained.

The *Centralia, Washington, Flood Damage Reduction Interim Feasibility Report and Environmental Impact Statement* (Corps, 1982) recommended modifying the dam to provide a low level flood control outlet (12-foot-diameter tunnel) and to raise the controlled reservoir (15-foot-high spillway gate) to provide flood control storage during winter months. The project would reduce flooding on 4,600 acres in the Skookumchuck River valley and on 17,500 acres in the Chehalis River valley. Total cost for this project was projected at $18.2 million (October 1982 prices) and would result in annual average flood damage reduction benefits of $2.5 million in the Skookumchuck and Chehalis River valleys, primarily in the Centralia urban area. The average annual costs were estimated to be $1,654,000 and the benefit to cost ratio for this plan was 1.5 to 1. The Corps would make structural modifications to the dam including gating of the existing spillway and constructing a 12-foot-diameter flood control tunnel with related intake and exit structures.

Once modifications were complete, Pacific Power and Light would continue to operate the dam. Operational changes would involve maintaining a lower reservoir pool level

during the early winter, to provide floodwater storage, with a programmed refill period between January 1 and March 1 to return the reservoir to the spillway crest (elevation 477 feet) before the summer dry season.

The Corps believed that, with planned mitigation features, adverse environmental impacts associated with the plan would not be major. Principal anticipated adverse impacts included alteration of wetland and riparian areas associated with the Skookumchuck River, with reductions in habitat values and impacts to dependent wildlife populations; reduction in available waterfowl habitat in the reservoir; and loss of a small number of fur-bearers (beavers and muskrats) in the Skookumchuck Reservoir. Beneficial impacts included significant flood damage reduction for the Skookumchuck River valley and the communities of Centralia and Bucoda, a minor amount of flood damage reduction for the Chehalis River floodplain downstream of Centralia, and an anticipated improvement of spawning conditions for anadromous fish in the Skookumchuck River.

1990s-Present

In response to flooding on the Chehalis River in the 1990s, the Corps initiated several flood damage reduction studies. While no action occurred as a result of these analyses, severe flooding in 2007 refocused the attention of regional stakeholders on appropriate structural solutions.

1990-Follow-up Evaluations of the Skookumchuck Dam Modifications

In May 1990, the Corps studies resulted in reduction of construction cost estimates for the Skookumchuck Dam modification from $24.8 million to $15.8 million. However, the new economic analysis also reduced the estimate of average annual flood damages. The new damage estimate appeared sufficient to justify only a $6 to $8 million project. In September 1990, further analysis of costs and benefits raised the benefit to cost ratio to 0.69 to 1, which was still well below economic feasibility. The Corps sent a negative report to the Division Office in September; the report recommended cessation of further study of Skookumchuck Dam modification by the Corps.

1998-Centralia Flood Damage Reduction Project

After the 1996 flood event, the Flood Action Council, a group of economic development, business activist, and commercial interests, developed a preliminary plan of modifying the Skookumchuck Dam and providing additional flood storage with overbank excavation of the Chehalis River (called the Centralia Flood Damage Reduction Project). A special flood control district was proposed to implement this plan, but it was rejected by the Lewis County Board of Commissioners because it did not meet the legal criteria for creation.

The Lewis County Board of Commissioners took the lead by establishing a countywide flood control district zone, and used local and state funding to study modifications to the 1984 Authorized Project (Skookumchuck Dam). The Skookumchuck Dam project had evolved to the point of having the Corps conduct Preconstruction Engineering and Design work from February 1988 through August 1990. Prior to the Preconstruction Engineering and Design, the Washington State Department of Transportation had plans to

widen and raise segments of Interstate 5 near Centralia and Chehalis. These post-1996 local flood studies also supported development of a flood hazard management alternative other than raising Interstate 5.

Lewis County asked that the Corps resume its Preconstruction Engineering and Design work on July 7, 1998, and to consider additional measures with the authorized dam modification element for a flood hazard reduction plan for the Centralia-Chehalis urban area. Although the City of Centralia was the project sponsor through the feasibility phase, Lewis County assumed sponsor responsibilities for project construction and to provide the appropriate cost sharing. The Corps resumed work in July 1998.

The study area for the authorized project includes the mainstem Chehalis River, its floodplain and tributaries from the South Fork Chehalis River confluence to Grand Mound, the Cities of Centralia and Chehalis, surrounding areas in Lewis and Thurston Counties, the Town of Bucoda, and along the Skookumchuck River to a point above the Skookumchuck Dam. Tributaries in the study area include the Skookumchuck and Newaukum Rivers, and several smaller creeks (Hanaford, China, Salzer, Coal, Dillenbaugh, and Berwick).

The Corps began the scoping process for the Environmental Impact Statement (EIS) by holding two public meetings on September 28 and 29, 1999, in Chehalis and Rochester, respectively. Supplemental studies were completed to address concerns raised during the scoping and project development processes. The Corps conducted a Post-Authorization Study, the Chehalis River General Reevaluation Study. This type of study is a reanalysis of a previously completed and authorized study using current planning criteria and policies, which is required because of changed conditions/assumptions. The results may affirm the prior study, reformulate or modify it, or find that no plan is currently justified. The results for this General Reevaluation Study are summarized in the Corps July 2002 *Draft EIS, Centralia Flood Damage Reduction Project*.

The EIS evaluated seven alternatives. The preferred alternative is a series of setback levees with modifications to the Skookumchuck Dam to increase flood storage, and non-structural features to be included in the local sponsor's revised floodplain management plan. The new plan for the project is to be in compliance with Executive Order 11988, which directs federal agencies to avoid impacts associated with floodplain development (see Chapter 3 for additional information on Executive Order 11988). The project has not yet been implemented.

1988-Salzer Creek Flood Damage Reduction Study

In response to a March 1988 request by the City of Centralia for assistance with flooding along Salzer Creek, the Corps conducted a reconnaissance study under authority of Section 205 of the 1948 Flood Control Act.

Flooding in the lower Salzer Creek basin causes damage within the Cities of Centralia and Chehalis, and in unincorporated Lewis County. Flooding within the Salzer Creek basin can occur from two different sources: high flows in the Chehalis River that back up water in Salzer Creek, or high flows on Salzer Creek itself. The most serious floods occur with backwater flooding. For most events, Salzer Creek can be expected to peak

about 6 to 8 hours before the Chehalis River. Studies indicate that when Salzer Creek experiences a 100-year flood, the Chehalis River would approximate the 75-year flood level. In addition to creating a backwater effect on Salzer Creek, water surface elevations on the Chehalis River with discharges in excess of about a 25-year frequency event overtop Interstate 5 both upstream and downstream from the Salzer Creek confluence, resulting in flooding conditions in both Chehalis and Centralia. The Skookumchuck River overflow may also contribute to the flooding near the mouth of Salzer Creek. No attempt was made by the Corps to analyze the effect of overland flow from the Skookumchuck River in this level of investigation.

The Corps determined the most feasible flood damage reduction alternative to be a closure structure and small levee across Salzer Creek in the vicinity of I-5 to prevent backwater flooding from the Chehalis River, and a pump (or pumps) to convey ponded Salzer Creek water across the closure structure. The project would protect not only improvements along Salzer Creek, but also a portion of Interstate 5 that is subject to flooding and the Centralia-Chehalis airport.

The project would consist of the following main elements:

- Constructing a short levee segment and a closure structure with a pump plant across lower Salzer Creek just west (downstream) of the Interstate 5 bridge over the creek. The levee would stretch from I-5 east to high ground and would protect the right bank only. It would have 3:1 (horizontal: vertical) side slopes, a 12-foot top width, and a height of 8 to 16 feet. The levee would be designed with a top elevation that allows 3 feet of freeboard over the 100-year water surface elevation.
- Raising and improving the airport dike to provide appropriate flood protection.
- Building two new short levee segments to tie the airport dike to the I-5 embankment.
- Designating a ponding area and channel improvement along Salzer Creek to improve conveyance.

The City of Centralia signed the Feasibility Cost Sharing Agreement in September 1990, and has been seeking cost sharing funds since that time. The estimated feasibility study cost is $650,000 (sponsor to pay half of this), and estimated construction cost is $3 million (sponsor to pay roughly one-quarter). The City of Centralia is the main sponsor. Participating sponsors are the City of Chehalis and Lewis County. In April 1993, affected property owners in the Salzer Creek basin did not approve the formation of a special district to fund this project. Instead, they approved construction of a levee that would provide a 45-year design level of protection. This project is called the “Long Road Levee” and was completed in September 2000. The levee is maintained and funded by the Lewis County Flood Control District No. 2, which was formed in 1991.

1988-Section 205 Initial Reconnaissance Report on China Creek at Centralia

In response to a March 1988 request by the City of Centralia for help with flooding along China Creek, the Corps conducted an initial reconnaissance study under authority of Section 205 of the 1948 Flood Control Act.

China Creek is a tributary to the Chehalis River and has a drainage area of 5.32 square miles at its mouth. The lower reach of the basin, below the Burlington Northern Railroad crossings (drainage area 0.87 square mile), is well developed and highly channelized with numerous constricted and covered sections. The upper portion of the basin is relatively undeveloped and wooded, surrounded by low-lying hills with a maximum elevation of about 600 feet. Stream gradients are mild to relatively flat from the confluence with the Chehalis River to 1 to 2 miles upstream of the Burlington Northern Railroad tracks.

Flood-producing streamflows occur from October through March and are generated primarily from maritime rainstorms with little or no snowmelt. Flooding near the mouth of China Creek is affected by backwater from the Chehalis River. Flooding in the project area can also result from overflows from the Skookumchuck River entering China Creek near the Burlington Northern Railroad during periods of high discharge. No streamflow records are available for China Creek. The 10- and 100-year frequency floods on China Creek are estimated to be 235 and 480 cfs, respectively.

Alternatives were identified for flood damage reduction, including levees, flood-proofing, channel modification, detention storage, and diversion. Extensive development around and over the channel eliminated most of these alternatives, including levees and channel modification. An alternative that provides detention storage and diversion of floodwaters upstream from the Burlington Northern Railroad may be the most effective solution to reducing flood damages from China Creek. A program of periodic channel maintenance by Centralia would also help reduce the potential for flood damage.

The recommended alternatives are not eligible for federal participation because the 10-year discharge on China Creek in the project area is estimated to be only 235 cfs. Federal participation criteria require the 10-year flood to be greater than 800 cfs. The Corps recommended that no further studies of the flood problems from China Creek at Centralia be undertaken using the authority of Section 205 of the 1948 Flood Control Act, as amended.

1990-Centralia-Chehalis Flood Warning and Flood Response Study

In January 1990, the Chehalis River at Centralia experienced a 100-year flood, and the greater Centralia-Chehalis area found it difficult to respond to this disaster. Property damage was estimated at $15 million, and three lives were lost. In March 1990, Lewis County asked the Corps to perform a non-structural study, and to work with the county and the Cities of Centralia and Chehalis to improve their flood warning and flood response plan. The Corps completed a reconnaissance report in August 1990 that indicated that substantial flood damage reduction and safety benefits could accrue from improving flood warnings, public awareness of the flood problem, and the government's flood response plan. In early 1991 the Seattle District Corps received $40,000 to complete the non-cost-shared feasibility phase.

During the feasibility phase, the following products were completed: (1) a public brochure that advises Centralia and Chehalis citizens what to do before, during, or after the flood; (2) a flood warning map that predicts what areas of Centralia and Chehalis would be flooded based on information received from upstream river gauges; and (3) a flood warning checklist that alerts city and county officials which of their facilities may

be threatened during a flood. No construction project was identified in the feasibility phase.

The Corps has investigated flood damages in the Centralia-Chehalis valley. Based on historical records, the Corps has identified water levels at selected gauges that cause both zero damage and major damage in the valley. These gauge heights provide a reference for quickly assessing the severity of anticipated floods, and triggering emergency flood response operations in Lewis County.

The Corps developed a Flood Phases Guidelines Manual in 1993 that includes the flood phase warning map for the Centralia-Chehalis valley. This map was developed prior to the 1996 flood of record, but the four flood phases in the flood warning map are still accurate and used for local alerts and flood emergency preparedness. Reproductions of the map are inserted annually in the local newspapers. Large wall maps are posted in county and city offices along with a graphic and narrative description of each of the four flood phases.

1989-Newaukum River at Chehalis Flood Reduction Study

In 1989, under Corps Section 205 authority, the Seattle District Corps investigated flood solutions to the flooding problem centered on the Chehalis Avenue Apartments in Chehalis. The solution proposed by the Corps was an approximately 1,000-foot-long levee and pump plant to the south of the apartments. The potential project had a benefit to cost ratio of only 0.2 to 1, and further consideration of the project ceased in November 1989. Flood-proofing by home, apartment, and business owners was encouraged by the Corps.

2007 Project Authorization

The Centralia Flood Damage Reduction General Reevaluation Report and EIS were completed in April 2004. A Record of Decision was issued in January 2006 and project authorization was received in Section 1001(46) of the Water Resources Development Act of 2007. The 2007 Water Resources Development Act authorized the Corps, in cooperation with the non-federal sponsor, to pursue three options—Water Resources Development Act 2007 Approved Plan, National Economic Development Plan, and Locally Preferred Plan. These are described below:

Water Resources Development Act 2007 Approved Plan:

- Construction of a 100-year level of protection levee system along the Chehalis River from approximately river mile (RM) 75 to RM 64 and along most of the lower 2 miles of both Dillenbaugh Creek and Salzer Creek;
- Construction of a levee along the lower approximately 2 miles of the Skookumchuck River to the confluence with Coffee Creek that would provide 100-year level of protection;
- Raising approximately eight structures that would incur damages from increased inundation as a result of the project;

- Modification of Skookumchuck Dam to allow 11,000 acre-feet of flood control storage.

National Economic Development Plan:

- Construction of a 100-year level of protection levee system along the Chehalis River from approximately RM 75 to RM 64 and along most of the lower 2 miles of both Dillenbaugh Creek and Salzer Creek;
- Construction of a levee 2 feet below the 100-year water surface elevation along the lower approximately 2 miles of Skookumchuck River to the confluence with Coffee Creek;
- Raising approximately eight structures that would incur damages from increased inundation as a result of the project;
- Modification of Skookumchuck Dam to allow 11,000 acre-feet of flood control storage.

Locally Preferred Plan:

- Construction of a 100-year level of protection levee system along the Chehalis River from approximately RM 75 to RM 64 and along most of the lower 2 miles of both Dillenbaugh Creek and Salzer Creek;
- Construction of a levee along the lower approximately 2 miles of Skookumchuck River to the confluence with Coffee Creek that would provide 100-year level of protection (based on 20,000 acre-feet of storage at Skookumchuck Dam);
- Raising approximately eight structures that would incur damages from increased inundation as a result of the project;
- Requires further federal evaluation.

Corps Twin Cities Flood Damage Reduction Project

The Corps and the State of Washington, the local sponsor, are conducting an evaluation of flood damage reduction projects in the Chehalis-Centralia area. These projects include the levee system along the Chehalis River, a control structure on Salzer Creek, and modifications to Skookumchuck Dam as well as other local improvements. The project is being conducted in two parts. Part 1 is an evaluation and update of the existing design based on the 2007 flood. Part 2 will be the design phase. The Corps anticipates beginning construction in 2014.

2009-Chehalis River Basin General Investigation

In 1999, the Corps initiated a General Investigation for the entire Chehalis River basin. The investigation is currently in the feasibility phase. The feasibility study phase began in 2000 as a single-purpose ecosystem restoration study with incidental flood damage reduction benefits. In 2009, flood risk management was added as an equal project purpose, bringing on the need for a fully-updated Project Management Plan. The Flood Authority is collaborating with Grays Harbor County, the local sponsor for the

investigation. The Project Management Plan has been drafted and is expected to be approved in May 2010.

FEMA Region X Interagency Hazard Mitigation Team

The FEMA Region X Interagency Hazard Mitigation Team is composed of numerous federal, state, and local agencies. The Supplemental Flood Hazard Mitigation Report (FEMA, 1991), prepared by the Region X Interagency Hazard Mitigation Team after the November 1990 floods, made recommendations concerning the recurring flooding in the Centralia-Chehalis area. Current flood control structural proposals identified in the area included: (1) a dam on the Skookumchuck River that would provide incidental flood control benefits for Centralia; (2) a levee segment on the Skookumchuck River that would protect a portion of Centralia; and (3) a levee that would protect the Chehalis-Centralia airport.

The following recommendations made by the Interagency Hazard Mitigation Team (FEMA, 1991) were identified as being interdependent and best implemented simultaneously:

- State government, with FEMA support, should provide leadership to encourage all home and business owners who receive flood damage to flood-proof their homes and businesses. Flood audits should be performed on selected structures.
- The federal government should aid the local governments and individuals in improving their flood warning and flood response systems.
- All potentially feasible structural projects should be investigated and their costs, benefits, and impacts thoroughly researched.

Natural Resources Conservation Service

The Soil Conservation Service (now Natural Resources Conservation Service or NRCS) conducted a series of flood hazard analyses for tributaries of the Chehalis River in the 1970s. Flood hazard analyses by the NRCS are conducted according to recommendations in a report by the 1966 Task Force on Federal Flood Control Policy, especially recommendation 9(c), “Regulation of Land Use.” It requires that preliminary reports be issued where guidance may be needed before a complete flood hazard information report can be prepared, or when a full report is not scheduled.

1978-Flood Hazard Analysis of Coffee Creek

This study was requested by the City of Centralia. The objective was to conduct a detailed flood hazard analysis of the Coffee Creek floodplain in and adjacent to the north portion of Centralia. Coffee Creek is a tributary of the Skookumchuck River, with headwaters in Thurston County, flowing south through Zenkner valley to the Skookumchuck River just north of Centralia. The NRCS report addressed the lower 3.4 miles of the watershed.

The NRCS flood hazard study developed information needed to show portions of the Coffee Creek floodplain subject to inundation by select frequency floods. A total of 395 acres is subject to inundation by the 100-year flood in the study area. The study did not

address flooding in the Coffee Creek basin caused by overland flow from the Skookumchuck River. Additional information on the Coffee Creek Flood Hazard Analysis can be found in the 2008 Lewis County CFHMP.

1977-Flood Hazard Analysis of China Creek

An analysis of flooding on China Creek was requested by the City of Centralia in 1974. The objective was to conduct a detailed flood hazard analysis of the China Creek floodplain in and adjacent to Centralia.

The NRCS study provided peak discharges, water surface elevations and profiles, and flood boundary and floodway information for select frequency floods. The study did not consider any structural changes on the streams. The results of this study were presented as a base from which Lewis County and the City of Centralia may compare the effects of future alternatives for development. The NRCS did, however, recommend that clearing the bridges and channels of sediment, debris, and heavy vegetation would reduce floodwater elevations, especially for smaller floods. The study also emphasized that land use and development trends within the watershed, coupled with the outside influence of the Chehalis and Skookumchuck drainages, have a direct effect on future flooding potential. Additional information on the China Creek Flood Hazard Analysis can be found in the 2008 Lewis County CFHMP.

1975-Flood Hazard Analysis, Salzer-Coal Creeks

An analysis of flood hazard for Salzer-Coal Creeks was requested by the Lewis County Commissioners in 1973. The objective of this study was to conduct a detailed flood hazard analysis of the Salzer-Coal Creek floodplain in and adjacent to Centralia. Information on the Salzer-Coal Creeks Flood Hazard Analysis can be found in the 2008 Lewis County CFHMP.

U.S. Bureau of Reclamation

In its publication *Upper Chehalis River Basin Reconnaissance Report* (Reclamation, 1965), Reclamation investigated the multipurpose land and water resource development potentials of the upper Chehalis River basin. Multipurpose development considered in this report included irrigation, flood control, fish and wildlife, and recreation. Water quality control, municipal and industrial water, navigation, and power generation were evaluated, but would not be involved in a development plan. The study area included only the upper part of the Chehalis River basin, which was defined as that portion of the basin lying upstream from the confluence of the Chehalis and Black Rivers in Grays Harbor County near Oakville.

A reconnaissance land classification survey made by Reclamation in 1960 and 1961 covered a total of 282,000 acres. Reclamation determined that the upper Chehalis River basin contains about 120,000 acres of arable land, of which about 85,000 acres, or 70 percent, are suitable for irrigation under long-range development plans.

The following plans for irrigation development in the Chehalis River basin were analyzed:

- Storage at the Doty site on Elk Creek to serve lands in the Adna area, and at the Alpha site on the South Fork Newaukum River to serve lands in the Newaukum area.
- Alternatives to Doty storage at the Pe Ell, Dryad, Meskill, and Ruth sites on the Chehalis River, Boistfort and Point Hill sites on the South Fork Chehalis River, and alternatives to Alpha storage at the Logan Hill, Middle Fork, and Bear Creek sites on the North Fork Newaukum River and Onalaska site on the South Fork Newaukum River.
- Bloody Run site on the Skookumchuck River.

The first plan was superior in providing storage and facilities within the range of requirements for multiple purposes considered in the plan formulation. Storage sites in the second plan were eliminated for cost or geologic reasons.

The plan was presented as having an engineering feasibility and a benefit-cost ratio of 1.22 to 1. Financial assistance to the water users would be necessary. The plan would provide full-scale irrigation development for an almost solid area or block of land.

The development plan provided for reservoir operation for flood control to the extent feasible. It was projected that the project could reduce flood damages primarily below the confluence of the Newaukum and Chehalis Rivers.

No further work was done on this project.

Existing Comprehensive Flood Hazard Management Plans

Several jurisdictions in the Chehalis River basin have developed CFHMPs. These plans have provided background information for the development of this basin-wide CFHMP.

2009-Chehalis Tribe Comprehensive Flood Hazard Management Plan

The Chehalis Tribe completed its CFHMP for the Chehalis Reservation in March 2009. Approximately 75 percent of the Reservation is in the active floodplain, and portions of the Reservation are isolated by floods for several days. The long-term goals of the Chehalis Tribe CFHMP are:

- Protect and preserve the lives, health, safety and well-being of the people living on the Chehalis Reservation.
- Reduce repetitive damages and costs associated with flooding.
- Protect the Reservation from negative impacts of upstream floodplain development.

Short-term goals of the CFHMP are intended to address the previous lack of (1) a science-based 100-year recurrence interval flood map for the entire Chehalis Reservation (update the 1977 USGS flood map), and (2) written record of hazard areas associated with flooding, and flood-related processes such as channel migration, within and adjacent to the Chehalis Reservation. The product of this short-term goal will be the 100-year

flood inundation surface map with hazard areas indicated. The flood map will be used as a tool for planning and permitting by the Chehalis Tribe.

The CFHMP includes a number of structural and non-structural mitigation measures that were evaluated and prioritized for the CFHMP. The structural measures include culvert and bridge improvements to reduce access limitations during flooding events. The non-structural measures include emergency response and preparedness measures, as well as elevating or removing structures from the floodplain. The Chehalis CFHMP also identifies studies needed to implement the mitigation measures and meet the CFHMP goals.

2001-Grays Harbor County Comprehensive Flood Hazard Management Plan

Grays Harbor County received funding for comprehensive flood hazard management planning from Ecology's Flood Control Assistance Account Program (FCAAP) grant program and FEMA's flood mitigation assistant (FMA) grant program administered by the State Emergency Management Department. The Grays Harbor County CFHMP covers a large portion of Grays Harbor County, with special focus on the Humptulips, Wynoochee, and Satsop Rivers. The plan addresses the watersheds contributing to Grays Harbor County and evaluates the potential for flooding and its impacts. It also proposes possible structural and alternative management solutions to reduce flood hazards.

The short- and long-term goals of the Grays Harbor County CFHMP include:

- Improve the protection of public health and safety from flooding events.
- Provide practical, cost-effective solutions that will result in measurable reductions in flood frequency, flood duration, and the amount of damage that occurs in frequently flooded areas.
- Identify and assess county-wide problem areas through public meetings and existing FEMA mapping.
- Develop a community-driven plan with positive working relationships among the community and governmental agencies.
- Ensure that all parties are aware of the issues, processes, and implications of a CFHMP.
- Reach public and agency consensus on solutions and funding.
- Document recommendations consistent with Ecology's FCAAP to permit further grant funding opportunities for plan implementation.
- Develop a plan consistent with FEMA Flood Hazard Mitigation Planning so that the county can be eligible for flood hazard mitigation assistance for the projects detailed in the plan.

Instrumental in implementation of this CFHMP goals and objectives, the FCAAP, administered by Ecology's shoreland and coastal zone management program, promotes a watershed approach to minimizing flood hazards. To be eligible for funding, jurisdictions must participate in the National Flood Insurance Program (NFIP).

Flood hazard management measures recommended in the CFHMP are categorized as non-structural or structural. Key non-structural approaches to flood hazard management include the following: land use regulations/permitting, accurate floodplain mapping, inter-jurisdictional coordination, floodplain conservation easements, educational materials on flood hazard management, flood warning system, new standards for design, construction, and maintenance, and a NFIP community rating program. Non-structural alternatives also include measures that homeowners can take to protect their homes from flood damage such as floodproofing, elevation, relocation, or buyout and demolition of affected structures. Structural management measures include levees, setback levees, floodplain excavation, flood control reservoir, overflow culverts and channels, onsite detention and retention, and biostabilization and other engineered solutions.

2008-Lewis County Comprehensive Flood Hazard Management Plan

A Project Advisory Committee guided development of the Lewis County CFHMP, and included members from the county, Ecology, cities and utilities. The policies laid out in the CFHMP include hazard identification, education and outreach, planning, regulations and development standards, corrective/mitigation actions, infrastructure, and emergency services. To address flood control issues in Lewis County, the CFHMP recommends drainage basin plans for Berwick and China Creek to identify structural and non-structural actions that will minimize peak flow increases, map channel migration zones, update hazards data sets and maps, and identify and collect missing data sets. Other recommended projects in the CFHMP are the Regional Flood Alleviation Project along I-5 consisting of levee construction and implementation of flow control facilities that minimize impacts to downstream populations, regional flood detention facilities, regional stormwater detention facilities, Salzer Creek backwater control, and a technical assistance program for bank stabilization and debris removal. The CFHMP also identifies coordinating with the Corps on its study of using the Skookumchuck Dam for flood control and creating flood district boundaries.

The Lewis County CFHMP recommends new flood hazard management policies to minimize future impacts of flooding. The policies are divided into seven categories:

- Hazard identification,
- Education and outreach,
- Planning,
- Regulations and development standards,
- Correction (mitigation) actions/repetitive loss,
- Infrastructure, and
- Emergency services.

The plan includes policy statements and recommended actions for each category.

Lewis County is currently in the process of developing a Multijurisdictional Hazard Mitigation Plan. A draft of the plan was released in November 2009.

2009-Natural Hazards Mitigation Plan for the Thurston Region

Thurston County completed a CFHMP in 1999. The County completed the majority of the projects and other recommendations in the plan. In September 2009, the County adopted a Natural Hazards Mitigation Plan for the Thurston Region.

The Natural Hazards Mitigation Plan includes a risk assessment, hazards profile, and mitigation goals and initiatives for earthquakes, storms, floods, landslides, wildland fire, and volcanic activity. It includes climate change projects.

The flood hazards profile in the plan includes the Skookumchuck, Chehalis, and Black Rivers which are in the Chehalis River basin. The assessment concludes that the probability of occurrence of flood events in the Thurston Region is high with the Chehalis and Skookumchuck Rivers expected to experience a major flood every 4 to 4.5 years. The plan also discusses groundwater flooding which occurs in the Scatter Creek and lower Black River portions of the Chehalis basin.

The plan includes the following mitigation priorities that relate to flooding:

- Create a lifeline transportation route GIS map for the Thurston region and integrate the data into the Thurston County emergency Operations Plan and other local planning needs.

- Develop inter-jurisdictional capabilities to share critical resources during emergencies and natural disasters.

- Improve the capabilities of managing debris from severe winter storm events.

- Obtain digital data and create GIS maps of the flood inundation from possible dam failures of the Skookumchuck Dam on the Skookumchuck Dam and the Alder and La Grande Dams on the Nisqually River, develop emergency evacuation routes, and update affected agencies comprehensive Emergency Management Plans.

- Develop public information and outreach website portal and complementary printed materials to increase the awareness and participation in natural hazards mitigation planning among the region's major employers, small businesses, and residents.

- Continue to refine the list of the region's critical facilities and jurisdictional asset data, geocode these locations, and update their financial value.

- Strengthen the capabilities of the Disaster Medical Coordination Center (DMCC) Hospital.

1999-Bucoda Comprehensive Flood Hazard Management Plan and 2009-Tow of Bucoda Annex to the Natural Hazards Mitigation Plan for the Thurston Region

The Town of Bucoda prepared its CFHMP in 1999 under a grant from Ecology's FCAAP. Bucoda is periodically inundated by floodwaters from the Skookumchuck River which result largely from upstream activities. Plan goals include prevention of harm to life and property, preservation of water quality, protection of fish and wildlife habitat, and minimization of cost.

The Bucoda CFHMP included structural and non-structural actions. Structural projects include building an overtopping levee at the north end of town, and installing a twin 18-inch culvert under Main Street at 11th Avenue to allow areas of town to drain rapidly following floods. Other structural recommendations are streambank stabilization with habitat rehabilitation, house raising, and regrading Market Street. Non-structural projects listed are overall cooperation with the flood control program on the Chehalis River, largely focused upon retrofit of the Skookumchuck Dam, improvement of the flood notification and response program, and adoption of an ordinance to restrict filling within the secondary overflow boundary.

The Town of Bucoda participated in the development of the Natural Hazards Mitigation Plan for the Thurston Region and its Natural Hazards Mitigation Plan is an Annex of the Thurston Region plan. The Town had not yet adopted this plan as of mid March 2010.

The Natural Hazards Mitigation Plan determined that flooding from the Skookumchuck River is the most prevalent natural hazard for Bucoda. The Skookumchuck River reaches flood stage at the Bucoda gage approximately once every four years with a 24 percent annual recurrence rate. Major flooding forces many people in the town to evacuate their houses and can isolate the town when SR 207 floods.

2008-City of Centralia Comprehensive Flood Hazard Management and Natural Hazards Management Plan

The City of Centralia adopted its Comprehensive Flood Hazard Management and Natural Hazards Management Plan in December 2008. Concern over major flooding events, evolution of the U.S. Army Corps of Engineers' proposed flood control project in the Chehalis River basin, and a lack of clearly articulated flood hazard management policies prompted the city to develop this new plan. The Action Plan section lists activities appropriate to the community's resources, hazards, and vulnerable properties. The Action Plan identifies who does what, when it will be done, and how it will be financed.

Proposed actions include preventative activities such as zoning, stormwater management regulations, building codes, preservation of open space, and an evaluation of the effectiveness of current regulatory and preventative standards and programs. The Plan lists property protection actions such as acquisition, retrofitting, and insurance, as well as activities to protect the natural and beneficial functions of the floodplain, such as wetlands protection. Also listed are the development and maintenance of a specific flood

warning and evacuation program for the city, retrofitting and updating of current infrastructure and emergency services, and structural projects such as reservoirs and channel modifications. The China Creek Drainage Basin Plan, Centralia Flood Reduction Project (CFRP), construction of regional stormwater and flood detention facilities, Salzer Creek Backwater Control, and construction of a levee system along the Chehalis River in the City of Centralia are all specific actions listed in the Plan.

2007-City of Montesano All Hazard Mitigation Plan: Addendum 2

In response to the Grays Harbor County Natural Hazards Mitigation planning process, the City of Montesano developed and integrated its own Natural Hazards Mitigation Plan (NHMP) with that of the county. The NHMP identifies vulnerabilities for future disasters and proposes the mitigation initiatives necessary to avoid or minimize those vulnerabilities. The NHMP outlines specific mitigation initiatives for the city that are expected to be implemented by the year 2025.

A risk assessment was performed for several hazard events including earthquake, storm, flood, landslide, tsunami, wildlife, volcano ash fallout, and hazardous materials releases. The assessment concluded the city is vulnerable to all of the hazards outlined in the plan. The NHMP makes the following mitigation recommendations: installation of a city-owned natural gas/propane generator at City Hall to avoid disruption to the Emergency Operations Center, and construction of a 750,000-gallon reservoir on city property as backup to the city's vulnerable primary water source. Additionally, long-term bank stabilization on the Wynoochee River is recommended to repair bank erosion which endangers the integrity of the city's sewage treatment plant and holding lagoons.

2004-Chehalis Basin Watershed Management Plan

The Chehalis Basin Watershed Management Plan provides the collective vision of citizens, utilities, federal, state, tribal, and local governments within the Chehalis Basin Partnership. The Plan is a framework for water resource management, examining water quantity, water quality, instream flow, habitat, and water rights issues in the basin.

In order to address water quantity, the Partnership recommends conducting a groundwater study that provides necessary information to decision-makers to address hydraulic continuity and better evaluate whether an individual water right application would impact stream flows. They also recommend creating a "tool box" of alternative approaches for those seeking water supply, water rights and tracking, and enforcement. Exempt wells should be evaluated to assess their real cumulative impact in the Chehalis River basin and its subbasins. The Partnership also makes various general and specific recommendations for water conservation. In order to address water quality, the Partnership recommends a basin-wide water quality monitoring program, and exploration of a range of approaches to improve communication, coordination and consolidation of all habitat efforts in the Chehalis River basin. The Partnership also recommends reevaluating minimum instream flows established in 1976 at sites within the basin using updated scientific information.

CHAPTER 5 BASIN FLOOD CHARACTERISTICS

Flooding is a common, historical occurrence in the Chehalis River basin. Major flood events on the Chehalis River and its tributaries have affected Lewis, Thurston, and Grays Harbor Counties in the years 1972, 1975, 1986, 1990, 1996, 2007, and 2009. This chapter reviews historical information on previous flood events, including flood damage reports and historical flood flows, and focuses on key physical factors that affect flooding in the Chehalis River basin.

The information presented in this chapter is based on flood history sections of existing Comprehensive Flood Hazard Management Plans (CFHMPs) in the Chehalis River basin, especially the Lewis County CFHMP (2008). Because the most current information is available from the Lewis County plan, the information presented here focuses primarily on the Lewis County portion of the basin. As information is collected for the lower basin, it will be added to future iterations of this plan.

These reports were in preparation prior to the 2007 and 2009 flood events, so information about these floods has yet to be fully incorporated into some of the tables in this chapter. Other primary sources of information included: CFHMPs developed by the Chehalis Tribe (2009) and Grays Harbor County (2001), meteorologic and hydrologic data collected by the National Weather Service and the U.S. Geological Survey (USGS), and the U.S. Army Corps of Engineers General Reevaluation Study for the Centralia Flood Control Project (2003).

Factors Affecting Flooding

The extent and severity of flood damage in the Chehalis River basin is determined by several factors, including time of year, flood magnitude and duration, sediment transport and deposition, the amount and type of development in the floodplain, and natural obstructions in the channel.

Seasonal Conditions

Flooding in the Chehalis River basin typically occurs during the fall and early winter months. Heavy rainfall, rapidly melting snowpack, or a combination of these factors can result in river and stream flood conditions. Recent major floods have occurred between November and March.

Flood Magnitude and Duration

The Chehalis River basin is a large, relatively low-elevation area with a relatively high drainage density. Flooding is largely the result of heavy rain events, and to a lesser degree to rain-on-snow events. The magnitude and duration of these types of floods can vary significantly depending on the type, spatial extent, and duration of storm events.

Flows within the mainstem of the Chehalis River respond to contributions from the major tributary channels. This response can be additive if the timing and spatial extent of precipitation is similar over the watershed. The response in the mainstem can also be driven by a limited number of tributaries, as seen in the 2007 event, when intense rain in the Willapa Hills resulted in very high flows in the upper mainstem and South Fork of the Chehalis River and flood flows downstream to the mouth.

All flow from the upper tributaries is routed through the lower valley, including a narrow portion of the valley downstream of Grand Mound. These flows can then combine with flows from the lower tributaries such as the Satsop, Wynoochee, and Wishkah Rivers. The lower valley is typically wider than the upper valley, with less structural modification (e.g., levees, bridges) than in the Chehalis and Centralia (Twin Cities) area. In past events, storms appear to have been more significant in either the upper or the lower basin. According to flood peak data maintained by the National Weather Service, the ranking of flood peaks in the lower basin is different than in the upper basin. For example, the 2007 event is ranked number eight on the list for the Satsop River, and is not in the top 10 peak flows for the Wynoochee River.

In the lower basin, flood stage becomes increasingly influenced by tides as the river approaches its mouth at Grays Harbor. Flood peaks below Elma are likely modified by tide stage, but there are no studies that detail this process.

In general, precipitation-driven flooding has distinct peaks associated with specific storm events, which limits the overall duration of flooding. The 1996, 2007 and 2009 flood events in the upper basin occurred in a timeframe of a week or less, according to data from the Grand Mound USGS gauge. The duration of flooding will be influenced by soil saturation and other conditions prior to the storm event, as well as the length of the storm event itself.

Sediment Transport and Deposition

The generation, transport, and storage of sediment are major functions of the Chehalis River and its tributaries. Sediment sources in the upper watershed include weathered bedrock, glacial sediments, and alluvial deposits (Chehalis Tribe, 2009). These sources can deliver sediment continuously or episodically as a result of landslides or significant channel changes. Channel migration will also result in localized erosion and deposition of sediments.

Sediment processes can influence flooding in a number of ways. Increasing sediment loads can result in deposition within active channels, reducing conveyance capacity. Discrete events, such as landslides, can block channels and divert flow. Deposition on the floodplain can also influence flood flows. This deposition typically includes sand or finer materials, since the transport capacity of flows on the floodplain is typically lower than in the channel.

There is limited recent information available regarding sediment transport processes within the Chehalis River basin. The USGS performed a study that investigated sediment

transport within the Chehalis River basin for the water years 1961 to 1965 (Glancy, 1971). This study identified the Wynoochee River and the Middle and West Forks of the Satsop River as having the highest unit yields of sediment production and transport. Within the upper basin above Porter, the streams that drain the Willapa Hills to the west were found to have larger sediment yields than the streams that drain the eastern portion of the contributing basin. The upper mainstem had the highest sediment yield and the Black River had the lowest (Glancy, 1971).

Development and Obstructions

Obstructions to flood flows can be structural elements (e.g., levees, bridges, roads), or they can form during the flood as debris collects. During flood events in the Chehalis River basin, downed trees and other debris can deposit and form blockages that can divert significant volumes of flow. These obstructions can also hold back volumes of water until they break, sending a wave downstream.

There are structural elements that could impact flood flows throughout the Chehalis River basin. In the upper basin, there are at least 21 bridge crossings (Corps, 2003). In the lower basin, there are similar crossings. The Sickman-Ford Bridge on the Chehalis Reservation and associated approaches reduce the floodplain width, resulting in a backwater condition during high flows (Chehalis Tribe, 2009). The airport levee near Chehalis was observed to trap overbank flows during the 2007 event. Newspaper reports during the flooding indicate that the airport levee was breeched during the event, to hasten the recession of water from over major roads. Other bridges and obstructions that exist in the Chehalis River basin are not discussed in detail in this chapter. Structures and fill in the floodplain can also alter flood flows.

Flood Damages

Floods are among the most frequent and costly natural disasters in terms of human hardship and economic loss. Flood damage costs are a way to compare the impacts of different size floods. This flood damage summary is taken from Lewis County's 2008 CFHMP.

Flood damage information was obtained by the Corps of Engineers (Corps) from field investigations, damage survey reports, and personal interviews with homeowners, farmers, businessmen, and federal, state, county, city, and public utility officials. Eyewitness accounts of flooding and reports of damage in local newspapers were also used in identifying and quantifying flood damages.

In the past 30 years Lewis County has experienced 16 federally declared disasters. Of these, 13 were either caused or exacerbated by flooding. Table 5-1 is from the Lewis County Hazard Identification and Vulnerability Analysis and lists floods that resulted in a Presidential Declaration of Disaster. Care should be used in viewing the damage costs listed in Table 5-1. This table represents damages in Lewis County only and includes some damages from the Cowlitz River, outside the Chehalis River basin. These damage costs are approximate, and for primary and significant structures and businesses.

Information about damages is collected by different agencies and does not include all damages. The information is further confused when initial estimates of damage are refined. This can result in a higher or lower value. At best, the primary damage was erosion of public infrastructure (riverbanks, roads, bridges, and revetments). Costs for public damages are based on actual costs or cost estimates reviewed by FEMA. Private costs are based on information provided by victims, Red Cross, and FEMA, and do not include any reduction in property values.

Table 5-1. Flood Damages in Lewis County

Federal Declaration No.	Date	River/Area	Reported Public Damages ($)
DR-1734	December 2007	Chehalis	*
DR-1172	March 1997	Cowlitz	9,400,000**
DR-1159	December 1996 – January 1997	Chehalis, Cowlitz	3,255,900
DR-1100	February 1996	Chehalis, Cowlitz	30,000,000
-	December 1994	Chehalis	40,000
DR-0883	November 1990	Chehalis	1,050,000
-	February 1990	Chehalis	200,000
DR-0852	January 1990	Chehalis	1,439,380
DR-784	November 1986	Chehalis	3,926,250
DR-322	January 1972	Chehalis	2,060,250
-	January 1971	Chehalis	446,570

Source: Lewis County Comprehensive Flood Hazard Management Plan (2008)
*Information pending.
** Amount of Stafford Act and Small Business Administration disaster loans approved

Precise information on private property damage is, for the most part, unavailable. FEMA collects several types of data for private property, including human resources claims, and requests for short-term assistance and claims through the National Flood Insurance Program (NFIP) and the Small Business Administration (SBA). Human resource claims data and the damage reported in the newspapers are not necessarily alike. Human resource data are aggregated by zip code to protect the privacy of applicants, which makes it difficult to identify localized flood problems, trends, and causes.

Another factor to consider is the unreported private property damages. Flood insurance claims were either not filed because of lapsed flood insurance policies, or fear of increased rates. This is a common misconception; however, rates do not increase because a claim may have been submitted. In any case, the actual damages are likely understated and do not reflect the true magnitude of the problem.

The scope of the flood damages is related to the magnitude of the flood and location. Low-lying areas, especially river valleys, have flooded regularly for hundreds of years.

The 1996 flood event was the most severe and it affected interstate travel, thus making the associated damage costs (estimated up to $100 million) the highest to date.

Table 5-2 shows NFIP loss statistics for jurisdictions in the Chehalis River basin between January 1, 1978 and December 31, 2009. This information is based on data from FEMA.

Table 5-2. NFIP Loss Statics from January 1, 1978 to December 31, 2009

	Total Losses	Closed Losses	Open losses	CWPO[1] Losses	Total Payments
Grays Harbor County[2]	203	180	3	20	$4,314,386.81
Lewis County[2]	726	630	11	85	$22,432,705.49
Thurston County[2]	216	172	2	42	$3,086,335.82
Aberdeen	220	144	0	74	$686,941.00
Bucoda	43	38	0	5	$257,010.48
Centralia	717	662	7	48	$25,202,553.92
Chehalis	508	442	7	59	$27,881,498.57
Montesano	15	14	0	1	$195,095.97
Oakville	8	8	1	0	$231,456.51
Pe Ell	1	1	0	0	$37,770.81
Total	2,657	2,291	31	334	$84,325,755.38

[1]Closed Without Payment
[2]Includes all losses in the counties, not just in the Chehalis River basin
Source: FEMA, 2008.

Historical Flow Records

Flow data have been collected on the Chehalis River and two of its major tributaries, the Newaukum and Skookumchuck Rivers, by the National Weather Service and USGS. The National Weather Service stations record only water levels, while the USGS stations record water levels and flow. The stream gauging network in the Chehalis River basin is described in Chapter 2. This historical flow record summary is taken from Lewis County's 2008 CFHMP. Similar information is not available for other tributaries in the Chehalis River basin.

Streamflow data are summarized in Table 5-3 for three USGS stations: the Chehalis River near Grand Mound, approximately 7 miles downstream from the Skookumchuck River confluence; the Newaukum River near Chehalis; and the Skookumchuck River near Bucoda. The data show that the monthly distribution of flow is similar for the mainstem of the Chehalis River and two major tributaries flowing through the Centralia-Chehalis valley (Figure 6-1 in Lewis County, 1994). The largest monthly flows occur from December through February, with this period accounting for over half of the annual runoff volume. The smallest mean monthly flows occur from July through September, when monthly flows range from only 1 to 3 percent of the annual runoff.

Table 5-3. Summary of Mean Monthly Flows

	Chehalis River Near Grand Mound			Newaukum River Near Chehalis			Skookumchuck River Near Bucoda		
Period of record	1928-2007			1929- 2007			1967- 2007		
Drainage Area (mi^2)	895			155			112		
Month	Flow (cfs)	Percentage of Annual Flow (%)	Flow per Unit Area (cfs/mi^2)	Flow (cfs)	Percentage of Annual Flow (%)	Flow per Unit Area (cfs/mi^2)	Flow (cfs)	Percentage of Annual Flow (%)	Flow per Unit Area (cfs/mi^2)
January	6,428	19	7.1	1,110	18	6.9	783	18	7.0
February	5,769	17	6.5	970	16	6.4	670	16	6.1
March	4,501	13	5.1	768	13	5.0	542	13	5.0
April	2,929	9	3.3	540	9	3.5	395	9	3.7
May	1,382	4	1.5	294	5	1.8	219	5	1.9
June	810	2	0.9	183	3	1.2	151	4	1.4
July	378	1	0.4	89	1	0.6	95	2	0.9
August	243	1	0.3	56	1	0.3	79	2	0.7
September	340	1	0.4	71	1	0.5	120	3	1.1
October	918	3	1.0	181	3	1.2	141	3	1.3
November	3,862	11	4.3	748	12	1.5	346	8	3.1
December	6,389	19	6.8	1,070	18	6.5	717	17	6.0
Annual Average	2,829	100	3.1	507	100	3.2	355	100	3.2

Peak annual flood data are summarized from greatest to lowest in Table 5-4. This table does not include 2009 data for the Newaukum or Sookumchuck Rivers.

Table 5-4. Summary of Peak Annual Floods

Chehalis River near Grand Mound			Newaukum River near Chehalis			Skookumchuck River near Bucoda		
1929- 2007			1929- 2007			1968- 2007		
Year	Date	Maximum Flow (cfs)	Year	Date	Maximum Flow (cfs)	Year	Date	Maximum Flow (cfs)
2007	Dec. 4, 2007	79,000 [1]	1996	Feb. 08, 1996	13,300	1996	Feb. 08, 1996	11,300
1996	Feb. 09, 1996	74,800	1987	Nov. 24, 1986	10,700	1990	Jan. 10, 1990	8,540
1990	Jan. 10, 1990	68,700	1990	Jan. 09, 1990	10,400	1991	Nov. 25, 1990	8,400
1987	Nov. 25, 1986	51,600	2007	Dec. 3, 2007	10,300	1997	Dec. 30, 1996	8,380
1972	Jan. 21, 1972	49,200	1978	Dec. 02, 1977	10,300	1972	Jan. 21, 1972	8,190
2009	Jan. 4, 2009	48,800[1]	1991	Nov. 24, 1990	10,300	1978	Dec. 02, 1977	7,170

Chehalis River near Grand Mound			Newaukum River near Chehalis			Skookumchuck River near Bucoda		
1929- 2007			1929- 2007			1968- 2007		
Year	Date	Maximum Flow (cfs)	Year	Date	Maximum Flow (cfs)	Year	Date	Maximum Flow (cfs)
1938	Dec. 29, 1937	48,400	1999	Nov. 26, 1998	10,000	2006	Jan. 30, 2006	6,640
1991	Nov. 25, 1990	48,000	1972	Jan. 21, 1972	9,770	1971	Jan. 26, 1971	6,630
1934	Dec. 21, 1933	45,700	1997	Dec. 29, 1996	9,700	1987	Feb. 01, 1987	6,470
1976	Dec. 05, 1975	44,800	2003	Jan. 31, 2003	8,940	1976	Dec. 04, 1975	6,110
1971	Jan. 26, 1971	40,800	2006	Jan. 30, 2006	8,720	2002	Dec. 17, 2001	6,060
1997	Dec. 30, 1996	38,700	1974	Jan. 15, 1974	8,440	2003	Feb. 01, 2003	5,990
1935	Jan. 23, 1935	38,000	1971	Jan. 26, 1971	8,390	1974	Jan. 16, 1974	5,950
1951	Feb. 10, 1951	38,000	2000	Dec. 16, 1999	8,100	1982	Jan. 24, 1982	5,250
2006	Jan. 31, 2006	37,900	1976	Dec. 04, 1975	8,020	2000	Dec. 16, 1999	5,150
1974	Jan. 17, 1974	37,400	1964	Jan. 25, 1964	7,970	1999	Dec. 28, 1998	5,010
1949	Feb. 18, 1949	36,500	1986	Feb. 23, 1986	7,960	2005	Jan. 18, 2005	5,000
1978	Dec. 03, 1977	36,500	2002	Dec. 17, 2001	7,920	1968	Feb. 04, 1968	4,850
1999	Nov. 26, 1998	36,500	1954	Dec. 09, 1953	7,880	1986	Feb. 24, 1986	4,650
1936	Jan. 15, 1936	36,300	1983	Dec. 04, 1982	7,820	1975	Jan. 14, 1975	4,610
1995	Dec. 21, 1994	35,900	2005	Jan. 18, 2005	7,740	1983	Jan. 05, 1983	4,570
1964	Jan. 26, 1964	35,700	2004	Jan. 30, 2004	7,460	1998	Jan. 15, 1998	4,340
1956	Dec. 22, 1955	35,100	1975	Jan. 14, 1975	7,400	1995	Feb. 20, 1995	4,100
1954	Jan. 06, 1954	34,700	1979	Feb. 07, 1979	7,280	1981	Dec. 26, 1980	3,980
1967	Dec. 14, 1966	34,400	1956	Dec. 12, 1955	7,200	2004	Jan. 30, 2004	3,900
1986	Jan. 20, 1986	32,100	1963	Nov. 20, 1962	6,960	1970	Jan. 14, 1970	3,810
2002	Dec. 18, 2001	31,900	1949	Feb. 17, 1949	6,950	1969	Dec. 04, 1968	3,680
2000	Dec. 17, 1999	31,000	1984	Jan. 25, 1984	6,760	1984	Nov. 18, 1983	3,260
1963	Nov. 21, 1962	29,800	1931	Apr. 01, 1931	6,750	1988	Mar. 27, 1988	2,820
1982	Jan. 25, 1982	27,300	1998	Jan. 14, 1998	6,580	2007	Dec. 5, 2007	2,810
1945	Feb. 09, 1945	27,000	1965	Dec. 23, 1964	6,500	1994	Mar. 03, 1994	2,770
1961	Feb. 22, 1961	27,000	1961	Nov. 20, 1960	6,460	1980	Dec. 18, 1979	2,740
1942	Dec. 20, 1941	26,900	1947	Dec. 11, 1946	6,350	1992	Jan. 29, 1992	2,620

Chehalis River near Grand Mound			Newaukum River near Chehalis			Skookumchuck River near Bucoda		
1929- 2007			1929- 2007			1968- 2007		
Year	Date	Maximum Flow (cfs)	Year	Date	Maximum Flow (cfs)	Year	Date	Maximum Flow (cfs)
1975	Jan. 15, 1975	26,900	1973	Dec. 21, 1972	6,330	1979	Feb. 07, 1979	2,000
1950	Feb. 26, 1950	26,300	1959	Nov. 12, 1958	6,290	1973	Dec. 21, 1972	1,770
1965	Dec. 24, 1964	26,200	1945	Feb. 08, 1945	6,080	1993	Apr. 11, 1993	1,760
1983	Dec. 05, 1982	25,600	1995	Dec. 27, 1994	6,040	1985	Nov. 29, 1984	1,620
1933	Dec. 03, 1932	24,900	1960	Nov. 21, 1959	5,950	1989	Mar. 13, 1989	1,550
1939	Feb. 16, 1939	24,800	1946	Feb. 06, 1946	5,900	2001	May 2, 2001	905
1968	Feb. 05, 1968	24,800	1950	Feb. 24, 1950	5,720	1977	Mar. 09, 1977	764
1960	Nov. 24, 1959	24,700	1948	Mar. 22, 1948	5,630			
1937	Apr. 15, 1937	24,300	1988	Dec. 10, 1987	5,500			
1947	Jan. 26, 1947	24,200	1981	Dec. 26, 1980	5,490			
1981	Dec. 27, 1980	24,000	1967	Jan. 20, 1967	5,450			
1932	Feb. 27, 1932	23,500	1970	Jan. 14, 1970	5,300			
1970	Jan. 28, 1970	23,300	1951	Feb. 09, 1951	5,240			
1946	Dec. 30, 1945	23,100	1980	Jan. 12, 1980	5,020			
2003	Feb. 01, 2003	23,100	1943	Nov. 23, 1942	4,990			
1940	Dec. 17, 1939	22,700	1968	Feb. 19, 1968	4,810			
1959	Nov. 13, 1958	22,500	1955	Feb. 08, 1955	4,780			
1966	Jan. 07, 1966	21,900	1953	Jan. 23, 1953	4,540			
1973	Dec. 28, 1972	21,900	1966	Jan. 06, 1966	4,520			
1998	Jan. 15, 1998	21,400	1944	Dec. 03, 1943	4,500			
1957	Feb. 27, 1957	20,900	1957	Dec. 10, 1956	4,300			
2005	Jan. 19, 2005	20,700	1969	Dec. 04, 1968	4,300			
1953	Jan. 10, 1953	20,500	1992	Jan. 28, 1992	3,990			
2004	Jan. 31, 2004	20,400	1952	Feb. 04, 1952	3,980			
1943	Feb. 07, 1943	20,200	1962	Dec. 24, 1961	3,820			
1948	Jan. 03, 1948	20,000	1993	Apr. 11, 1993	3,730			
1992	Jan. 30, 1992	19,600	1985	Nov. 04, 1984	3,630			

Chehalis River near Grand Mound			Newaukum River near Chehalis			Skookumchuck River near Bucoda		
1929- 2007			1929- 2007			1968- 2007		
Year	Date	Maximum Flow (cfs)	Year	Date	Maximum Flow (cfs)	Year	Date	Maximum Flow (cfs)
1931	Apr. 01, 1931	19,400	1958	Dec. 26, 1957	3,590			
1984	Jan. 26, 1984	19,200	1989	Dec. 30, 1988	3,570			
1980	Jan. 13, 1980	19,000	1994	Jan. 05, 1994	3,170			
1941	Jan. 19, 1941	18,800	1929	Mar. 27, 1929	3,090			
1952	Feb. 05, 1952	18,800	1930	Mar. 24, 1930	3,090			
1958	Dec. 27, 1957	18,500	1977	Mar. 09, 1977	2,570			
1979	Feb. 08, 1979	18,300	2001	Apr. 11, 2001	2,030			
1955	Feb. 09, 1955	18,100						
1985	Nov. 29, 1984	18,000						
1969	Feb. 12, 1969	17,500						
1944	Dec. 04, 1943	16,400						
1988	Dec. 11, 1987	16,400						
1962	Dec. 21, 1961	15,900						
1977	Mar. 09, 1977	15,200						
1989	Dec. 31, 1988	14,400						
1929	Mar. 27, 1929	13,700						
1994	Mar. 04, 1994	13,100						
1930	Feb. 08, 1930	12,200						
1993	Apr. 12, 1993	10,400						
2001	Feb. 05, 2001	5,750						

[1] Flows are preliminary

Flood data in Table 5-4 show that almost all annual floods occurred during the fall/winter period from November through February. For this period of record on the Chehalis River near Grand Mound, only five of the peak annual floods occurred outside of this period. Of the remaining four, two occurred in March and two in April. Similarly, most peak annual floods on the Newaukum and Skookumchuck Rivers also occurred during the November through February period.

Examination of the flood data in Table 5-4 reveals some interesting trends. First, recent years have experienced some of the largest floods on record. For example, the 1980,

1990 and 1986 floods rank in the top five all on three rivers. These flood data support the perception that flooding has been worse in recent years. In fact, floods in recent years have been some of the largest to occur during the past 63 years.

Table 5-5 is a summary and ranking of the top 10 peak flows in the upper Chehalis River basin (Water Resource Inventory Area [WRIA] 23). The February 1996 flood is considered the flood of record for WRIA 23. Flow data for the 2007 flood are only available for the Chehalis River near Grand Mound. Data for the 2009 flood were not yet available. Recorded flows in WRIA 23 show numerous peak flows from the period 1971 to 1996.

Table 5-5. Summary of Ten Peak Annual Flows

WRIA 23 Chehalis Near Ground Mound		WRIA 23 Newaukum at Chehalis	
Date	**Flow (cfs)**	**Date**	**Flow (cfs)**
December 2007	79,000[1]	February 1996	13,300
February 1996	74,800	November 1986	10,700
January 1990	68,700	January 1990	10,400
November 1986	51,600	December 1977	10,300
January 1972	49,200	November 1990	10,300
January 2009	48,800[1]	November 1998	10,000
December 1937	48,400	January 1972	9,770
November 1990	48,000	December 1996	9,700
December 1933	45,700	January 2003	8,940
December 1975	44,800	January 2006	8,720

[1] Flows are preliminary

As part of a Flood Insurance Study, FEMA (1981) estimated flood magnitudes at various locations in the Chehalis River basin for return periods ranging from 10 to 500 years. These flood estimates are summarized in Table 5-6. For the extreme flood event in January 1990, the USGS (Hubbard, 1991) estimated the return period of the peak flow on the Chehalis River near Grand Mound to be about 100 years; this flow has a 1 percent chance of occurring in any given year. The return periods of the peak flows at this time on major tributaries were less, estimated to be 30 years (3.3 percent probability) on the Newaukum River and 45 years (2.2 percent probability) on the Skookumchuck River. The USGS is expected to create new flood frequency returns in response to the recent flood events.

Table 5-6 Magnitude and Frequency of Floods within the Chehalis River Basin

Location		Drainage area (mi^2)	Peak flood (cfs)			
			10-year	50-year	100-year	500-year
Chehalis River						
Chehalis River mainstem	at Grand Mound	895	38,700	51,600	56,000	70,000
	downstream of confluence with Skookumchuck River	834	38,600	51,600	55,780	70,000
	upstream of confluence with Skookumchuck River	653	32,500	42,000	45,000	59,200
	downstream of confluence with Newaukum River	593	32,100	38,500	42,500	58,700
	downstream of confluence with South Fork Chehalis River	332	24,600	32,000	35,220	43,800
	at Pe Ell	95	15,200	20,000	23,000	28,000
Tributaries to Chehalis River						
Skookumchuck River	at confluence with Chehalis River	181	8,750	11,000	13,000	17,900
	Coffee Creek at confluence with Skookumchuck River	7	150	275	234	510
	Hanaford Creek at confluence with Skookumchuck River	58	2,100	3,150	3,700	4,800
China Creek	at confluence with Chehalis River	6	120	220	290	*[1]
Salzer Creek	at confluence with Chehalis River	25	600	1,070	1,360	
	Coal Creek at confluence with Salzer Creek	9	230	420	530	790
	South Fork Salzer Creek at confluence with Salzer Creek	8	250	450	580	*[1]
	Middle Fork Salzer Creek at confluence with Salzer Creek	2	190	340	440	*[1]
	North Fork Salzer Creek at confluence with Middle Fork Salzer Creek	3	180	320	410	*[1]
Dillenbaugh Creek	at confluence with Chehalis River	12	440	560	630	800
	Berwick Creek at confluence with Dillenbaugh Creek	5	130	180	220	280
Newaukum River	at confluence with Chehalis River	155	7,860	10,750	11,500	13,640
South Fork Newaukum River	North Fork Newaukum River at confluence with Newaukum River	69	4,400	6,350	7,400	9,400
	Middle Fork Newaukum River at confluence with North Fork Newaukum River	19	660	1,000	1,250	1,700
South Fork Chehalis	at confluence with Chehalis River	123	9,300	12,860	14,800	18,600

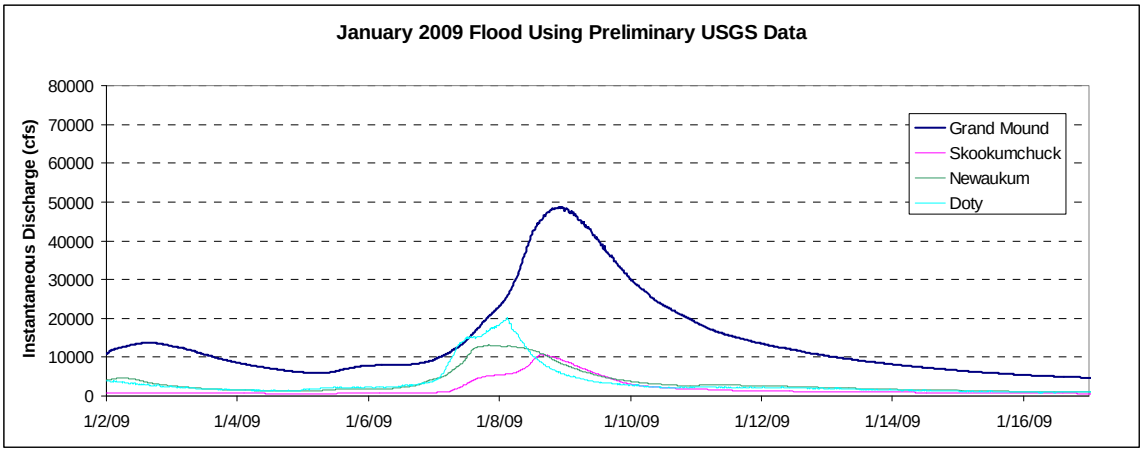
[1]Data not available
Source: FEMA 1981

Recent Significant Flood Events

January 2009

The Chehalis River was above the National Weather Service flood stage at the USGS gauge at Grand Mound between January 7 and January 10, 2009. This event resulted in a two-day closure of Interstate 5 through Centralia-Chehalis. Preliminary flow data from the USGS indicates the peak discharge at Grand Mound was 48,800 cfs (Figure 5-1). The January 2009 event was generated by significant precipitation (6 to 15 inches over the preceding week) over snow at low elevations (USGS, 2009).

Figure 5-1. Hydrographs of the January 2009 Flood Event



Source: USGS, 2009.

The peak flow crests for the January 2009 event were within the top five of measured events at the Chehalis River at Porter, the Chehalis River at Centralia, and the Skookumchuck River USGS gauges. The event was in the top 10 for the Chehalis River at Grand Mound, the Chehalis River at Chehalis, and the Chehalis River at Doty gauges. The event was not in the top 10 for the Newaukum River or the Wynoochee River gauges. The 2009 flood event appears to have been a result of more evenly-distributed precipitation, compared to the 2007 event (National Weather Service data from the Advanced Hydrologic Prediction System).

There is evidence that storage available behind the Skookumchuck Dam may have played a role in reducing the downstream flood peak. The Skookumchuck Dam had been drawn down, and the reservoir had more available storage volume than would typically be the case.

December 2007

The most significant recent flooding in the Chehalis River basin occurred in December 2007. This event resulted in substantial flooding throughout the basin, including a four-day closure of a 20-mile section of Interstate 5 at Chehalis.

The December 2007 flooding occurred after substantial precipitation associated with a climatic event known as an atmospheric river. An atmospheric river forms when atmospheric conditions allow for a significant movement of subtropical moist air to northern latitudes. This type of event is often referred to as a "pineapple express," because the moist subtropical air often passes Hawaii on the way to the West Coast. The December 2007 event had a disproportionate effect on the upper Chehalis River basin, resulting in significant precipitation over the Willapa Hills that feed the upper mainstem Chehalis and South Fork Chehalis Rivers. Rainfall data summarized by the Office of Washington State Climatologist suggest that the December 1 to 4, 2007 rainfall totals for the upper portion of the Willapa Hills exceeded 14 inches, while the surrounding area received between 3 and 8 inches during the same time period (Mote et al., 2008). Heavy precipitation in the southwestern portion of the basin (the Willapa Hills) resulted in the flood of record at the USGS stream gauge at Doty. The gauge telemetry system transmitted an instantaneous discharge of 51,100 cfs with the flows still rising when the gauge was destroyed. Post-event measurements using high water marks were used by the USGS to estimate that the peak flow reached 63,100 cfs at the Doty gauge. These flows are substantially larger than the previous record flow of 28,900 cfs measured during the 1996 flood event (USGS, 2008).

The USGS gauge at Grand Mound also recorded the record peak for the 2008 water year. The December 2007 instantaneous maximum discharge at Grand Mound was about 79,000 cfs, exceeding the past peak of 74,800 cfs recorded in 1996. The daily average discharge for the 2007 event was lower than the 1996 event, indicating that the 2007 event had a more distinct peak (Mote et al., 2008).

The storm resulted in widespread damages across the Chehalis River basin (Lewis County, 2008). Numerous landslides occurred, levees broke, and dikes were overtopped. Late in the afternoon on December 3, flooding of the Chehalis River forced the closure of Interstate 5 in the Chambers Way area, and by the next day a 20-mile stretch of the freeway was covered by as much as 10 to 15 feet of water in some locations. The floodwaters did not start receding until December 5. Late in the evening on December 6, the Washington State Department of Transportation reopened one lane for commercial truck traffic, followed the next day by the reopening of all lanes of traffic. The economic cost of the Interstate 5 closure was estimated at approximately $4 million per day (City of Centralia, 2009).

On December 3, Governor Chris Gregoire declared a state of emergency for the entire state, citing rains, flooding, landslides, road closures, and extensive property damage. Grays Harbor, Lewis, and Thurston Counties were part of a federal disaster declaration made on December 8, 2007.

Anecdotal accounts indicate this flood was more damaging than the one in 1996. The water rose faster, and it flooded places that no one remembered being inundated before. Floodwater high up the Chehalis River caused landslides and loads of silt and timber were deposited in streams. In some areas, log jams may have acted like small dams, temporarily holding back water until they toppled over or breached. Water swamped

homes, garages and barns to depths of up to 12 feet in some upriver communities. Near downtown Centralia, 20 square blocks were flooded.

Damage to the Chehalis Reservation from the December 2007 flood has been documented in the Chehalis Tribe's CFHMP (Chehalis Tribe, 2009). During the flood, homes in the central area of the Chehalis Reservation were inundated with up to 4 feet of water. The water moved swiftly and covered the reservation to record water depths within 24 hours of notification of flooding. At the east end of the Chehalis Reservation, water overtopped Anderson Road. Up to 2 feet of water overtopped U.S. Highway 12 and flowed into the Black River east of Anderson Road. Southeast of the reservation, Independence Road was overtopped near the bridge and a section of the Chehalis River channel migrated south and eroded a portion of the abandoned railroad grade. The central portion of the Chehalis Reservation, at the confluence of the Chehalis and Black Rivers, was flooded from U.S. Highway 12 south to the abandoned railroad grade. Floodwater ponded upstream of the western glacial terrace and rose high enough to overtop Blockhouse Road and flow down Harris Creek. Between the glacial terrace and Oakville, bridges and culverts were overtopped, road pavement was damaged, and houses were flooded. At the west end of the reservation, portions of Balch Road were damaged and the east approach to the Sickman-Ford Bridge was overtopped and damaged. Elsewhere within the Chehalis Reservation, gravel driveways and rural roads were scoured clean of gravel. Wells and septic systems were swamped and well heads were overtopped.

December 1999

Significant flooding occurred throughout the lower basin, including the Wynoochee and Satsop River basins, during December 1999. This event was not a federally-declared disaster, but did result in approximately $1.3 million of reported losses in Grays Harbor County (Grays Harbor County, 2001).

March 1997

Heavy rainfall and low-elevation mountain snowmelt caused flooding in Grays Harbor County. The recorded peak flow on the Wynoochee River above Black Creek (USGS gauge 12037400) was 25,600 cfs, which is the highest recorded flow at this gauge since the Wynoochee Dam was completed in 1973. Similarly for the Satsop River, the peak flow in 1997 was 63,600 cfs, rated as a greater than 100-year recurrence interval event (Grays Harbor County, 2001).

December 1996 – January 1997

Saturated ground combined with snow, freezing rain, rain, rapid warming and high winds within a 5-day period were the causes of flooding in Grays Harbor, Lewis, and Thurston Counties. The recurrence intervals of the Chehalis River in Grays Harbor County and the Skookumchuck River in Lewis County were projected at 10 years. The recurrence level of the Newaukum River in Lewis County was projected at 100 years (Washington State Military Department Emergency Management Division, 2007).

February 1996

The February 1996 flood is the flood of record on many major drainages in WRIA 23 (Lewis County, 2008). Heavy rainfall, mild temperatures and low-elevation snowmelt caused flooding in many Washington counties, including Grays Harbor, Lewis, and Thurston. Record floods occurred on the Chehalis and Skookumchuck Rivers. The recurrence interval of the Newaukum River in Lewis County is projected at 90 years. The recurrence interval of the Chehalis River in Thurston and Lewis Counties is projected at 90 to 100 years. The maximum flow recorded at the Grand Mound gauge was 73,900 cfs on February 6 (Washington State Military Department Emergency Management Division, 2007).

Several antecedent conditions were in place before the February 6, 1996 flood. The ground throughout the basin was at or near saturation. Recent snowfall had occurred as low as 500 feet above sea level. Warm, moist subtropical air was transported from the Pacific Ocean into the Pacific Northwest with a freezing level above 8,000 feet. There was also a strong polar jet stream with maximum core wind speeds in excess of 150 knots (172.6 miles per hour). Storms fed upon the jet stream, and this powerful jet stream sustained and strengthened the storms as they moved in off the eastern Pacific Ocean. Local atmospheric conditions had set up a blocking pattern, which meant the major troughs and ridges around the Northern Hemisphere were stationary. There was a major trough to the west of the Pacific Northwest and a major ridge to the east. This pattern makes ideal conditions for weather systems to be at maximum strength. The atmosphere remained in this pattern for at least 96 hours, maximizing precipitation amounts. Large quantities of water were released from the heavy amounts of rain and snowmelt (Lewis County, 2008).

The 1996 flood covered 75 percent of the Chehalis Reservation with measured flood depths up to 10 feet. All access routes, including Howanut Road, Anderson Road, and Moon Road, were under 1 to 4 feet of fast-moving water. U.S. Highway 12, which provides access to many secondary roads, also was flooded, and Interstate 5 was flooded and closed for several days. (Chehalis Tribe, 2009)

January 1990

Flooding occurred on the Chehalis and Skookumchuck Rivers as heavy rainfall and severe storms affected Grays Harbor, Lewis, and Thurston Counties. Maximum flow at the Grand Mound gauge was 68,700 cfs recorded on January 10, 1990. The recurrence interval was projected at 70 years (Washington State Military Department Emergency Management Division, 2007).

Floodwater affected Centralia, Chehalis, Montesano, Elma, Bucoda, and Oakville (Lewis County, 1994). Hundreds of people were evacuated and several hundred homes and businesses were damaged or destroyed. The Chehalis hospital was isolated by floodwaters and several nursing homes were evacuated. Interstate 5 in Chehalis closed for several days, covered by 3 to 5 feet of water (Washington State Military Department Emergency Management Division, 2007). The dikes around the Chehalis-Centralia

Airport and Lewis County Fairgrounds failed or were overtopped. Wastewater treatment plants in Chehalis and Centralia were out of service and the Centralia landfill was inundated. Approximately 10,000 acres of agricultural land was flooded and cattle and chickens were killed.

The flood was caused by a stalled, southwesterly weather system over the region (Lewis County, 1994). The two-day storm rainfall was about 5.3 inches on average with the average basin runoff at 5.1 inches. Ground conditions were saturated, resulting in minimal infiltration and high runoff.

November 1986

Heavy rainfall, mild temperatures, and low-elevation snowmelt generated major floods on the Chehalis and Skookumchuck Rivers. Less severe flooding occurred on the Satsop River. Two-hundred eighty homes and businesses flooded in Lewis County. Impacts included a major hazardous materials spill (pentachlorophenol) from an underground storage tank. The Lewis County Fairgrounds was under 9 feet of water. Numerous levees overtopped and were damaged throughout flooded counties. The recurrence interval of the Chehalis River in Grays Harbor County was projected at 45 to 50 years. At Grand Mound the maximum flow was 51,600 cfs. The recurrence interval of the Chehalis River at Grand Mound was projected at 20 years (Washington State Military Department Emergency Management Division, 2007).

Other Floods

Other significant floods occurred in the Chehalis River basin in 1975 and 1972. The maximum flow at Grand Mound during the 1972 flooding event was 49,200 cfs. The flood recurrence interval at Grand Mound was projected at 15 years (Washington State Military Department Emergency Management Division, 2007). No other information is readily available for these floods.

CHAPTER 6 FLOOD PROBLEM AREAS

Problem Identification

Flood problem areas are located throughout the Chehalis River basin. As discussed in previous chapters, flooding occurs to some extent in most years and can be dramatically different in the upper or lower basins. To frame a discussion of flood problem areas, general flooding problems are presented, followed by a partial listing of specific flood problem areas throughout the Flood Authority's study area. The specific flood problem areas were developed by reviewing existing Comprehensive Flood Hazard Management Plans for jurisdictions in the area, soliciting comments from the public at the Flood Authority's public meetings in February 2009, reviewing recent detailed hydraulic modeling, and analyzing Geographic Information System (GIS) data.

This discussion is intended to support the development of solutions to these known flooding problems. In the Flood Authority's previous deliberations, several overarching problems have been identified, and initial steps (known as "ripe and ready" projects) have been identified and targeted for support. These projects are identified throughout this chapter as appropriate.

General Flooding Issues

General flooding issues in the Chehalis River basin include understanding the sources, potential extent, and potential consequences of flooding; communicating flood hazard information; responding to flood events; and impacts of flood waters. These general flooding issues are described in the following sections.

Understanding the Sources, Potential Extent, and Potential Consequences of Flooding

Initial scientific and engineering hydrologic and hydraulic investigations are an essential element of planning for flood events. These studies can help show the potential extent of flooding, and can suggest the consequences of flooding outside the inundated area. For the Chehalis River basin, initial flood studies have been completed along most of the major channels. The resolution of these studies varies significantly throughout the study area, with more detailed models available in the upper basin (generally upstream of Grand Mound) and less detailed models available for the lower basin.

The Flood Authority is addressing the variable level of detail of the studies through the authorization, in April 2009, of funding for several ripe and ready projects. Those projects include:

- Extending LiDAR[1] coverage throughout the entire study area to establish a consistent, high quality representation of floodplain surface topography;

[1] LIDAR = Light Detection and Ranging – a remote sensing technology that measures properties of scattered light to find range and/or other information of a distant target.

- Developing an unsteady HEC-RAS[2] model for the lower basin, to match the resolution of the existing model in the upper basin; and
- Augmenting the existing precipitation and stream gauge network.

Communicating Flood Hazard Information

Information about flood hazards needs to be conveyed to all residents of the Chehalis River basin. Flood hazard information is available in three phases: prior to flood events, during flood events, and post-event. Prior to flood events, it is important that the public understand that floods can and will occur, both to support decisions about property acquisition, insurance, and development, and to prepare for future events. Challenges with communicating flood hazards include:

- Lack of public understanding of river system behavior and flood hazards;
- The real-time nature of these events; and
- Highly variable levels of understanding of, and tolerance for, risk.

Communication is vital during flood events to ensure that information is disseminated to all affected residents in a way that provides adequate warning. Post-event communication focuses on informing and reminding people of proper cleanup and sanitary measures.

A flood warning system exists for the Chehalis River basin, based primarily on the National Weather Service's Advanced Hydrologic Prediction System. This system is available on the web and provides measured and predicted hydrographs at established USGS stream gauges. This system provided advance warning of flooding in both 2007 and 2009, and provided a reasonable level of accuracy for both events.

Public comments at public workshops suggest that this system may not provide the level of detail necessary to achieve the overall goal of providing clear warning to residents throughout the basin. The National Weather Service information is often interpreted through media outlets, which can influence the impact of the information.

To address this potential gap, the Flood Authority authorized funding for an Early Warning System project to evaluate the adequacy of the existing warning system and make recommendations for augmenting existing systems and improving communication tools. The needs assessment portion of that project will be presented to the Flood Authority at its March 2010 meeting.

[2] HEC-RAS = Hydrologic Engineering Centers River Analysis System – a hydraulic model of water flow through rivers and other channels developed by the Corps of Engineers.

Responding to Flood Events - Emergency Management

The quality of response to flood events is tied to advance planning, preparation of materials, and broad understanding of plan implementation. Key factors for emergency management include:

- Adequate warning of flood events;
- Established circulation/access routes;
- Established coordination protocols;
- Access to flood fighting materials; and
- Access to hospitals and emergency headquarters.

Specific emergency response issues have included the lack of access from one side of the flooded valley to the other, loss of local radio stations, and impaired access to a major hospital. The Early Warning System project authorized by the Flood Authority will include recommendations for improvements for emergency management.

Impacts of Flood Waters

The direct impacts of flood waters extend across the floodplain, and include temporary and long-term impacts. These impacts include:

- Inundation during the flood event;
- Risk to human safety;
- Loss of property due to bank erosion and channel migration;
- Sedimentation;
- Water quality impacts, including domestic well contamination;
- Damage to buildings, machinery, or roads;
- Risks to livestock and crops; and
- Compromised vital infrastructure, including wastewater treatment plants.

Summary

Table 6-1 summarizes the flooding issues in the basin and identifies ripe and ready projects that the Flood Authority has authorized to further evaluate the issues.

Table 6-1. General Flooding Issues

Issue	Ripe and Ready Project(s)
Understanding the Sources, Potential Extent, and Potential Consequences of Flooding	• LiDAR • Unsteady HEC-RAS model • Stream and rain gauge program • Study of ecosystem services
Communicating Flood Hazards • Lack of public understanding of river system behavior and flood hazards • The real-time nature of these events • Highly variable levels of understanding of, and tolerance for, risk	• Early Warning System
Response to Flood Events – Emergency Management • Adequate warning of flood events • Established circulation/access routes • Established coordination protocols • Access to flood fighting materials • Access to hospitals and emergency headquarters	• Early Warning System
Impacts of Flood Waters • Inundation during the event • Loss of property due to bank erosion and channel migration • Sedimentation • Water quality impacts, including domestic well contamination • Damage to buildings, machinery, or roads • Compromised vital infrastructure, including wastewater treatment plants	• Early Warning System • Unsteady HEC-RAS model • PUD Storage Study

Site-Specific Flood Issues

The following sources were used to develop a list of site-specific flooding issues:

- Existing Comprehensive Flood Hazard Management Plans for jurisdictions in the Chehalis River basin;
- Public comments solicited at public meetings held on February 11, 2009, in Chehalis and February 12, 2009, in Montesano;
- Contacts with floodplain and emergency managers at member communities; and
- A general mapping analysis of the basin comparing major transportation infrastructure to mapped special flood hazard zones.

The existing CFHMPs are described in Chapter 4. These plans provided the basis for identifying flood problem areas in the basin.

The Flood Authority conducted public meetings in Chehalis on February 11, 2009, and Montesano on February 12, 2009. At the meetings, the Flood Authority solicited public input on flood-related problems, potential solutions, and recommended goals for the Authority. The problems identified by members of the public are listed below. The

problems are presented as a list of actual comments made by the public, and no attempt has been made to edit or categorize them.

Problems identified by the public at the public meeting in Chehalis on February 11:

- Restricted flow of the Chehalis River at Galvin Road
- Water built up at Mellen Street, goes into Chehalis and Centralia
- Water backing up over Highway 6 / Closure of Highway 6
- Residential flooding along Highway 6
- Flooding in West Adna
- Residential flooding 3 to 4 miles up Salzer Creek
- Bridges washed out
    - Dryad
    - Meskill
    - Rainbow Falls State Park
- Extensive flooding on Bunker Creek – loss of livestock and feed, major property damage, river changed course
- Flooding on Scheuber Road – across from Airport
- Flood on Newaukum, Rice Road area
- Flooding on Sylvenus Street – across from Riverside
- Lack of forest duff causes faster runoff
- Flooding in homes near Veteran's Memorial Museum in Chehalis
- Lack of flood prediction and gauges near Veteran's Memorial Museum
- South Street area of Chehalis, by Salzer Valley Creek, floods between the landfill and the tracks
- Emotional trauma related to flooding of homes
- Flooding along River Street in Chehalis
- Long Road dike area
- Long Road dike breach (2007), impact on houses
- Residential flooding in Curtis
- Flooding in China Creek
- Retail business losses due to flooding
- Debris and mud flow contributing to property damage
- Inability to travel

- Inability to develop
- Stalled process
- Lack of responsiveness from Corps
- Levees push water into houses
- Consequences of filling runoff spots (wetlands)
- Communications break down in 2007 flood
- Not enough stormwater drains, or they back up (near Veteran's Memorial Museum)
- Poor predictions
- "Best" practices that are not
- River does not have enough capacity
- Roads acting as a dike or levee, particularly as a result of road repairs
- Projects that contribute to what they are supposed to fix
- Bureaucracy
- Waiting too long for solutions
- Steep-slope clear-cutting / logging practice - rotation lengths that are too short
- Unclear rules on rebuilding permits
- State sales tax on rebuilding
- Impacts on business/commerce
- Need better flood notification to neighborhoods
- Need for better flood cleanup, should involve community
- Environmentalists in the way
- Some folks are trapped
- Difficulty with government processes – billing, requirements, permitting
- Corps cannot be trusted
- Inadequate flood fighting
- Water super tunnels
- Levee failure / levees get overtopped often
- Inadequate levee repair
- Levees displace people

Problems identified by the public at the public meeting in Montesano on February 12:

- Mismanagement of the lake level on the Wynoochee Dam
- Log jams in the rivers
- Erosion of farm lands – mile long stretches
- Flooding of Oakville
- Water from Capital Forest
- Loggers and property owners cut down trees before they get to 30 inches and that causes more water runoff and more soil erosion in a flood
- Lost livestock
- Loss of three dairies – each dairy loses $1 million a year during floods
- Bank erosion on the lower Satsop – there are 250,000 cubic yards of dirt that went into the river
- Barometric pressure of water coming out of the ground
- Difficulty for citizens to predict flooding on their property from available information
- Anderson Road (Chehalis Reservation) acts as dam
- Black River Bridge acts as a dam
- Highway 12 acts as a dam
- Moon Road (Chehalis Reservation) gets closed every flood
- Levees just cause someone else to get flooded
- 100-year floods happen more often than every 100 years
- Dams only work during unique situations planned for by hydrologists
- Erosion in Boistfort – soils end up downstream

A general GIS analysis was performed to identify other potential flood problem areas not identified in existing CFHMPs or by public comment. The analysis used the Washington State Department of Transportation (WSDOT) “major roads” layer and the mapped 1 percent annual chance flood. The 1 percent annual chance flood mapping used was the FEMA Q3 data for Lewis and Grays Harbor Counties, and a data layer developed by Thurston County in that area. The major roads layer and the 1 percent annual chance flood area were overlayed to identify infrastructure at risk for flooding. The results were then evaluated to identify long stretches of major road that have the potential to be overtopped in a major flood. If these areas provided what appeared to be regionally-important access (e.g., connecting a more rural portion of the area to an urban center), they were included in the mapping. This analysis was a mapping exercise only and has not been verified through field work.

More recent flood mapping developed by Northwest Hydraulics Consultants (nhc) for the Lewis County prosecutor's office was also inspected to identify areas with significant flooding. This mapping is based on an unsteady HEC-RAS model that has been developed to show the approximate extent of the 2007 flood event. While the general flood mapping is similar to the FEMA Q3 mapping described above, the Northwest Hydraulics Consultants mapping is more detailed in many areas, and also is set up to depict the depth of flooding.

To simplify the discussion of site-specific flood issues, the issues were categorized into three areas:

- Major Infrastructure (MI),
- Human Health and Safety (HHS), or
- Emergency Response (ER).

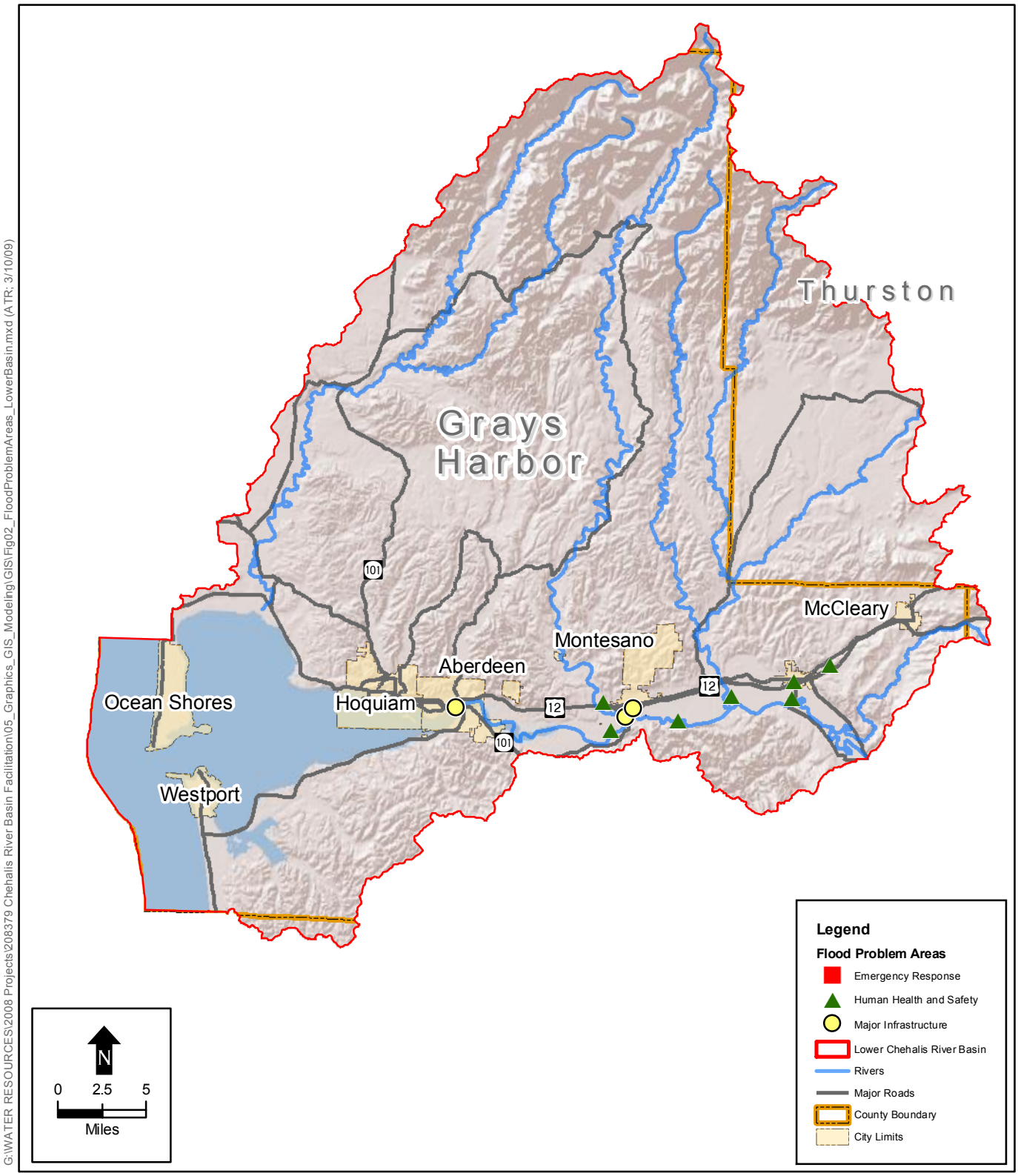
Major Infrastructure issues include major items such as interstate highways and wastewater treatment plants that are threatened by flood events. Human Health and Safety includes flooding of private property, secondary roads, and other public infrastructure. The Emergency Response category is intended to capture key elements of the emergency response network that have been damaged or cut off during floods, when they are needed most. Table 6-2 lists the identified flood issues. All site-specific flood issues are mapped in Figures 6-1 (upper basin) and 6-2 (lower basin).

Table 6-2. Site-Specific Flood Issues

Location	Type[1]	Information Source	Flooding Source(s)
I-5 at Dillenbaugh Creek Confluence	MI	GIS	Mainstem Chehalis and Dillenbaugh Creek
Highway 6	MI	GIS and Public Comment	Mainstem Chehalis and Newuakum
I-5 at Chehalis	MI	GIS, nhc map	Mainstem Chehalis
Mellen Street Wastewater Treatment Plant	MI	Lewis County CFHMP	Mainstem Chehalis
Centralia Central Business District at China Creek	MI	Lewis County CFHMP	Mainstem Chehalis, China Creek, Skookumchuck River
Montesano Wastewater Treatment Plant Lagoons	MI	Montesano Hazard Plan	Mainstem Chehalis, Tidal Action
Highways 105 and 107 at Montesano	MI	GIS	Mainstem Chehalis
US Highway 12 at Elma	MI	GIS	Mainstem Chehalis
Chehalis River at Aberdeen	MI	GIS	Mainstem Chehalis, Tidal Action
Long Road	HHS	GIS and Public Comment	Mainstem Chehalis
Stearns Creek Confluence	HHS	nhc mapping	Stearns Creek, Mainstem Chehalis
SF – Mainstem Confluence	HHS	nhc mapping	South Fork, Mainstem Chehalis
Salzer Creek/Fairgrounds	HHS	Lewis County CFHMP	Salzer Creek,

Location	Type[1]	Information Source	Flooding Source(s)
Dillenbaugh Creek Industrial Area	HHS	Lewis County CFHMP	Dillenbaugh Creek, Mainstem Chehalis
Lower Coffee Creek	HHS	Lewis County CFHMP	Coffee Creek, Skookumchuck River
Galvin	HHS	Lewis County CFHMP	Mainstem Chehalis, Lincoln Creek
Bucoda	HHS	Bucoda CFHMP	Skookumchuck River
Adna	HHS	Public Comment	Mainstem Chehalis
Residential flooding on Salzer Creek	HHS	Public Comment	Salzer Creek
Newaukum at Rice Road	HHS	Public Comment	Newaukum River
Curtis	HHS	Public Comment	South Fork Chehalis
Bridge failures at Dryad and Rainbow Falls State Park	HHS	Public Comment	Mainstem Chehalis
Bridge failure at Meskill	HHS	Public Comment	Mainstem Chehalis
Highway 507	HHS	GIS	Skookumchuck, China Creek
Wakefield Road near Elma	HHS	GIS	Mainstem Chehalis
Oakville	HHS	Chehalis Tribe CFHMP	Mainstem Chehalis
Sickman Ford Bridge Approach	HHS	Chehalis Tribe CFHMP	Mainstem Chehalis
Upper Falls Creek	HHS	Grays Harbor CFHMP	Upper Falls Creek
Elma	HHS	Grays Harbor CFHMP	Mainstem Chehalis
Road near Satsop – Chehalis Confluence	HHS	Grays Harbor CFHMP	Mainstem Chehalis, Satsop River
Chehalis downstream of Satsop-Chehalis Confluence	HHS	Grays Harbor CFHMP	Mainstem Chehalis, Satsop River
Chehalis near Arland Road	HHS	Grays Harbor CFHMP	Mainstem Chehalis
Wynoochee River near Montesano	HHS	Grays Harbor CFHMP	Wynooche, Mainstem Chehalis
Hospital on Crooks Hill Road	ER	Lewis County CFHMP	Mainstem Chehalis
Moon Road at Chehalis Tribe	ER	Chehalis Tribe CFHMP	Mainstem Chehalis, Black River
Anderson Road at Chehalis Tribe	ER	Chehalis Tribe CFHMP	Mainstem Chehalis
Howanut Road	ER	Chehalis Tribe CFHMP	Mainstem Chehalis, Black River

1 MI = Major Infrastructure, HHS = Human Health and Safety, ER = Emergency Response

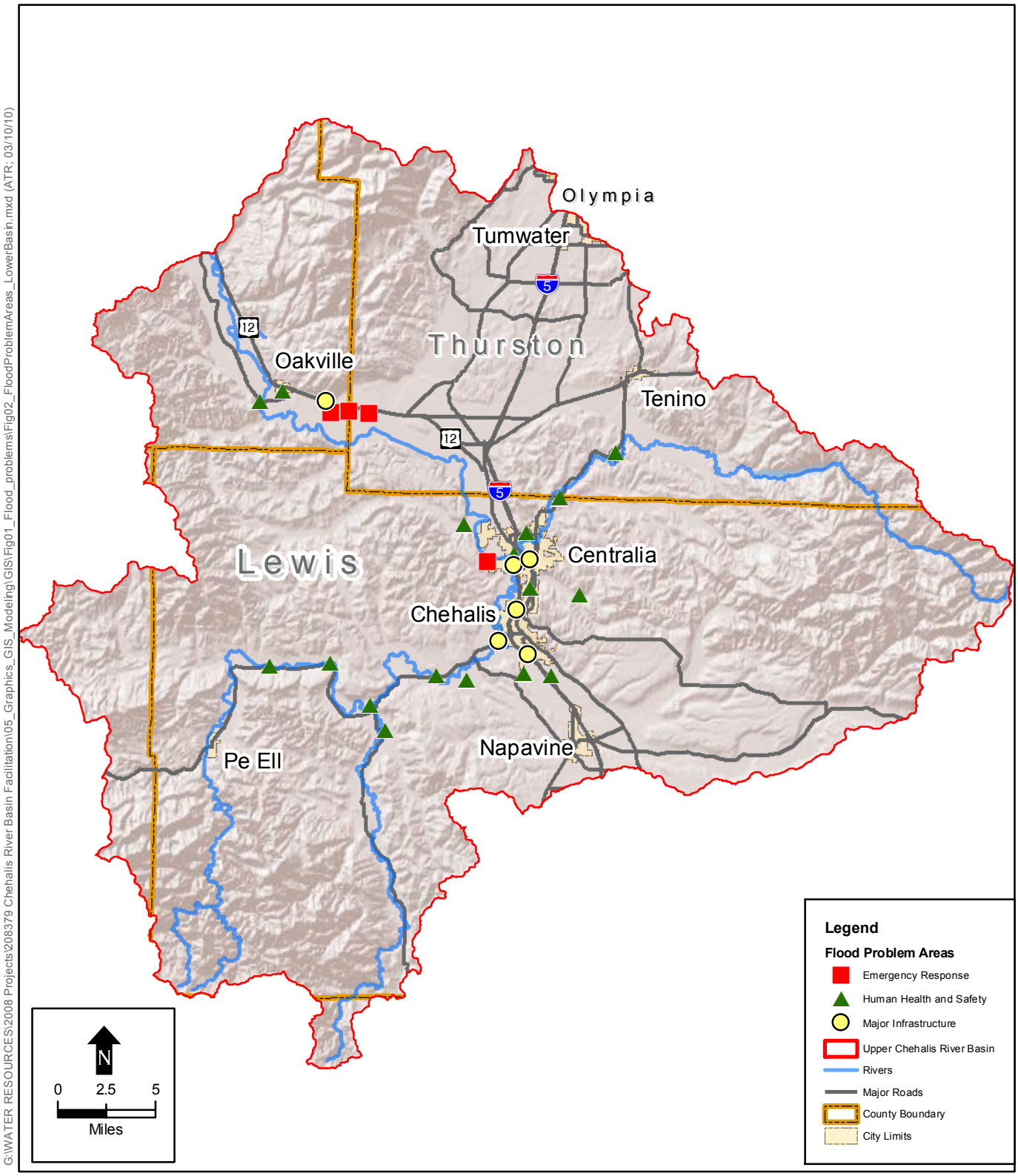


G:\WATER RESOURCES\2008 Projects\208379 Chehalis River Basin Facilitation\05_Graphics_GIS_Modeling\GIS\Fig02_FloodProblemAreas_LowerBasin.mxd (ATR; 3/10/09)

SOURCE: ESRI, 2008; Regional CFMHPS, 2007; WSDOT, 2008, Department of Ecology; 2007

Chehalis River Basin Facilitation . 208379

Figure 6-1
Lower Chehalis River Basin
Flood Problem Areas
Lewis County, Washington



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SOURCE: ESRI, 2008; Regional CFMHPS, 2007; WSDOT, 2008, Department of Ecology; 2007

Chehalis River Basin Facilitation . 208379

Figure 6-2
Upper Chehalis River Basin
Flood Problem Areas
Lewis County, Washington

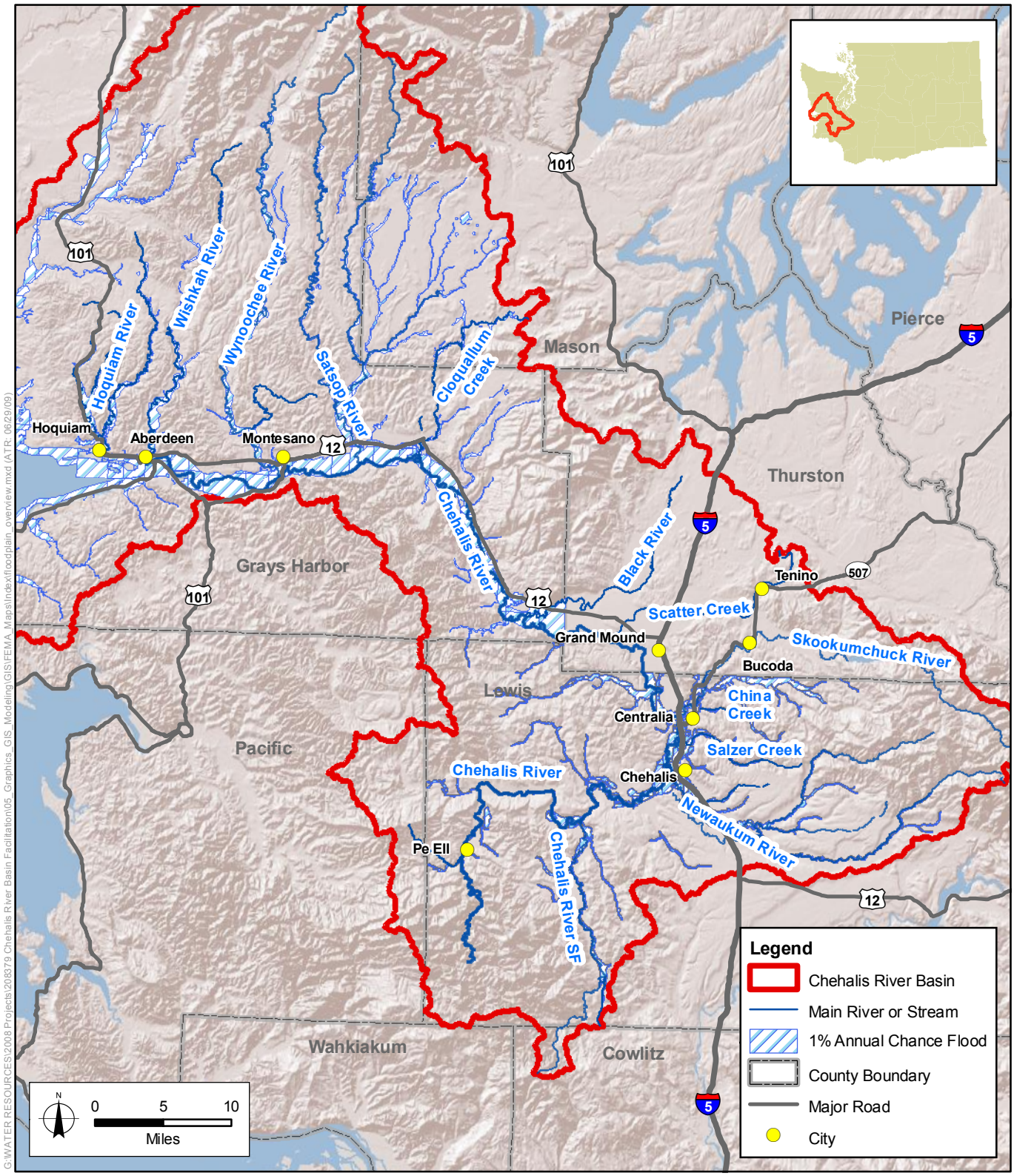
FEMA Mapping

FEMA has mapped most of the floodplain in the Chehalis River basin. The Chehalis Reservation has not been officially mapped by FEMA. FEMA is currently updating floodplain mapping for portions of the basin, but those maps have not been finalized.

This CFHMP includes a Map Folio of the floodplain maps as a CD attachment. The coverage of the floodplain mapping is illustrated in Figure 6-3. The Map Folio in the attached CD includes a detailed map for areas of floodplain mapping shown on Figure 6-3. The detailed floodplain maps are overlain on aerial photograph of the basin.

The Chehalis River Basin Map Folio maps the approximation of the 1 percent annual chance flood extent for the Chehalis River and its main tributaries. The source for the 1 percent annual chance flood dataset is the FEMA Digital Q3 library. The Q3 flood data represent FEMA's most current floodplain data. The aerial imagery is provided by ESRI, the GIS software company, and dates from 2006.

The Map Folio in the attached CD is organized by major river and/or tributary. It includes index maps and accompanying internal links to aid users as they navigate and locate maps associated with certain geographic areas. The maps are presented at one of three scales (from larger to smaller): 1:5,280; 1:7,920; and 1:15,840. The scale used for a given map is dependent upon the relative density of development. In general, more urbanized and developed areas are mapped at larger scales (more detail) while more natural and less developed areas are mapped at smaller scales (less detail).



SOURCE: ESRI, 2005, 2008; FEMA (Q3 Flood); WDNR, 2008

Chehalis River Basin Facilitation . 208379.01

Figure 6-3

Floodplain Mapping Coverage
Chehalis River Basin, Washington

CHAPTER 7 DEVELOPMENT OF MITIGATION ALTERNATIVES

Options for addressing flooding concerns include infrastructure and capital projects, public information programs, regulations, planning measures, and environmental protection and enhancement measures. Comprehensive flood hazard management emphasizes selecting a mix of approaches to minimize flooding impacts. This chapter presents and defines the general types of alternatives commonly used in floodplain management.

General Categories of Solutions

Flood hazard management measures are commonly classified as structural or non-structural. Structural measures involve physical activities in or near the stream such as storage facilities, levees, placement of bank protection materials, and other engineering and construction activities. Non-structural measures include stormwater and land use regulations, flood preparedness programs, public awareness programs, floodproofing, and maintenance programs. The federal government encourages the use of cost-effective, long-term non-structural alternatives. Tables 7-1 and 7-2 summarize typical non-structural and structural solutions, respectively.

Table 7-1. Typical Non-structural Flood Hazard Management Solutions

Measure	Description	Typical Activities
Public Information	Public information activities to advise people of the risks associated with flood hazards, about flood insurance, and ways to reduce flood damage	• Public outreach projects • Flood protection library • Flood preparedness programs • Elevation certification • Hazard disclosure • Public workshops or meetings
Regulation	Regulatory measures to provide protection for existing structures and new development through land use regulation	• High regulatory standards • Low-density zoning • Open space preservation • Regulatory consistency • Building codes • Stormwater management
Planning and Data Collection	Activities to develop accurate floodplain information and flood data and increase the understanding of the river's flood characteristics	• Floodplain and channel meander zone (CMZ) mapping • Flood data maintenance (GIS, databases) • Engineering studies • Modeling
Reduce Damage to Existing Structures	Measures addressing flood damage to existing structures (buildings, roads, bridges, levees, etc.)	• Acquiring or relocating floodprone structures • Floodproofing • Developing repetitive loss plans • Elevating buildings and roadways • Flood insurance

Measure	Description	Typical Activities
Emergency Response and Preparedness	Actions to minimize the effects of flooding on people, property, and the contents of buildings	• Individual action plans • Comprehensive planning • Flood warning systems • Stream and precipitation gauge monitoring • Flood facility maintenance programs • Emergency response plans • Critical facilities protection • Post-distaster mitigation
Natural Resource Protection Projects	Measures to preserve or restore natural areas or the natural functions of floodplain and watershed areas	• Wetland protection • Habitat protection • Erosion and sediment control • Forestry practices

Table 7-2. Typical Structural Flood Hazard Management Solutions

Measure	Description	Typical Activities
Floodplain Protection	Measures that reduce flood hazards for property, structures and occupants in the floodplain. Protection from inundation, floating debris, sediments, and the force of water flowing in the floodplain	• Setback levees • Dikes • Elevating roads • Redesigning and replacing bridges • Constructing/expanding storage reservoirs
Bank Protection	Measures designed to produce a stable, durable streambank that can withstand flood waters	• Reestablishing riparian vegetation • Constructing approach dikes • Installing gabions (wire cages filled with rocks to stabilize the bank) • Constructing windrow revetments (a line of stone placed on the edge of a bank) • Reducing bank slope • Riprap
Conveyance Capacity	Increasing channel bed slope or cross-sectional area or decreasing channel roughness in order to increase the amount of flow that a stream can carry; increasing off-channel storage or floodplain storage	• Constructing overflow/secondary channels • Removing vegetation and debris • Widening or deepening the channel • Controlling growth of vegetation in the channel • Increasing floodplain storage by removing levees or moving roads

CHAPTER 8 FUNDING OPTIONS

Background

The Chehalis River Basin Flood Authority is a unique institution for flood control. It is composed of 11 separate jurisdictions—one Native American Tribe, three counties, five cities, and two towns. The Legislature created the Flood Authority to evaluate flooding issues throughout the basin. The Legislature also provided funding to serve as local match for a basin-wide solution to flooding problems, a solution to be agreed to by the Flood Authority. Currently, the Flood Authority has no funding mechanism other than funds appropriated by the State Legislature.

This chapter outlines funding options available to individual jurisdictions in the basin, especially the counties, to complete the smaller projects identified in this plan. These include internal funding options (which Counties and other local governments can implement) and external funding options (grants and loans). This chapter also discusses two basin-wide options (Flood Control District and Flood Control Zone District). The chapter ends with an evaluation of the funding options presented.

Options of Individual Jurisdictions

A variety of funding options exist for counties and cities to fund flood hazard reduction projects. A summary of funding options is displayed in Table 8-1.

Table 8-1. Funding Options for Individual Jurisdictions

Internal Funding Options	External Funding Options
Developer Contributions - Drainage Development Fees - Construction in Lieu of Fees River Improvement Fund Drainage Districts Local Improvement Districts Surface Water Utility County Revenues - Current Expense Fund - Road Fund - Real Estate Excise Tax - Debt Financing	FEMA - Reigle Community Development & Regulatory Improvement Act - Robert T. Stafford Disaster Relief and Emergency Assistance Act - Disaster Mitigation Act of 2000 Corps of Engineers - Small Flood Control Projects - Emergency Bank Protection - Floodplain Management Services - Planning Assistance to the States - Habitat Restoration NRCS - Watershed Protection and Flood Protection Act USDA - Farm Program Ecology - Flood Control Assistance Account Program - Centennial Clean Water Fund - State Water Pollution Control Revolving Fund Emergency Management Department - State Hazard Mitigation Grant Program Department of Commerce - Public Works Trust Fund WSDOT/FHWA - Emergency Relief Funds

Internal Funding Sources

Developer Contributions

Developing land increases the amount and rate of surface water runoff and the need for drainage facilities to handle it. Thus, development creates the need for additional drainage facilities. Developer contributions are a means of recovering a share of the cost of drainage facilities constructed downstream to handle the increased runoff.

Regional drainage facilities may be constructed to handle the runoff from private property within a drainage basin. A comprehensive plan identifies the regional drainage improvements needed to accommodate a projected level of development – usually the maximum development allowable under the comprehensive land use plan or current zoning for the properties within the basin.

The comprehensive plan or development standards may assume that property owners are responsible for limiting runoff from their property to a specified rate or level of flow. If regional facilities are needed, the plan identifies the type and cost of such facilities.

Developers' contributions are frequently used to help fund regional drainage capital improvements but provide no mechanism to operate and maintain improvements or other elements of a comprehensive surface water program. Developer contributions most commonly involve drainage development fees and/or construction in lieu of fees.

Drainage Development Fees

Drainage development fees are collected from a developer at the time the runoff from the property is increased (when the property is developed). The cost of drainage improvements can be allocated among undeveloped properties in the basin based on the total area of land in each zoning classification and the estimated contribution to runoff potentially generated by all land at full development. This determines the share of the capital system costs that should be paid by each land use classification. That value is divided by the undeveloped area in each classification to determine the fee per square foot for developing properties in that classification.

The development fees are collected as each parcel is developed. This method works well in drainage basins with undeveloped property that will need downstream improvements off-site as the land is developed.

The following are the key advantages of drainage development fees:

- An equitable fee for each parcel can be calculated that is determined by the size of the parcel and applicable zoning. This calculation is easy for developers to understand and for the county to administer.
- Fees are based on the estimated cost of constructing off-site improvements.
- New drainage improvements can be scheduled by the county as they are needed. The need is determined by the level of development in each basin.
- Fees are assessed equitably because those collected from property in any drainage basin are used to pay for improvements in that basin only.

The key disadvantages of drainage development fees are as follows:

- The county incurs a liability to provide needed improvements upon receiving the fees.
- Basin plans with capital-cost estimates must be in place before the fee can be calculated.
- Significant changes in zoning, particularly down-zoning, may result in inadequate revenue to fund the facilities.
- Significant increases in construction costs over estimates used in the basin plan may result in insufficient revenue recovery.
- Patterns of development may require construction of more improvements than money is available for.
- Flexibility is limited because funds must be used for improvements in the basin from which they were collected. This requires an accurate accounting record.
- New developers may perceive an unfair burden if most land in the basin is already developed and development fees have not been charged historically.
- Fees pay for capital improvements only.

Construction in Lieu of Fees

This method assumes that the developer will construct or contribute directly to the construction of needed regional improvements in return for the ability to develop the land. This method tends to be used in developed areas with drainage facilities already in place that cannot accommodate increased runoff created by the additional development, or in areas that are experiencing development pressure where facilities are needed before development can take place.

The maintenance responsibility for drainage facilities constructed by developers needs to be defined. If the county is granted ownership or control of the facilities, the county will be able to ensure that the facilities are maintained to an acceptable level.

Key advantages of construction in lieu of fees are as follows:

- Facilities are constructed before the new development occurs.
- The county does not have to administer design and construction.
- The development creating the need for the new improvements will pay for the cost of the improvements.
- The new facilities will often benefit the county and other properties in addition to the new development.
- The county does not have to fund the costs of improvements or may fund only a portion of the costs.
- The county and the developer do not have to wait for the needed improvements to be scheduled into the annual budgeting cycle before the land can be developed.

Key disadvantages of construction in lieu of fees are as follows:

- New development may pay more than its equitable share of the cost of the system. This can be recovered by the initial developer through a "reimbursement agreement" using future development fees.
- Private developers may be financing facilities that serve public needs.
- This method deals only with capital improvements, not with ongoing operation and maintenance (O&M) costs.

River Improvement Fund

The River Improvement Fund, created under the taxing authority established by RCW 86.12, has been a source for financing of flood control maintenance for some counties. The fund was created for counties to finance the construction and repair of flood control facilities.

A River Improvement Fund would be generated from a county-wide levy of up to $0.25 per $1,000 assessed value, subject to statutory limitations on rate and amount. The levy rate must be consistent throughout the county, but the revenue appropriation can vary among basins. The funds can be used as a match for flood control costs with the state Flood Control Assistance Account Program (FCAAP). The levy is subject to the following limitations:

- It may not exceed $0.25 per $1,000 assessed value.
- Increases in the levy may not force the overall county assessment to exceed statutory limits.

Because this funding strategy is considered a senior taxing district, it is included when calculating the local tax lid set by Initiative 747 (2001). This means the tax for a River Improvement Fund has the same status as mandatory and essential services such as police, public health, courts and other criminal justice services. If a county has reached the local tax lid, increasing the River Improvement Fund levy would require either a reduction in funding for mandatory and essential services, or a majority vote by county citizens.

Drainage Districts

Creating a drainage district is a method of financing drainage capital improvements and ongoing O&M. The processes of creating a drainage district and setting assessments are specified in RCW 85.06, Drainage District, and RCW 85.38, Special District Creation and Operation. These laws apply specifically to counties and provide a method of financing and operating facilities to serve specific areas of land. A city may operate as a drainage district; however, the creation and assessment process is specifically tied to the legislative authority of the county in which the drainage district is located.

Creation of a drainage district involves a vote by landowners and the election of a board of commissioners. Election of the board reduces the active involvement of the county in the operation and management of the district.

State law also specifies the method of assessing property within a district. Assessment zones must reflect the relative benefit or use each property will receive from district

operations and facilities. The assessment zones determine the dollar value of benefit per acre.

A budget must be adopted each year and must demonstrate that the assessments are sufficient to cover annual expenses. The cost of improvements is not included in the special assessment until the year after the improvements are constructed.

Advantages of drainage districts include the following:

- They provide funding for both O&M and capital improvements.
- Assessments are billed on property tax statements and collected with property taxes.
- Costs are equitably allocated to property owners in the district based on benefit or use received on a district-wide basis.

Disadvantages of drainage districts include the following:

- Involvement of the county in the management and operation of the district is limited. The county has a legislative role in creation, but a separately elected board of commissioners manages the district.
- Property owners must approve by vote the creation of a district.
- Funds for capital improvements cannot be collected until after the improvements are completed.
- District creation and benefit-assessment processes defined by statute are very complicated.
- The county's flexibility in working with developers is limited.
- Assessments may be limited by the property tax lid.

Local Improvement Districts

Local improvement districts (LIDs) allow the county to issue bonds for the cost of improvements and to recover the cost through assessments based on "specially benefiting" property. Special benefit is defined by the increased property value that results from the improvements.

For water and sewer improvements, properties are considered specially benefiting when they are physically connected to, or have the ability to physically connect to, the sewer or water system. For drainage improvements, it is often difficult to demonstrate special benefit because there is generally no physical connection, and property value often is not directly affected by the existence of a drainage system, except where flooding is frequent. Moreover, property at the top of a hill does not specially benefit from drainage improvements, but it does contribute to the surface water problems. Property at the bottom of the hill sees a more positive effect from the drainage improvements, even though it contributes only a portion of the runoff.

LIDs have been used to finance water supply, sanitary sewers, and storm drains when all three utilities are needed in an area. An LID might be appropriate for construction of a facility to serve several properties where the runoff contribution and benefit are similar.

Surface Water Utility

The underlying concept of a surface water utility is that all properties contribute surface water runoff to the drainage system and therefore should pay an equitable share of the system's O&M and capital costs.

RCW 36.89 gives the county authority to generate revenue by charging those who contribute to an increase in surface water runoff or who benefit from any stormwater control facility the county provides. Schools, churches, and other tax-exempt properties, as well as public entities and public property, are subject to the same rates and charges as private properties.

The formation of a surface water utility would give jurisdictions in the basin a continuous and reliable funding source to pay for both capital improvements and ongoing O&M costs. The county would have direct control over rates and charges, rather than being limited to the prescribed methods set forth by statute for a drainage district.

A reliable source of funding is a key element in developing and continuing a successful, well managed surface water management system or a comprehensive flood hazard management plan. The county can create a county-wide utility that is implemented on a basin-by-basin approach using variable rates. The fees can be included with property tax statements; a new billing system is not needed.

The primary disadvantage to establishing a drainage utility is the public perception that a new charge is being imposed for a service already being provided.

County Revenues

A number of county funding sources can be used in a discretionary manner to finance storm drainage and flood control. They include the current expense fund, the road fund, the real estate excise tax, and debt financing.

Current Expense Fund

The current expense fund provides the general revenue used for county operations and services. It is derived from sources including property and sales taxes, fees, licenses, fines, investment interest, and contributions for services from other governments. Taxes are the most significant source of revenue for the current expense fund. Of the amount derived from taxes, property taxes provide the largest percentage. Taxes are levied on all taxable real and personal property. Only a portion of the levy goes into the current expense fund. Dedicated levy amounts are deposited in other funds, such as the River Improvement Fund discussed previously.

The property tax is based on the assessed value of property and the levy rate per $1,000 assessed value. The county commission or board sets the levy rate, which is subject to two statutory restrictions. RCW 84.52.043 sets the maximum levy rate for the all-county levy at $1.80 per $1,000 assessed value. In addition, RCW 84.55.010 restricts the amount of taxes levied to 106 percent of the highest of the three prior years' levy amounts plus an additional amount derived from taxing the assessed valuation of new construction. The latter restriction, called the 106 percent lid, has historically held the maximum levy rate below the $1.80 per $1,000 assessed value level.

State law also provides full or partial exemptions to certain types of property and classes of ownership. Some non-profit organizations, such as churches and government, are totally exempt from property taxes, while partial exemptions are given to low-income or senior and handicapped citizens. Also, farm, open space, and timber land is generally valued at less than fair market value.

Road Fund

The road fund is generated by sources including a county road levy, gasoline sales tax, and federal and state grants. A portion of the road fund is used to pay for drainage activities associated with county roads. The county road levy is limited to a maximum rate of $2.25 per $1,000 assessed value and is restricted by the 106 percent lid.

Road funds cannot be used for activities unrelated to roads without jeopardizing the county's eligibility for state financial programs including the Rural Arterial Program.

Real Estate Excise Tax

RCW 82.46 allows counties and cities to levy an excise tax equivalent to 0.25 percent of the sale of real property. These funds are used explicitly for capital facilities on the premise that revenues generated through property sales reduce the burden on the general public of the problems created by growth and development.

Debt Financing

Capital bond financing is an alternative to funding the acquisition, design, construction, mitigation, permit compliance, or other activities such as technical studies needed to achieve a specific "fixed" tangible capital asset such as a levee, revetment or pump station.

The sale of bonds is an option, but financing capital projects without establishing an additional revenue stream to pay for the debt service cost will create additional financial strain on current funds. Options for debt financing include the following:

- General Obligation Bonds are bonds for which the full faith and credit of the issuing government is pledged. The bonds are secured by an unconditional pledge of the issuing government to levy unlimited taxes to retire the bonds. General Obligation Bonds require voter approval and may create a need to raise taxes to service the debt. To approve these bonds requires 60 percent voter approval and 40 percent voter turnout from the last general election. Interest rates are generally the lowest available.
- Revenue Bonds are bonds whose principal and interest are payable exclusively from earnings of an Enterprise Fund (such as a surface water utility), and therefore may be more equitable than General Obligation Bonds. The Revenue Bonds generally carry higher interest rates and a reserve is required. Bonds usually contain restricted operations and the market is not as broad as for General Obligation Bonds. Usually there is no need for voter approval and limits are often not subject to a debt ceiling.

External Funding Sources

Table 8-2 lists potential funding sources from state and federal grant and loan programs that should be explored for financing flood hazard management projects in the Chehalis River Basin. This Flood Plan specifies projects that are non-emergency in nature. Most of the funding sources listed here are designed for preventative flood mitigation projects and could address the projects listed in this plan. Other funding sources are available for recovery efforts after a flood disaster is declared. The following external funding sources are sorted by whether they relate to flood prevention or recovery.

Table 8-2. External Grant and Loan Funding Sources

Funding Source	Agency	Grant/ Loan	Eligible Projects	Funding Amounts	Local Match
PREVENTION					
Reigle Act	FEMA	Grant	Flood hazard mitigation	Variable	25%
Disaster Mitigation Act	FEMA	Grant	Flood hazard mitigation and planning	Variable	25%
Small Flood Control Projects	Corps	Grant	Flood control	$7 million	0% - reconnaissance 25-50% - construction 100% - maintenance
Emergency Bank Protection	Corps	Grant	Streambank protection	$1 million	35%
Floodplain Management Services	Corps		Technical assistance and planning guidance	$7.6 million (Corps-wide)	0%
Planning Assistance to States	Corps	Grant	Preparation of plans and studies relating to flood control	Limited to $500,000 per state annually	50%
Habitat Restoration	Corps	Grant	COE project for habitat restoration	Unknown	25%
Watershed Protection and Flood Prevention Act	NRCS	Grant	Improvements to small watersheds	Unknown	0% - construction
Flood Control Assistance Account Program	Ecology	Grant	Projects and plans related to flood hazard management	$500,000	25% - comprehensive plans 50% - projects 20% - emergency projects
Centennial Clean Water Fund	Ecology	Both	Projects and activities that result in water quality benefits	$2.5 million – facilities $250,000 – activities	50% - facilities 25% - activities
Water Pollution Control Revolving Fund	Ecology	Loan	Projects and activities that result in water quality benefits	Unknown	Not applicable
RECOVERY					
Stafford Act	FEMA	Grant	Flood disaster relief and emergency assistance	Variable	25%
Farm Program	USDA	Loan	Emergency assistance to farms and ranches	$500,000 per disaster	Loan limited to 80% of loss
Hazard Mitigation Grant Program	Commerce	Grant	Flood hazard mitigation	Variable	25%
Public Works Trust Fund	Commerce	Loan	Public works projects	Variable	100% local
Emergency Relief Funds	WSDOT/ FHA	Grant	Flood-damaged roadways	Variable	0% - restoration before 180 days 12.5% - restoration after 180 days

Prevention

Reigle Community Development and Regulatory Improvement Act (PL103-325) - FEMA

Title V of the Reigle Community Development and Regulatory Improvement Act of 1994 (PL 103-325) is referred to as the National Flood Insurance Reform Act of 1994. The Act establishes a program to provide financial assistance to states and communities for planning and implementation of flood mitigation activities.

A new National Flood Mitigation Fund is set up through the Act to fund flood mitigation planning and implementation activities (referred to as FMA- Flood Mitigation Assistance). Money for this fund comes from the National Flood Insurance Fund. The total amount to be credited to the new mitigation fund is $20,000,000 in each fiscal year.

Conditions

The following conditions for participation in the program are described in the Act:

- Community is defined as a political subdivision that has building code and zoning code jurisdiction over the flood hazard area, and is participating in the flood insurance program.
- To be eligible for funding, the state or community must have a flood risk mitigation plan that:
  - Describes the activities to be funded;
  - Is consistent with specific criteria contained in section 1361 of the National Flood Insurance Act of 1968 ("Criteria for Land Management and Use");
  - Provides protection to structures that are covered by an existing flood insurance policy;
  - Is approved by the Director;
  - Includes a comprehensive strategy for mitigation activities for areas affected by the plan;
  - Has been adopted by the state or the community following a public hearing.
- The Director (FEMA) has 120 days in which to review submitted mitigation plans and notify the state or community that the plan has been approved or disapproved.
- Funding can be used only for activities included in the approved plan. Activities must be technically feasible, cost-effective, and cost-beneficial to the National Mitigation Fund. Mitigation activities for repetitive loss structures and structures that have incurred substantial damage will receive higher priority.

Funding

Planning and implementation activities have different funding limits under the Act. Both categories of grants are provided on a 75 percent to 25 percent federal to local cost-share basis. The funding limits are described as follows:

- Planning Activities
  - The total amount available for mitigation planning will be $1,500,000 per year. Single grants to states and communities cannot exceed $150,000 and $50,000, respectively. The total amount of grants to any one state and all communities in that state in a fiscal year may not exceed $300,000.
  - Grants for mitigation planning to states or communities cannot be awarded more than once every 5 years, and each grant may cover a period of 1 to 3 years.
- Implementation Activities
  - Grants for mitigation activities during any 5-year period may not exceed $10,000,000 to any state or $3,300,000 to any community. The sum of the amounts of mitigation grants that can be made during any 5-year period to any one state and all communities in that State is limited to $20,000,000.
  - The limits on grants for mitigation activities described above can be waived for any 5-year period during which a major disaster or emergency is declared by the President as a result of flood conditions in the state or community.

Eligible Activities

The Act lists specific activities that are eligible for funding, as follows:

- Demolition or relocation of any structure located along the shore of a lake or other body of water and certified by an appropriate state or local land use authority to be subject to imminent collapse or subsidence as a result of erosion or flooding;
- Elevation, relocation, demolition, or flood proofing of structures (including public structures) located in areas having special flood hazards or in other areas of flood risk;
- Acquisition for public use by states and communities of property (including public property) located in areas having special flood hazards or in other areas of flood risk and properties substantially damaged by flood;
- Minor physical mitigation efforts that do not duplicate the flood prevention activities of other federal agencies and that lessen the frequency and severity of flooding and decrease predicted flood damages, not including major flood control projects such as dikes, levees, seawalls, groins, and jetties unless the Director specifically determines in approving a mitigation plan that such activities are the most cost-effective mitigation activities for the National Flood Mitigation Fund;
- Beach nourishment activities;
- The provision by states of technical assistance to communities and individuals to conduct eligible mitigation activities;
- Other activities the Director considers appropriate and specifies in regulation;
- Other mitigation activities not described above that are described in the mitigation plan of a state or community.

Disaster Mitigation Act of 2000 (P.L. 106-390) - FEMA

The Disaster Mitigation Act of 2000 (P.L. 106-390) provides an opportunity for states, Tribes and local governments to take a new and revitalized approach to mitigation planning. Disaster Mitigation Act 2000 amended the Robert T. Stafford Disaster Relief and Emergency Assistance Act (the Stafford Act) by repealing the previous mitigation planning provisions (Section 409) and replacing them with a new set of mitigation plan requirements (Section 322). This new section emphasizes the need for state, Tribal, and local entities to closely coordinate mitigation planning and implementation efforts.

The Pre-Disaster Mitigation Program was authorized and created when the Disaster Mitigation Act 2000 amended the Stafford Act to provide a funding mechanism that is not dependent on a federal disaster declaration. Funding for the program is provided through the National Pre-Disaster Mitigation Fund to assist states, local governments and Native American tribal governments in implementing cost-effective hazard mitigation activities that complement a comprehensive mitigation program. This is an annual grant program with funding limits established by congressional appropriation. Since this program is a pre-disaster program, a national competitive process has been established by FEMA that evaluates and ranks project applications, with an emphasis on overall project benefits versus costs. Like the Hazard Mitigation Program, project eligibility is limited based on program requirements. States and Native American governments applying for Pre-Disaster Mitigation must have an approved mitigation plan to be eligible to receive project grant funding.

Small Flood Control Projects – Corps of Engineers

Section 205 of the 1948 Flood Control Act authorizes construction of small flood control projects, including levees, channel enlargement, realignments, obstruction removal, and bank stabilization. Non-structural alternatives may include flood warning systems, raising or flood-proofing of structures, and relocation of floodprone infrastructure. An important proviso attached to this assistance is that each project must be a complete solution to the problem and must not commit the federal government to additional improvements to insure effective operation.

Local government is responsible for 25 to 50 percent of the costs of the project and 100 percent of all future O&M costs. The federal share may not exceed $7 million for each project under existing authorities.

Emergency Bank Protection – Corps of Engineers

Section 14 of the 1946 Flood Control Act provides for emergency streambank protection to prevent damage to highways, bridge approaches, municipal water supply systems, sewage disposal plants, and other essential public works facilities. Churches, hospitals, schools, and nonprofit public facilities may also benefit from work done under this program. Projects cannot be used solely to protect privately owned properties or structures. Again, each project must constitute a complete solution to the problem and must not commit the federal government to additional improvements to insure effective project operation.

Local government is responsible for 35 percent of the project cost. The maximum amount that the Corps can spend on a single project is $1 million.

Floodplain Management Services – Corps of Engineers

Section 206 of the Flood Control Act of 1960 authorizes the Corps to provide information, technical assistance, and guidance to city, county, state and federal agencies. Examples of the types of informational assistance provided through this program are data on flood sources and types, obstructions to flood flows, flood depths or stages, flood water velocities, flood warning and preparedness, flood damage reduction studies and audits, and floodproofing.

While the Corps provides study findings and pamphlets to its customers free of charge, all costs for services must be reimbursed according to a set fee schedule. Other grant funds may be used to pay for these services wholly or in part.

Planning Assistance to the States – Corps of Engineers

Section 22 of the Water Resources Development Act allows the Corps to assist local governments in the preparation of comprehensive plans for the development, utilization, and conservation of water and related land resources. This program may encompass many types of studies, including water quality, habitat improvement, hydropower development, flood control, erosion, and navigation. Studies are typically at a planning level and do not include design for project construction.

Costs for projects undertaken under this program require a 50 percent local match. The local match can be met either wholly or in part with other non-federal grant funds. Allotments for each state or Tribe are limited to $500,000 annually, but typically are much less.

Habitat Restoration – Corps of Engineers

Assistance is available under Section 1135 of the Water Resources Development Act (PL 99-662) to provide funding to modify Corps project structures to restore fish and wildlife habitat.

Fish and wildlife benefits must be associated with past Corps projects. Planning studies, detailed design, and construction are funded with a 75 percent federal cost-share. The program requires a non-federal sponsor to contribute the remaining 25 percent funding match. The potential sponsor requests by letter that the Corps initiate a feasibility study. Following receipt of the letter of intent, the Corps will request study funds.

Watershed Protection and Flood Prevention Act (PL 83-566) - NRCS

The Small Watershed Program of PL 83-566 provides federal funding for watershed protection, flood prevention, and agricultural water management. Funds from PL 83-566 can be used to prepare studies and construct flood control projects, both structural and non-structural. PL 83-566 was modified in 1990 to authorize cost-share assistance to project sponsors for acquisition of wetland and floodplain easements to maintain or enhance the floodplain's ability to retain excess floodwaters, improve water quality and quantity, and provide habitat for fish and wildlife. PL 83-566 is a cost-sharing program that requires matching funds from a local sponsor.

This program was modified as a result of the 1993 flooding on the Mississippi River. The types of eligible projects have been expanded and for some projects the federal cost is shared.

Flood Control Assistance Account Program (FCAAP) - Ecology

The FCAAP program was established by the State Legislature in 1984 to assist local jurisdictions in comprehensive planning and maintenance efforts to reduce flood damages. To be eligible, a community must receive Ecology's approval of its floodplain management activities. Additionally, the county has to meet the requirements of the National Flood Insurance Program (NFIP). Every 2 years, $500,000 in non-emergency grant funds are available within any one county, but only approximately $4 million is available statewide, depending on the amount appropriated by the State Legislature. The application period is during the winter, with a deadline in the spring. Ecology evaluates and releases a priority list for funding in July. Non-emergency grants may be effective for work 6 months after funding and negotiations are complete.

Eligible projects include acquisitions; flood protection facility retrofits, setbacks and removals; floodplain and channel migration zone mapping studies; comprehensive flood hazard management planning; and flood emergency warning services.

Distribution of FCAAP grant money is based on eligibility of the applicant and the proposed project. Conditions for funding include the following:

- Grants are limited to 50 percent of the total cost of non-emergency projects.
- Emergency funds of up to $150,000 per county per biennium are available on a first-come/first-served basis; the state will fund up to 80 percent of the cost of emergency projects.
- Unused emergency funds ($500,000 to emergency fund) can be disbursed on a discretionary basis by Ecology.
- The state can fund 75 percent of the cost for comprehensive flood hazard management plans.

Centennial Clean Water Fund - Ecology

The Centennial Clean Water Fund is both a grant and a loan program. Centennial Clean Water Fund-approved projects must be for the planning, design, acquisition, construction, and improvement of water pollution control facilities and activities. Flood control projects are typically not eligible for Centennial Clean Water Fund funds. However, if a water quality benefit can be demonstrated as a result of a flood control project, Centennial Clean Water Fund funds can be made available. A total of $2.5 million is available per funding cycle for facilities, with $250,000 available for activities under the Centennial Clean Water Fund.

The Centennial Clean Water Fund grants program will fund a maximum of five projects per year, no more than two of which can be for facilities. The Centennial Clean Water Fund requires a 50 percent local match for facilities and a 75 percent local match for activities. The local share may come from any combination of cash, other grants, or loans. In-kind contributions may be used for activities projects only.

The Centennial Clean Water Fund loan program will issue loans at the following interest rates: 0 to 5 years, 0 percent interest; 6 to 14 years, 60 percent of market rates; 15 to 20 years, 75 percent of market rates.

State Water Pollution Control Revolving Fund - Ecology

Like the Centennial Clean Water Fund, the State Revolving Fund finances planning, design and construction of facilities and the planning and implementation of activities that address water quality problems or water pollution prevention. While the State Revolving Fund is designed to provide assistance for water pollution control efforts, some flood control projects that will result in water quality benefits may be considered.

SRF loans may be used for up to 100 percent of a project's cost. SRF loans may also be used to provide a match for State Revolving Fund grants, with some restrictions.

The following interest rates apply to State Revolving Fund loans: 0 to 5 years, discretion of Ecology; 6 to 14 years, 60 percent of the bond buyer's index for municipal bonds; 15 to 20 years, 75 percent of the bond buyer's index for municipal bonds.

Recovery

Robert T. Stafford Disaster Relief and Emergency Assistance Act (PL 93-288) - FEMA

The Robert T. Stafford Disaster Relief and Emergency Assistance Act (the Stafford Act) provides assistance following Presidential declarations of major disasters. Title IV presents details on major disaster assistance programs, including provisions for property acquisition and relocation assistance. Cost-sharing is available for up to 75 percent of the cost of any hazard mitigation measures that the President has determined are cost-effective and which substantially reduce the risk of future damage, hardship, loss, or suffering in any area affected by a major disaster. However, the total amount of mitigation funding under any disaster declaration cannot exceed 15 percent of the total grant funds provided for the disaster.

The specific terms and conditions used to determine if an acquisition or relocation project is eligible to receive federal funding under the Stafford Act are as follows:

- Acquisition and relocation projects funded under this Act must be cost-effective and substantially reduce the risk of future damage, hardship, loss, or suffering in any area affected by a major disaster;
- Acquisition and relocation projects and all other mitigation measures must be identified based on an evaluation of natural hazards;
- The applicant (the county or state) must complete an agreement stating that:
    - The property will be dedicated and maintained in perpetuity for a use that is compatible with open space, recreational, or wetlands management practices;
    - The only new structures erected on the property will be public facilities open on all sides and functionally related to a designated open space, rest rooms, or structures approved by the Director in writing before the start of construction;

- No application will be made for additional disaster assistance for projects relating to the property and no federal funding will be granted for such projects.

For more details on state implementation of the mitigation section of this federal act, see "State Hazard Mitigation Grant Program" later in this chapter.

Farm Service Agency Farm Program - USDA

The Farm Service Agency provides emergency loans to help cover production and physical losses in counties declared as federal disaster areas. Emergency loans may be used to replace essential property, pay production costs associated with the disaster year, pay living expenses, reorganize the farming operation, and refinance debt. To be eligible for Farm Program loans, the applicant must fulfill the following requirements:

- Be an established family farm operator;
- Be a citizen or permanent resident of the United States;
- Have the ability, training, or experience necessary to repay the loan;
- Have suffered a qualifying physical loss, or a production loss of at least 30 percent in any essential farm or ranch enterprise;
- Be unable to obtain commercial credit;
- Be able to provide collateral to secure the loan;
- Have multi-peril crop insurance, if available.

The loan limit is up to 80 percent of actual loss with a maximum of $500,000 per disaster; special loan requirements and terms apply. Application for emergency loans must be received within 8 months of the disaster designation date.

State Hazard Mitigation Grant Program – Washington Emergency Management Department

The Emergency Management Division of the Washington Military Department coordinates state disaster mitigation, preparedness, response, and recovery activities. Under this mandate, the agency administers the State Hazard Mitigation Grant Program (also called the "404 program" after the section of the Stafford Act dealing with hazard mitigation). The Hazard Mitigation Grant Program is authorized and partially funded under the Stafford Act. State Hazard Mitigation Grants are made to local governments on a cost-share basis, with the federal, state, and local percentage matches set at 75, 12.5, and 12.5 percent, respectively. Federal funding for this program is contingent on a Presidential disaster declaration. Activities that may be funded through this program include:

- Elevating flood-prone homes or businesses;
- Acquiring (and either demolishing or relocating) flood-prone homes from willing owners and returning the property to open space;
- Retrofitting buildings to minimize damage from high winds, flooding, earthquakes, and other hazards; and

- Implementing minor flood control projects to protect critical facilities.

From the program's inception through August 2006, a total of $82 million was allocated for these grants in Washington State. Even with this apparently high level of mitigation funding, total requests for grants have consistently exceeded the funds available. Therefore, the state has established a competitive procedure for funding. Applications are reviewed by a panel of state and local officials and scored based on how well they meet the specific terms and conditions required by the Stafford Act (see description above). This process is administered by the Emergency Management Division and selected applications are then sent to FEMA for approval.

Public Works Trust Fund – Department of Commerce

This state fund offers low-interest loans for rehabilitation and repair of public works infrastructure, including surface water facilities. Local governments, such as counties, cities, and special purpose districts, are eligible for these loans. Loans are paid back using revenue from sources such as local utility and sales taxes on local water, sewer, and garbage collection, and from a 0.24 percent real estate excise tax. Applications are accepted annually between April and July.

Emergency Relief Funds—WSDOT and FHWA Title 23

WSDOT serves as the clearinghouse for emergency road repair grants for damage associated with declared federal disaster areas. These grants can provide technical assistance and construction funds to the county from state (Rural Arterial Program) and federal (Federal Highway Administration) sources for temporary or permanent restoration of flood-damaged roadways. Title 23 Emergency Relief Funds are a major source of these funds. Permanent repairs can often incorporate designs that help prevent future damage. The local jurisdiction can also contribute additional funds, beyond that allocated for the emergency relief permanent restoration, to incorporate additional mitigation features into the project.

Basin-Wide Funding Options

The Flood Authority is interested in setting up a basin-wide governance and financing structure. Revised Code of Washington allows for two types of flood-related districts that could serve the basin as a whole: the Flood Control District (RCW 86.09) and the Flood Control Zone District (RCW 86.15).

Flood Control District

The formation of a Flood Control District, authorized by RCW 86.09, may be initiated by a petition of at least 10 property owners or a county legislative authority resolution. The district is established by the registered voters within the district boundaries, which are determined by county engineers. A Flood Control District is governed by an elected board of directors.

The purpose of a Flood Control District is the investigation, planning, construction, improvement, replacement, repair or acquisition of dams, dikes, levees, ditches, channels, canals, banks, revetments and other works, appliances, machinery and equipment and

property and rights connected therewith or incidental thereto, convenient and necessary to control floods and lessen their danger and damages. Certain powers and rights are governed by RCW 85.38 (Special Districts).

This type of district has the authority to use several different funding mechanisms, including the following:

- Rates and charges (RCW 85.38.145),
- Furnish water for a toll (RCW 86.09.154),
- Special assessments (RCW 85.38.150-.170),
- Special benefit assessments on farm and agricultural land exempted (RCW 86.09.152),
- Special assessment bonds and notes (RCW 85.38.230),
- Special assessment bonds/notes as per RCW 86.09.157 and RCW 85.38.140-170,
- Utility revenue bonds (RCW 86.09.592-.616), and
- All governmental entities benefited by improvements are assessed (RCW 86.09.523 -.529).

Flood Control Zone District

Flood Control Zone Districts, authorized by RCW 86.15, may be established by either a petition signed by 25 percent of the voters in the proposed district, or by action of the county commission or board. A Flood Control Zone District is governed by a board of supervisors, typically the county commissioners or board.

The purpose of a Flood Control Zone District is to undertake, operate, or maintain flood control projects or stormwater control projects or groups of projects that are of special benefit to specified areas of the county (RCW 86.15.020).

This type of district has the authority to use several different funding mechanisms, including the following:

- A regular levy requiring authorization by the supervisors. The maximum amount that can be levied is 50 cents per $1,000 of assessed valuation (RCW 86.15.160).
- An excess levy as a property tax requiring annual voter approval. This type of levy does not fall under the constitutional and statutory limitations of regular levies. An excess levy is based on property value and would not affect existing county revenues. The levy, if approved annually by voters, can generate substantial revenue for overall surface water management or flood control. However, considerable cost is involved in making voters familiar with the issues on an annual basis, and there is no certainty of funds from year to year (RCW 86.15.160).
- Assessments (RCW 86.15.160).
- Service charges including public entities (RCW 86.15.176).

- Local improvement districts (LIDs) (RCW 86.15.160).
- Subzones which are operated as flood control zones (RCW 86.15.025).
- Revenue and GO Bonds (RCW 86.15.178 and RCW 86.15.170 respectively).
- Stormwater fee charges, including public property (RCW 86.15.160).
- Voluntary assessments for flood or stormwater control (RCW 86.15.165).

Washington has a regular property tax limitation of 1 percent of a parcel's fair and true value. Flood Control Zone Districts are considered to be junior taxing authorities, so their levies are reduced if more senior authorities bring property taxes up to the maximum allowed. Whenever a portion of the county tax levy has reached this maximum, taxes collected for the Flood Control Zone District have to be refunded annually to the more senior taxing authority.

A Flood Control Zone District must be within a county, but a basin-wide entity could be formed by the three counties each forming their own Flood Control Zone District and the Chehalis Tribe forming a similar district. The zone could be county-wide or cover only the portion of the county affected by Chehalis River flooding. The districts could then be governed by an interlocal agreement between the three counties and the Tribe. The interlocal agreement would define governance, cost share, and coordination between the entities. Another model for coordinating the different Flood Control Zone Districts would be to form a new entity under the interlocal agreement using the authority of the Watershed Management Partnership law (RCW 39.34.200).

The purpose of a watershed management partnership would be to implement a watershed management plan. This CFHMP may meet the requirements of a watershed management plan. The watershed management partnership would have the authority to incur debt and to issue bonds (RCW 39.34.210).

Funding Source Evaluation

Evaluation Criteria

As the Flood Authority seeks a governance and financing structure, it will need to evaluate the different structures that are available. The following criteria can be used to compare the options listed in this chapter.

- Equity—Does the funding source collect revenue equitably from those who contribute to drainage problems and those who will benefit from improvements?
- Stability—Are revenues from this source reliable and predictable? Can the county plan on them over the long run?
- Control—Can basin jurisdictions control the revenue, increasing it or decreasing it as required to fund programs?
- Adequacy—Does this source generate sufficient revenue to fund the desired program?

- Relatedness—Is this source of funding related to the problem that the revenue will be used to address?
- Ease of Implementation—Can this revenue source be activated quickly enough to fund a program?
- Restrictions—What are the restrictions on using this funding source? Will it fund capital operations? Work on private property? What other restrictions are there?
- Acceptability—Is this source likely to be acceptable to the citizens of the basin and its elected officials?
- Legality—What are the legal restrictions and requirements for implementing or using this source?
- Basin-Wide Applicability—Can this approach be used to fund basin-wide projects across jurisdictional boundaries?

Programs to be Funded

When determining the adequacy of a funding source, it is important to consider the types of programs and projects to be funded. Few funding sources can by themselves meet all the financial needs of hazard mitigation. Therefore, the selected funding mix should be adequate to fund each program element. Basic program elements to be funded include the following:

- Operations and maintenance (O&M),
- Capital improvements,
- Implementation and management of the flood hazard management program, and
- Billing, collection and administering revenue generation.

How each of the internal funding options described above meets these funding use requirements is shown in Table 8-3.

Table 8-3. Adequacy of Internal Funding Sources for Various Uses

Option	O&M	Capital Improvements	Management Programs	Billing and Administration
Developer Contributions		X		
Drainage District	X	X		X
River Improvement Fund	X	X		X
Local Improvement District	X	X		X
Surface Water Utility	X	X	X	X
County Revenues	X	X	X	X
Flood Control Zone District	X	X	X	X
Flood Control District	X	X	X	X

A preliminary evaluation of each of the internal funding sources was performed against the criteria listed above. The results are shown in Table 8-4. Ratings are on a scale of 1 to 10, with 10 being the highest rating.

Table 8-4. Evaluation of Funding Methods

Evaluation Criteria	River Improvement Fund	Other Districts	Surface Water Utility	County Revenues	Developer Contributions	Flood Control Zone District	Flood Control District
Equity	7	7	8	3	6	8	8
Stability	6	6	9	4	3	9	9
Control	7	4	7	8	4	7	7
Adequacy	8	8	9	6	3	8	8
Relatedness	9	7	9	4	8	9	9
Ease of Implementation	4	2	3	5	5	4	1*
Restrictions	4	6	8	6	4	8	4**
Acceptability	7	7	5	3	8	8	8
Legality	5	5	5	5	4	5	5
Basin-Wide Applicability	1	1	1	1	1	9	10
Total	**58**	**53**	**64**	**45**	**46**	**75**	**69**
Overall Ranking	**4**	**5**	**3**	**6**	**7**	**1**	**2**

* A Flood Control District requires a public vote, making it significantly more difficult to implement than a Flood Control Zone District.

** A Flood Control District is limited to certain types of projects that are fully engineered before the district is set up. Therefore, it has greater restrictions than a Flood Control Zone District.

Project Funding Strategy

Most internal and external funding sources listed in this chapter are only appropriate for projects within a single jurisdiction. However, larger projects that will be part of a basin-wide package will require a basin-wide funding mechanism such as a Flood Control District or a Flood Control Zone District. A policy decision between the two types of districts will need to be made by the Flood Authority.

CHAPTER 9 RECOMMENDED ACTIONS AND ALTERNATIVE ANALYSIS

Introduction

The Chehalis River Basin Flood Authority has limited funding to implement flood mitigation projects. The majority of the funding appropriated by the Legislature for the Flood Authority is set aside as matching funds for the U.S. Army Corps of Engineers flood hazard mitigation projects for the Chehalis river basin area. The Flood Authority determined that the best use of its limited funds would be to fund projects they have called Ripe and Ready Projects and to gather project ideas that could be implemented in the future when a governance structure, such as a flood district, is in place and funding is available. In addition, the Flood Authority has funded and/or supported the study of two major capital projects for the basin—the Corps Twin Cities Project and Lewis County PUD's Upstream Storage Project. The Flood Authority also developed a selection criteria process for evaluating proposed projects.

This chapter describes the two major capital projects being evaluated for the basin, the Ripe and Ready Projects that the Flood Authority has undertaken, and the Regulatory Review Project. It also presents lists of project ideas that have been proposed by jurisdictions and individuals in the basin. At the end of the chapter is a description of selection criteria that can be used in the future.

Existing Flood Mitigation Actions

Major Regional Capital Projects

Major regional capital projects address flood issues on a broad or regional basis. These include projects such as levee construction, flood storage, and dam modifications. The Flood Authority is currently supporting two such projects.

The Twin Cities Project is being undertaken by the Corps of Engineers. It consists of a series of levees along the Chehalis River in Centralia and Chehalis. The project is intended to alleviate flooding of Interstate 5 near Chehalis and will also mitigate local flooding in the vicinity. The project also includes evaluation of modifications to Skookumchuck Dam to allow the reservoir to be used for flood storage. The design of the project is scheduled to be complete in November 2011 with construction extending from 2013 to 2020. The project is authorized by Congress through the Water Resource Development Act and requires a local match. The state authorization of the Flood Authority includes the matching funds.

Lewis County PUD is studying the feasibility of two upstream storage facilities, one on the Upper Chehalis River and one on the South Fork Chehalis. These facilities are intended to provide flood Mitigation, hydropower production, and instream flow benefits. The PUD is currently studying the feasibility of the facilities.

Neither of these projects is ready to be implemented. To support decision-making on these major regional projects, the Flood Authority decided to undertake the Ripe and Ready projects described below.

Ripe and Ready Projects

An early interest of the Flood Authority was to implement some flood risk reduction projects as soon as possible. These projects were identified as ones that could provide an immediate benefit, would not adversely affect others, and would not preclude any future actions. These have been referred to as "Ripe and Ready" projects. Under the category of Ripe and Ready studies, the Flood Authority has chosen to support a number of studies that would support decision-making on major capital projects in the basin. The Ripe and Ready projects also included two nonstructural projects—an evaluation of regulatory programs in the basin and the design of an early warning system for the basin.

The Flood Authority has funded or provided support for studies that will be useful in evaluating future flood mitigation projects.

- Seamless LiDAR. This project would acquire Light Detection and Ranging (LiDAR) data for the entire Chehalis River mainstem and major tributaries. The project would provide a consistent topographic dataset throughout the area that could be used with hydraulic models to improve the evaluating of flood impacts and the effectiveness of flood mitigation projects.

- Lower-basin Hydraulic Model. This project would produce a calibrated 1D hydraulic model for the lower basin, similar to the existing unsteady HEC-RAS model used by Northwest Hydraulic Consultants **(nhc**) and the Corps for the upper basin. This model would allow for evaluation of downstream impacts and benefits of potential flood mitigation projects.

- Ecosystem Services. This project includes an economic analysis to value flood protection and other ecosystem services in the basin. It can be used as a tool to select flood mitigation projects.

- Lewis County PUD Upstream Storage Phase 2 Studies. These studies are evaluating the feasibility of constructing the two storage facilities in the upper Chehalis basin proposed by the PUD.

- Coordinated Study. This project will develop timely, comparable data on the Twin Cities Project and an upstream storage facility designed solely for flood mitigation and to determine if there is an economically feasible combination of the two projects.

- Early Warning Program. This project is evaluating the need for improved flood warning and emergency management systems in the basin. An improved system will be designed and implemented.

- Evaluation of Regulatory Approaches. This project evaluated existing flood regulations of jurisdictions in the basin and made recommendations for improved regulations that could be adopted by those jurisdictions. Additional information on the recommendations is presented below.

In addition to the studies listed, the Flood Authority also considered involvement in the Skookumchuck Dam Modification Feasibility and Decision Support Tool projects. The Skookumchuck Dam feasibility study is evaluating alternatives for modifying the discharge system of the dam to allow more effective use for flood control. TransAlta has determined that the best approach to modification of the Skookumchuck Dam is to work with the Corps of Engineers as part of the Twin Cities project. The USGS Decision Support Tool is a rainfall-runoff model that could improve flood prediction. The USGS and Corps are developing a scope of work for the project and it appears the Flood Authority will not be involved at this time.

Regulatory Program Recommendations

In response to concerns and questions about development impacts on flooding and the adequacy of existing local regulations, the Flood Authority agreed to evaluate existing regulations in the basin. The Flood Authority authorized an approach to considering regulatory programs in June 2009.

The purpose of the project was to make recommendations for improvements to regulatory programs in the basin. The project consisted of an evaluation of existing flood regulations of member jurisdictions and development of recommendations for improved regulations. The evaluation and development of recommendations was conducted by a Regulatory Work Group consisting of Board Advisory Committee members and representatives from the basin jurisdictions planning and building departments.

The Work Group determined that all jurisdictions in the Flood Authority meet state flood regulations requirements as well as the minimum requirements of the National Flood Insurance Program. The Work Group developed recommendations to improve regulations beyond those standards using concepts presented in FEMA's Community Rating System (CRS). The CRS gives discounts on flood insurance to citizens of communities that implement regulations that go beyond the minimum National Flood Insurance Program (NFIP) requirements.

In addition to using the CRS guidelines, the Work Group evaluated regulatory approaches to development in the floodplain from the perspective of:

- Risk to proposed structures,
- Risk to existing structures and properties,
- Ecological risks (including habitat, water quality, and wetland impacts), and
- Emergency management costs.

The recommendations are listed below. Additional details on the recommendations are included in Appendix A.

Basic Recommendations

The Work Group decided to present its recommendations in two categories. Basic recommendations are those that the work group felt all jurisdictions in the basin should adopt.

Recommendation 1 - Require that all new residential structures in the floodplain (Special Flood Hazard Area) be built 2 feet above the base flood elevation (freeboard).

Recommendation 2 - Require that all new commercial or industrial structures in the floodplain be built 1 foot or more above the base flood elevation (BFE) or be floodproofed so that areas located 1 foot above the BFE or lower are watertight.

Recommendation 3 - Require that buildings in the floodplain have an approved foundation (per the requirements of NFIP Technical Bulletin 11-01).

Recommendation 4 - Adopt regulations that limit enclosures below the BFE to discourage finishing elevated areas.

Recommendation 5 - Require a lower threshold for substantial improvements.

Recommendation 6 - Require that substantial improvements be counted cumulatively within a specific time period such as 10 years.

Recommendation 7 – Place limitations on critical facilities in the floodplain.

Recommendation 8 - Adopt subdivision and development regulations that avoid or minimize development in floodplains.

Recommendation 9 - Adopt low density zoning in the floodplain.

Recommendation 10 - Adopt the current version of the Department of Ecology's Stormwater Manual.

Recommendation 11 - Include floodplain protection in the Critical Areas Regulations or adopt floodplain regulations as part of the Critical Areas Regulations.

Recommendation 12 - Adopt wetland and stream buffers that protect the natural and beneficial functions of wetlands and streams.

Recommendation 13 - Restrict activities allowed in wetland and stream buffers to those that do not increase impervious surfaces.

Recommendation 14 - When Shoreline Management Programs are updated, incorporate Shoreline Management Program guidelines for flood hazards.

Recommendation 15 - Include "associated wetlands" as part of the shoreline management zone.

In addition, at its January work session, the Flood Authority decided to add an additional recommendation:

Recommendation 16 – All jurisdictions should participate in the NFIP CRS program.

Ideal Recommendations

The Work Group also developed "ideal" recommendations. These are recommendations that the Work Group thinks all jurisdictions in the basin should consider and work towards if practical for the conditions in their jurisdictions

"Ideal" Recommendation 1 - Require compensatory storage for fill in the floodplain. Consider a 1:1 or 1.5:1 requirement for storage.

"Ideal" Recommendation 2 - Adopt a zero-rise policy in the floodplain.

"Ideal" Recommendation 3 - Restrict development in the floodplain, requiring all development proposals to acquire a special permit or reasonable use exception.

"Ideal" Recommendation 4 - Require new streets in the floodplain to be at or above base flood elevation

"Ideal" Recommendation 5 - Prohibit the storage of hazardous materials in the floodplain or require that such materials be stored above the flood protection elevation for residential structures.

Flood Mitigation Alternative Actions

The Flood Authority solicited input on structural and non-structural alternatives to reduce flooding impacts in the Chehalis River basin. The Flood Authority identified these mitigation alternatives in a number of ways. First, project lists were compiled from existing Comprehensive Flood Hazard Management Plans (CFHMPs) for jurisdictions within the Chehalis River basin. Second, the public was asked to recommend projects at the public workshops held in February 2009. The Flood Authority also requested project recommendations from member jurisdictions and the public.

These projects have not been developed or designed to a level adequate to evaluate their potential feasibility or effectiveness. The Flood Authority presents these projects as a list of identified projects that could be further evaluated in the future and possibly be implemented under a flood district.

The identified projects are presented in Table 9-1. The projects are classified using the categories described in Chapter 7. Both structural and nonstructural measures are presented. Many of the projects identified are Planning and Data Collection efforts to support the development of projects in the future.

Table 9-1. Identified Flood Mitigation Alternatives in the Chehalis River Basin

Project	Location
Floodplain Protection	
Salzer Creek backwater control	On Salzer Creek in Lewis County
Increased on-site detention and retention	Grays Harbor County
Overtopping levee on the north end of town	Bucoda
Twin culverts under Main Street at 11th	Bucoda
Relief culvert for north side runoff	Oakville
Harris Creek fish enhancement	Oakville
Sickman-Ford Bridge culvert	Oakville
Open old migration channels to allow river braiding	Wynoochee and Satsop Rivers
Culvert projects on Hiram Hill	Grays Harbor County
Montesano WWTP protection	Montesano
Adna levee improvement	Adna
Tilley Road culvert replacement	Thurston County
Bank Protection	
Bank stabilization and debris removal program	Basin-wide
Biostabilization	Basin-wide
Wynoochee River bank stabilization	Montesano
Streambank stabilization	Bucoda
Mary's River Lumber bank protection	Montesano
Independence Road bank protection	Thurston County
Conveyance Capacity	
Open migration zone of the Satsop	Satsop River
Dredge Lake Sylvia	Montesano
Regulatory Programs	
Floodplain conservation easement program	Basin-wide
Improve floodplain regulations	Basin-wide
Tax breaks for removing structures from floodplain	Basin-wide
Penalization for building in the floodplain	Basin-wide
Planning and Data Collection	
Remap high groundwater areas	Thurston County
Channel migration zone mapping	Basin-wide
Channel migration analysis	City of Chehalis to Grays Harbor County
Augment Chehalis Tribe Flood Plan with 2-, 5-, and 10-year recurrence interval maps	Chehalis Reservation
Survey of river cross-sections	Basin-wide
Remap floodplains	Thurston County
Berwick Creek Drainage Plan	Chehalis and Lewis County
China Creek Drainage Plan	Lewis County and Chehalis
Rochester Stormwater Plan	Rochester
Reevaluate land uses and zoning based on new mapping	Thurston County
Study of woody debris and aggregates	Basin-wide
Evaluate channel response to sediment	Basin-wide
Study of failed riprap	Basin-wide

Project	Location
Conduct studies needed to design proposed mitigation strategies	Chehalis Reservation
Investigate conditions near Wickett levee	Chehalis Reservation
Determine cause of water backup over Highway 6	Highway 6
Study of fill adjacent to Harris Creek to determine if it should be removed	Harris Creek, Chehalis Reservation
Independence Road Bank Realignment Feasibility Study	Thurston County
Skookumchuck River scour potential study	Skookumchuck River
Develop dynamic model of middle basin to assess effects of future development	Middle basin
Construct a 2-D flow model	Chehalis Reservation specifically and basin-wide
Model effects of removing/modifying the Sickman-Ford Bridge Approach	Sickman-Ford Bridge
Cumulative downstream flood impact analysis	Lower basin
Monitoring program on channel conditions	Basin-wide
Study of impact of recent development of trucking and warehouse facilities	Basin-wide
Evaluate how groundwater impacts flooding events	Basin-wide
Riparian habitat inventory	Basin-wide
Develop a floodplain property acquisition program	Basin-wide
Education and Public Information	
Provide educational materials on flood hazard management	Basin-wide
Provide floodproofing guidance to residents	Basin-wide
Establish a Flood Awareness Week	Basin-wide
Governance and Management	
Form a flood district	Basin-wide
Emergency Response and Preparedness	
Evaluate opportunities for flood warning systems	Lewis County
Flood Hazard Warning Policies	Grays Harbor County
Improve gauge system in Grays Harbor County	Grays Harbor County
Acquire generator for City Hall	Montesano
Construct drinking water reservoir	Montesano
Improve flood notification and response program	Bucoda
Develop and maintain a specific flood warning program	Centralia
Manage Wynoochee and Skookumchuck dams for flood control	Skookumchuck and Wynoochee dams
Install generator at Grays Harbor Fairgrounds	Grays Harbor Fairgrounds
Address loss of power and cell phone coverage	Basin-wide
Establish critter pads to reduce livestock loss	Basin-wide
Reduction of Damage to Existing Structures	
Join the NFIP Community Rating System	Basin-wide
Develop a home elevation and buyout program	Basin-wide
Regrade Main Street	Bucoda
Raise elevation of Moon Road/Easton 188th Roadway	Thurston County
Lincoln Creek floodplain purchase	Lincoln Creek Road area in Lewis County
Protect access to Satsop Development Park	Grays Harbor County
Natural Resource Protection	
Protect and restore critical areas	Basin-wide
Provide habitat for wildlife and fish	Basin-wide
Camp Creek drainage improvements	Grays Harbor County

Selection Criteria

The Flood Authority has developed a process for evaluating recommended actions. The process includes a list of project considerations and a set of project criteria. The criteria has not yet been applied to proposed projects because the projects have to be sufficiently defined and scoped before the criteria can be applied successfully. None of the projects proposed for the Chehalis River basin have been adequately defined at this time.

Project Considerations

The Flood Authority reviewed and commented on draft considerations for evaluating projects at the May 2009 work session. Those considerations have been revised and are presented here.

- **Definition of the Project.** Has the project been sufficiently defined and scoped to be considered and evaluated as a potential project by the Flood Authority? What is the intent of the project? Who will benefit?
- **Implementing Agency**. Is there an identified agency or jurisdiction who will take the lead on the project? Is there an identified agency or jurisdiction that will be in charge of maintenance on the project?
- **Ability to Meet Goals**. Does the project meet the goals outlined in the Chehalis River Basin CFHMP?
- **Effectiveness of Mitigation.** What flood hazard problems does the project solve? Is it a permanent or temporary solution? Is it a complete or partial solution? How much of the basin would be affected? Has the project been evaluated for downstream and upstream impacts (both positive and negative)?
- **Feasibility**. Are there technical obstacles that would prevent the project being constructed?
- **Cost and Funding Sources**. How expensive is the project and who will bear the cost? Are funding sources available, both in the short-term and long-term?
- **Cost-effectiveness**. How much benefit does the project deliver per dollar invested?
- **Environmental Impacts**. Does the project have significant environmental impacts or can adverse impacts be mitigated?
- **Permitting Ease**. What approvals or permits will be required? Are those approvals or permits likely to be granted?
- **Timeliness**. How long will it take to implement the project? Are there other projects that must be completed before this project can begin?
- **Acceptability**. Is the project acceptable to the stakeholders in the Chehalis basin?

Project Criteria

The Flood Authority has translated the project considerations into criteria that can be used in numerical ranking system. These rankings will serve as one consideration used by the Flood Authority in determining which projects to support and fund.

Three of the project considerations are framed as yes or no questions. The answer to all three questions needs to be yes, or the project is not ready to rank. The three questions are:

- Is the project sufficiently defined?
- Is there an identified implementing agency or agencies?
- Is the timeline of the project acceptable to the Flood Authority?

The other considerations are framed as criteria for which each project can be ranked high, medium, or low. These are shown in Table 9-2.

Table 9-2. Project Criteria

Criteria	Prioritization Ranking		
	LOW	MEDIUM	HIGH
Goals	Meets no/few goals	Sufficiently meets multiple goals	Meets most goals very well
Effectiveness of Mitigation	Not effective	Moderately effective	Very effective
Upstream and Downstream Impacts on People and Structures	Significant negative impact	Neither positive or negative impact	Positive impact
Technical Feasibility	Difficult to implement	Moderately able to implement	Easy to implement
Funding	Unlikely to be funded	Potential to be funded	Likely to be funded
Cost-Effectiveness	Benefits do not meet costs	Benefits meet or somewhat outweigh costs	Benefits significantly outweigh costs
Environmental Impact	Significant negative impact	Neither positive or negative impact	Positive impact
Permitting	Unlikely to be permitted	Unclear how likely to be permitted	Likely to be permitted
Acceptability	Unpopular/affects few	Not popular with some groups	Popular/affects many

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Appendix A

Regulatory Staff Report

Regulatory Work Group Staff Report

Date: January 14, 2010

Subject: Recommendations of the Regulatory Work Group

Background

At its June 18, 2009 meeting, the Flood Authority authorized a work group consisting of the Board Advisory Committee and representatives from the Basin jurisdictions' planning and building departments. The work group was tasked to develop findings and options for building and land use regulations to achieve flood damage reduction. The work group was asked to undertake the following steps:

1. Evaluate regulatory approaches to development in the floodplain from the perspective of:
    a. Risk to proposed structures,
    b. Risk to existing structures and properties,
    c. Ecological risks (including habitat, water quality, and wetland impacts), and
    d. Emergency management costs.

2. Review local jurisdictions' options for credit from the Community Rating System (CRS)[1] to reduce flood insurance premiums under Activity 430, Higher Regulatory Standards.

3. Develop findings and options for presentation to the Flood Authority, including:
    a. Best management practices and/or model regulations for local jurisdictions to consider, and

[1] Acronyms used in this document are explained on the last page.

b. Pros and cons of various practices and approaches.

Ann Root of ESA Adolfson facilitated three meetings of the Regulatory Work Group.

The first meeting was held on September 2, 2009 and was attended by: Brian Shea, Ryan Harriman, and Mike Ferry, Grays Harbor County; Bob Johnson and Fred Chapman, Lewis County; Mike Kain, Thurston County; Don Terry, Chehalis Tribe and the City of Oakville; LG Nelson, City of Centralia; Bob Nacht, City of Chehalis; Loren Hiner, City of Montesano; and Chris Hempelman, Department of Ecology. The work group discussed regulations that impact flooding, brainstormed possible recommendations, and developed the inventory of existing regulations in the basin.

The second meeting was held on October 26, 2009 and was attended by: Mike Ferry, Grays Harbor County; Bob Johnson, Lewis County; Mark Swartout, Thurston County; Glen Connelly, Chehalis Tribe; Don Terry, Chehalis Tribe and City of Oakville; LG Nelson, City of Centralia; Bob Nacht, City of Chehalis; Loren Hiner, City of Montesano; and Chris Hempelman, Department of Ecology. The work group discussed a draft list of recommended regulations.

The third meeting was held on November 17, 2009 and was attended by: Mike Ferry, Brian Shea, and Ryan Harriman, Grays Harbor County; Bob Johnson and Fred Chapman, Lewis County; Tim Rubert, Thurston County; Glen Connelly, Chehalis Tribe; Don Terry, Chehalis Tribe and City of Oakville; LG Nelson, City of Centralia; Bob Nacht, City of Chehalis; and Loren Hiner, City of Montesano. The work group reviewed and finalized their recommendations and findings.

Approach

The work group determined that all jurisdictions in the Flood Authority meet state flood regulation requirements as well as the minimum requirements of the National Flood Insurance Program (NFIP). Thus, the work group focused on developing recommendations that basin jurisdictions could use to improve their regulations beyond minimum state and national requirements.

The work group based their recommendations on concepts presented in FEMA's Community Rating System (CRS). The CRS gives discounts on flood insurance to citizens of communities that implement regulations that go beyond the minimum NFIP requirements. Lewis County, Thurston County, Centralia, and Chehalis are members of the CRS and currently receive credit for higher regulatory standards. They may receive greater discounts by implementing the recommendations contained herein. Every 500 points a community earns can result in up to a 5 percent reduction in annual premiums. Other communities in the basin are not members of the CRS but would provide greater protection to citizens and structures in the floodplain by adopting these recommendations. Those jurisdictions not already participating in the CRS program could become members to provide their constituents lower insurance premiums. The work group also used the No Adverse Impacts guide book developed by the Association of State Floodplain Managers and their own ideas to develop recommendations.

The work group discussed whether the recommendations should be presented as a model ordinance to be adopted by member jurisdictions or whether they should be

presented as best management practices or guidelines. The term “model” ordinance implied to work group members that the provisions of the ordinance are minimum requirements that must be adopted by all jurisdictions. Model ordinance was also considered to imply that any jurisdiction not adopting the ordinance exactly as written would not be in compliance. The recommendations presented here are steps beyond the minimum requirements and are intended to provide more protection for life and property than the existing flood related regulations.

The work group decided to present their recommendations as best management practices or guidelines to allow each community the opportunity to select recommendations suited to their jurisdictions and to fit the modifications into their existing ordinances in a manner they feel is most appropriate. The work group divided the recommendations into two categories—basic and “ideal”. The basic recommendations are those that the work group feels all jurisdictions in the basin should adopt. The “ideal” recommendations are those that the work group thinks all jurisdictions in the basin should consider and work towards if practical for the conditions in their jurisdictions.

Basic Recommendations

The work group identified 16 basic recommendations. Each addresses certain risks, and has advantages and disadvantages to its implementation.

<u>Recommendation 1 - Require that all new residential structures in the floodplain (Special Flood Hazard Area) be built 2 feet above the base flood elevation (freeboard).</u>

Currently, regulations in the basin allow residential structures in the floodplain to be built anywhere from base flood elevation (BFE) (the minimum NFIP requirement) to 2 feet above BFE. Requiring all new residential structures in the floodplain to be built 2 feet above the BFE would address risk to new structures by adding a margin of safety against risks that are not yet known and possible future changes in flood elevations due to increased peak flood flows caused by changes in land use or climate.

Risks addressed:

- Risk to new structures
- Emergency management costs

Advantages to implementing this recommendation include a reduction of flood damages, provision of a measure of safety against future changes to the BFE, and lower flood insurance rates for property owners. The disadvantage is that additional material and building costs, though minimal, would be required.

Jurisdictions that adopt this recommendation would receive CRS credit up to 200 points.

<u>Recommendation 2 - Require that all new commercial or industrial structures in the floodplain be built 1 foot or more above the BFE or be floodproofed so that areas located 1 foot above the BFE or lower are watertight</u>.

Requiring all commercial or industrial structures in the floodplain to be built 1 foot above BFE or be floodproofed would address risk to new structures by adding a margin of

safety against risks that are not yet known and possible future flood increases. To be considered floodproofed, a structure must be built so that all areas located 1 foot above BFE or lower are watertight (NFIP Technical Bulletin 3).

Risks addressed:

- Risk to new structures
- Emergency management costs

As with recommendation 1, advantages include a reduction of flood damages, the minimal cost of elevating new structures an additional foot, a measure of safety against uncertain future changes to BFE, and lower flood insurance rates for property owners. The disadvantage is that additional material and building costs, though minimal, would be required.

Jurisdictions that adopt this recommendation would receive CRS credit up to 100 points.

<u>Recommendation 3 - Require that buildings in the floodplain have an approved foundation (per the requirements of NFIP Technical Bulletin 11-01).</u>

Requiring that foundations be approved would address risk to new structures by ensuring that parts of the building likely to flood would sustain minimal damage in a flood event.

Risk addressed:

- Risk to new structures

This change would reduce flood damages, but would require additional material and building cost for new construction.

Jurisdictions that adopt this recommendation would receive CRS credit up to 35 points.

<u>Recommendation 4 - Adopt regulations that limit enclosures below the BFE to discourage finishing elevated areas.</u>

Prohibiting first floor enclosures in the floodplain would discourage finishing areas below the BFE and storing valuables and hazardous materials below BFE. This would address risk to new structures and elevated structures by ensuring that parts of the building likely to flood would sustain minimal damage in a flood event. It would also address ecological risk by limiting hazardous materials in potentially flooded areas

Risk addressed:

- Risk to new structures
- Ecological risk

This change would reduce flood damages, but would require enforcement to insure that an elevated area is not enclosed in the future.

Jurisdictions that adopt this recommendation would receive CRS credit up to 300 points.

<u>Recommendation 5 - Require a lower threshold for substantial improvements.</u>

When improvements or damage repair on an existing structure hit a certain threshold (usually 50 percent), it is considered a substantial improvement. After passing this threshold, the structure must comply with current regulatory standards. Lowering the threshold at which a structure triggers this regulation would address risk of flood damage to existing structures that have been damaged by flooding in the past.

Risk addressed:

- Risk to existing structures and property

This approach would lead to reduced flood damages by bring buildings up to code sooner and would allow property owners access to insurance money to be used as match for a grant to comply with code requirements. However, this recommendation would require additional permit review effort. In the past, lowering the threshold below 50 percent would have conflicted with FEMA's Increased Cost of Compliance criteria. However, recent changes in CRS Requirements and FEMA's interpretation of the Increased Cost of Compliance criteria allow a lower threshold provided the ordinance applies the rule to all damages regardless of cause (i.e., fire, wind, earthquake, as well as flood).

Jurisdictions that adopt this recommendation would receive CRS credit up to 90 points.

<u>Recommendation 6 - Require that substantial improvements be counted cumulatively within a specific time period such as 10 years.</u>

Jurisdictions could also count improvements (recommendation 5) cumulatively. More structures would trigger the regulation and be updated to meet current regulatory standards. The regulatory work group recommends a time period of 10 years. Another option, in use by Grays Harbor County, counts cumulative improvements from the adoption of the regulation.

Risk addressed:

- Risk to existing structures and property

This approach would lead to reduced flood damages, but would require additional permit review effort and record keeping.

Jurisdictions that adopt this recommendation would receive CRS credit up to 110 points.

Recommendation 7 – Limitations on critical facilities in the floodplain.

A critical facility is any property that, if flooded, would result in severe consequences to public health and safety. Critical facilities include: structures or facilities that produce, use, or store highly volatile, flammable, explosive, toxic, or water-reactive materials; hospitals, nursing homes, and housing that contains occupants who may not be sufficiently mobile to avoid death or injury during a flood; police stations, fire stations, vehicle and equipment storage facilities, and emergency operations centers that are needed for flood response activities before, during and after a flood; and public and private utility facilities that are vital to maintaining or restoring normal services to flooded areas before, during, and after a flood.

The work group recommends that basin jurisdictions require that new critical facilities be located outside the floodplain, OR where there is no feasible alternative, require that:

- The lowest floor be elevated 3 feet or more above the BFE,
- The foundation be floodproofed,
- No toxic substance will be displaced or released into floodwaters,
- Access routes be elevated to or above the BFE.

Risks addressed:

- Risk to new structures
- Risk to existing structures and property
- Risk to health and safety
- Ecological risks
- Emergency management costs

This recommendation would reduce damage to vital public facilities, improve emergency response, ensure facilities will be operable during and after flood emergencies, and reduce pollution of floodwaters by hazardous substances. Disadvantages of this recommendation include a need for additional design and construction costs and a possible need for additional area for critical facilities.

Jurisdictions that adopt this recommendation would receive CRS credit up to 100 points

Recommendation 8 - Adopt subdivision and development regulations that avoid or minimize development in floodplains.

The work group recommends that basin jurisdictions adopt subdivision and development regulations that avoid or minimize development in floodplains. Examples include:

- Density transfers,
- Transfers of development rights,
- Bonuses for avoiding the floodplain,
- Open space subdivision design,
- Planned unit developments,
- Cluster development,
- Greenway and setback rules,
- Open space ratio credits for open space in the floodplain.

Risks addressed:

- Risk to new structures

- Risk to existing structures and property
- Ecological risks

The advantage of this recommendation is that it reduces impact to existing developments and the ecosystem. Disadvantages include land use implications and potentially reduced tax revenue because open space areas are taxed at a lower level if the total value of improvement is reduced.

Jurisdictions that adopt this recommendation would receive CRS credit between 100 and 700 points.

Recommendation 9 - Adopt low density zoning in the floodplain.

Adopting low density zoning in the floodplain reduces the number of structures in the floodplain and maintains flood storage capacity.

Risk addressed:
- Risk to new structures

This approach would reduce flood damage, maintain flood storage capacity, and protect natural and beneficial floodplain functions. Disadvantages include potential changes to existing land use patterns and problems with compliance with GMA requirements.

Jurisdictions that adopt this recommendation would receive CRS credit based on the number of residences allowed per acre, up to 600 points.

Recommendation 10 - Adopt the current version of the Department of Ecology's Stormwater Manual.

In adopting the current version of the Department of Ecology's Stormwater Manual, codes should specify the current version of the manual as opposed to a specific date to allow an automatic update when new manuals are issued.

Risks addressed:
- Risk to existing structures and property
- Risk to new structures
- Ecological risks

Advantages include reduction in downstream storm peaks, slower surface water runoff and reduced downstream storm peaks, reduced pollution of flood water, and reduced public costs from flooding. However, this potentially would require larger detention and treatment facilities.

Jurisdictions that adopt this recommendation would receive CRS credit up to 115 points.

Recommendation 11 - Include floodplain protection in the Critical Areas Regulations or adopt floodplain regulations as part of the Critical Areas Regulations.

Risk addressed:
- Ecological risks

This approach recognizes that floodplains provide natural and beneficial functions. If regulation of floodplains falls under Critical Area Regulations, reasonable use exemptions and permits will apply. This approach would have land use implications.

Jurisdictions that adopt this recommendation may receive CRS credit up to 40 points.

Recommendation 12 - Adopt wetland and stream buffers that protect the natural and beneficial functions of wetlands and streams.

Buffer widths should be based on best available science and the type and intensity of human activity in the area and be consistent with the recommendations of the Departments of Ecology and Fish and Wildlife.

Risks addressed:

- Ecological risks
- Risk to new structures
- Risk to existing structures and property

This approach would reduce flood damage, maintain flood storage capacity, and provide natural and beneficial functions. It would have land use implications. This regulation is already required by the Growth Management Act.

Jurisdictions that adopt this recommendation may receive CRS credit up to 40 points.

Recommendation 13 - Restrict activities allowed in wetland and stream buffers to those that do not increase impervious surfaces.

Risks addressed:

- Risk to new structures
- Risk to existing structures and property
- Ecological risk

Advantages to this approach are that it would reduce flood damage, minimize the increase in runoff/flood peaks, maintain flood storage capacity, and protect natural and beneficial functions. The disadvantage is that it would have land use implications.

Recommendation 14 - When Shoreline Management Programs are updated, incorporate Shoreline Management Program guidelines for flood hazards.

Risks addressed:

- Risk to new structures
- Risk to existing structures and property
- Ecological risks

This approach would provide natural and beneficial functions and maintain flood storage capacity.

Recommendation 15 - Include “associated wetlands” as part of the shoreline management zone.

Associated wetlands are those wetlands that are in proximity to rivers or streams that are subject to the Shoreline Management Act and either influence or are influenced by such waters. Factors used to determine proximity and influence include but are not limited to: location contiguous to a shoreline waterbody, presence of a surface connection including through a culvert, location in part or whole within the 100 year floodplain of a shoreline, periodic inundation, and/or hydraulic continuity.

Including associated wetlands as part of the shoreline management zone would address ecological risk by protect natural and beneficial functions and maintaining flood storage capacity.

Risk addressed:

- Ecological risks

This approach would have land use implications.

Jurisdictions should be eligible for more CRS credits for open space, buffers, etc.

“Ideal” Recommendations

The regulatory work group has identified five recommendations that would provide greater benefits to citizens and structures in the basin, but that may not be acceptable for some jurisdictions. The work group still recommends these regulatory changes, but acknowledges that they are ideals. “Ideal” recommendations may be implemented in some jurisdictions but not in others. Jurisdictions could also take smaller steps toward these recommendations over time.

“Ideal” Recommendation 1 - Require compensatory storage for fill in the floodplain. Consider a 1:1 or 1.5:1 requirement for storage.

Risks addressed:

- Risk to new structures
- Risk to existing structures and property

This approach would offset the loss of flood storage capacity and reduce downstream impacts. However, it would require additional design and construction costs as well as additional land area to implement. Compensatory storage may be effective in all situations, but may work on specific sites.

The City of Centralia has included this requirement in its latest floodplain management regulations.

Jurisdictions that adopt this recommendation would receive CRS credit up to 80 points.

"Ideal" Recommendation 2 - Adopt a zero-rise policy in the floodplain.

A zero-rise policy would mandate that development proposals and alterations shall not reduce the effective base flood storage volume or conveyance capacity of the floodplain.

Risks addressed:

- Risk to new structures
- Risk to existing structures and property

This approach would reduce the impacts of lost conveyance capacity on structures upstream of a project and would reduce downstream impacts by requiring the mitigation of lost floodplain storage. However, it would require additional design and construction costs as well as additional land area to implement. It would also require additional regulatory review.

No jurisdictions in the Chehalis River basin have adopted this requirement. King County includes this in its floodplain regulations as a conveyance standard.

Jurisdictions that adopt this recommendation would receive CRS credit up to 200 points.

"Ideal" Recommendation 3 - Restrict development in the floodplain, requiring all development proposals to acquire a special permit or reasonable use exception.

Risks addressed:

- Risk to new structures
- Risk to existing structures and property
- Ecological risk

The review associated with a special permit or reasonable use exemption allows jurisdictions to more specifically regulate the type and location of development in the floodplain. This approach would maintain flood storage capacity, but would require additional regulatory review and additional cost to developers.

Thurston County and the Chehalis Tribe use this approach to managing development in the floodplain.

"Ideal" Recommendation 4 - Require new streets in the floodplain to be at or above base flood elevation

Risks addressed:

- Health and safety
- Emergency management costs
- Reduced risk to utilities located within the public right-of-way

It would allow emergency vehicle access during flood events. Disadvantages include additional construction costs and the possibility that roads could act as dikes unless properly designed to allow water to pass through. This recommendation may be less feasible in rural areas.

Jurisdictions that adopt this recommendation would receive CRS credit up to 100 points.

"Ideal" Recommendation 5 - Prohibit the storage of hazardous materials in the floodplain or require that such materials be stored above the flood protection elevation for residential structures.

Risks addressed:

- Health and safety
- Ecological risk
- Emergency management costs

The advantage this approach provides is reduction of pollution of floodwaters. The disadvantage is that it would be difficult to enforce.

Lewis County prohibits storage of hazardous materials in the floodplain and Thurston County requires that they be stored 2 feet above BFE.

Next Steps

The regulatory work group will present these recommendations at the January 21, 2010 work session for Flood Authority review and discussion. The recommendations will then become part of the revised Comprehensive Flood Hazard Management Plan.

The Flood Authority can recommend these regulatory changes to its member jurisdictions. Member jurisdictions should carefully consider these changes when they update their regulations. When a sustainable governance structure, such as a Flood Control District or Flood Control Zone District, is formed, it will have a greater ability to encourage member jurisdictions to adopt recommended regulations.

Acronyms

The following acronyms were used in this document.

BFE	base flood elevation
CRS	Community Rating System
FEMA	Federal Emergency Management Agency
NFIP	National Flood Insurance Program