Mid-Coast Water Resources Characteristics

Ecology

Version 2

Mid-Coast Water Planning Partnership

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2.5.1 Introduction

This report describes the ecology in the Mid-Coast, which includes the relationships between living organisms, including humans, and their physical environment. Thus, ecology focuses on interactions between natural processes, physical processes (e.g., geology and hydrology), and human management practices. This report focuses on the ecology of aquatic habitats.

The Mid-Coast Place Based Planning Partnership (Partnership) has created this report to help develop a common understanding of water resources characteristics, uses, and needs in the Mid-Coast region. The contents of this report are based on best available information. This report is part of a larger report that builds a foundation of understanding of the ecology, water quality, water quantity, and water-related built systems in the Mid-Coast with the purpose of helping balance the instream and out-of-stream water needs in the region.

Given that ecology is directly tied to water quantity, water quality, and built systems, readers of this report are encouraged to read the Water Quantity, Water Quality, and Built Systems reports of the Mid-Coast Water Resources Characteristics report for additional information.

Overall, the ecology in the Mid-Coast can be summarized as follows:

- The Mid-Coast supports a variety of habitats, with aquatic habitats being of particular interest because of their connection to human population water supply needs. Aquatic habitats include streams and springs, lakes, riparian areas, wetlands, and estuaries.
- The Oregon Conservation Strategy (ODFW[3], 2017), developed by Oregon Department of Fish and Wildlife (ODFW), identifies species of interest and areas of ecological importance in the different regions of the state. The OCS identified 12 streams or estuary habitats as areas of ecological importance in the Mid-Coast because of the diverse habitats and species they support. For example, the Siletz Watershed has the only coastal origin population of summer steelhead in Oregon.
- Aquatic species of interest in the Mid-Coast include seven species of salmon, green and white sturgeon, beaver, and three species of lamprey. The seven salmonids are: coho, chum, fall chinook, spring chinook, winter steelhead, summer steelhead, and sea-run cutthroat. Oregon coast coho salmon is listed as threatened under the Endangered Species Act and large portions of the Mid-Coast are designated as critical habitat for coho. Green sturgeon also is listed as threatened within the Southern Distinct Population Segment, which includes Yaquina Bay.
- Salmon are considered a keystone species in the Mid-Coast because of their proportionally large influence on other plant and animal species. Salmon also serve as an indicator species for habitat health because they require a diverse range of quality habitats throughout their lifecycle that other species also require.
- Sources of habitat degradation include: stream channel simplification and incision, warm stream temperatures, altered streamflow timing and watershed function, and turbidity related to peak streamflow. Other sources of habitat degradation include toxic

and non-toxic pollutants (ODEQ, 2015). These are discussed in the Water Quality Report.

- Numerous aquatic habitat restoration efforts have occurred in the Mid-Coast and have focused on: increasing stream channel complexity, reducing fine sediment inputs and summer water temperature, addressing fish passage barriers, and encouraging formation of beaver dams or similar structures.

2.5.2 Ecology Overview

2.5.2.1 Habitats in the Mid-Coast

The Mid-Coast consists of numerous watersheds, each of which contains a variety of aquatic and terrestrial habitats. The focus of this report is on aquatic habitats given that they support biotic communities of concern and can be directly affected by surface water diversions and water quality limitations. Aquatic habitats include rivers, streams, springs, riparian areas (i.e., interface between water and land), estuaries, wetlands, and lakes.

At a landscape scale, the shape of each river basin (how confined the river valley is, the type of bedrock geology, the gradient or slope of the stream, and the local climate) determine the types of streams that occur in a particular basin. At a smaller scale, the level of stream channel complexity in each stream is an important characteristic of high quality habitat and affects the types and populations of biota that live in streams. Stream channel complexity is characterized by a diverse array of habitat features such as pools, riffles, gravel beds, and large woody debris, as well as connections between the stream channel and its floodplain and riparian area (e.g. side-channels and backwater sloughs).

To provide good habitat, streams also need good water quality, such as cool temperatures, high dissolved oxygen, and low turbidity. Temperature affects water chemistry and species survival. Healthy streams are able to maintain summer temperatures below levels that are unhealthy for the biota of interest. The main factors in moderating temperature are shade, groundwater and subsurface flow, and overall streamflow (i.e., water quantity). Streams are more vulnerable to warming when riparian areas do not provide enough shade, most or all of the streamflow is on the surface (i.e., the stream is running over bedrock), and streamflow decreases. Temperature and dissolved oxygen concentration are linked, and both parameters are critical to the reproduction and survival of anadromous fish.

Riparian habitats are the upland areas immediately adjacent to streams. Healthy riparian habitats have woody plants that stabilize banks, contribute large woody debris, contribute food supply for instream species, and provide shade that reduces stream temperature fluctuations. Common riparian vegetation in the Mid-Coast includes a number of conifers (e.g., Douglas fir, Sitka spruce, and red cedar) and deciduous trees (e.g., big leaf maple, red alder, Oregon ash, Cascara, willows, and filbert). Floodplains are part of riparian habitats and healthy streams are connected to their floodplain, meaning that the floodplain is saturated during high streamflow events. The floodplain enables the dissipation of floodwater energy, cycling of nutrients between aquatic and terrestrial habitats, sorting of substrates, and providing refuge for aquatic species.

At the interface between freshwater and saltwater are estuary habitats, which support diverse plant and animal species because of the dynamic environment. Estuary habitats provide an important freshwater-saltwater transition area for salmon during smolting (i.e., adaptation to saltwater). Estuaries also continuously cycle sediments and nutrients as a result of tides and storm events. The Mid-Coast primarily has two types of estuaries: drowned river mouth and tidally restricted coastal creek. Drowned river mouth estuaries are river valleys that flooded about 10,000 years ago from sea level rise, and tidally restricted coastal creek estuaries are streams that discharge directly into the ocean and experience inputs of ocean water during high tides.

Wetlands habitats can vary considerably across the landscape given that wetlands are characterized as areas with saturated (hydric) soils during periods of the year and plants adapted to wet environments (hydrophytes). Wetlands support aquatic and terrestrial species. The main types of wetlands in the Mid-Coast are: aquatic beds, marshes, peatlands, wet prairies, scrub swamps, and forested swamps.

Lakes in the Mid Coast provide habitat for fish, wildlife, and riparian and aquatic species. They also support recreational, municipal, and industrial water uses. The largest lakes in the Mid Coast are Devil's Lake, a natural lake located near Lincoln City, Valsetz Lake, which is formed by Valsetz Dam on the South Fork Siletz River, Olalla Reservoir, which is formed by Olalla Dam on Olalla Creek, and Newport Reservoir, which is formed by Big Creek Dam on Big Creek (Atlas of Oregon Lakes). Lakes are dynamic ecosystems that are constantly changing in physically, chemically, and biologically. Lakes are sensitive to excess thermal load and nutrients that change aquatic species abundance and composition and affect fish and wildlife species (Beckham, Dow, & Hepp, 1975).

2.5.2.2 Habitat Degradation and Restoration

Types of habitat degradation affecting aquatic habitats in the Mid-Coast include: stream channel simplification and incision, warm stream temperatures, altered streamflow timing and watershed function, excess turbidity at periods of peak streamflow, and impairments or barriers to fish passage. Stream channel simplification and incision can arise from actions such as removal of riparian vegetation, removal of large woody debris from streams, and channelization of streams. Historical land use practices are the source of stream channel simplification and incision in many areas. Warm temperatures can arise from lack of riparian vegetation, reduced streamflow, and stream channel simplification. Altered streamflow timing can result from land management practices and streamflow withdrawals, both of which affect how water moves through the landscape (i.e., watershed function). Land management practices can affect the rate at which fine sediments from the landscape are transported to streams and also can affect the magnitude of peak flows, which may combine to increase turbidity to levels that negatively affect wildlife and impair or prohibit water treatment for human consumption.

Habitat restoration projects are occurring throughout the Mid-Coast to improve habitat conditions and reduce further degradation. These projects focus on activities such as: adding large woody debris into streams, increasing fish rearing areas off the main channel's streams, supporting gravel substrate used for spawning and deep pools, increasing streamflow during key times of the year for fish species and in the summer to reduce settling of fine sediment inputs, maintaining riparian vegetation for shading and filtering, and lower water

temperatures, improving roads to reduce sediment inputs, and encouraging beaver dam formation.

2.5.2.3 Species of Interest and Habitat Needs

The Mid-Coast has many species of interest, which for the purposes of this report, are limited to aquatic species that spend at least part of their life cycle in water and are listed by state or federal agencies for protection or monitoring and/or identified by the Oregon Conservation Strategy (OCS) as a "species of interest." Species of salmon (i.e., salmonids) in Mid-Coast watersheds include: coho, chum, fall chinook, spring chinook, winter steelhead, summer steelhead, and sea-run cutthroat Trout. Salmonids require high-quality habitat features described in the habitats overview, such as large woody debris, deep pools, and spawning gravels. Factors negatively impacting these salmonids include: low water availability (particularly in late summer and fall), impaired water quality (e.g., warm stream temperatures), and fish passage barriers (e.g., undersized culverts). Green and white sturgeon are also species of interest in the Mid-Coast. Sturgeon are especially sensitive to estuary conditions, where they congregate during summer and fall. Sturgeon spawn in freshwater several times during their adult life, so adults and juveniles are also sensitive to freshwater conditions, including stream temperature and gravel conditions (NOAA[2], 2017).

Several species of lamprey (Pacific, River, and Brook) are also species of interest and require many of the same habitat characteristics as salmonids. Beavers are yet another species of interest because of their ability to build dams and create ponds that provide habitat for other wildlife, promote nutrient cycling, moderate flows, and recharge the aquifer, among other benefits. Other species of interest are invasive species. Invasive species are non-native species that have a disproportionate effect on the ecosystem that is typically negative, such as outcompeting and displacing native species and reducing species diversity. A more complete list of species of interest is included in **Appendix F**.

2.5.2.4 Ecological Summaries by Drainage Area

The Oregon Conservation Strategy (OCS) has identified areas of ecological importance in the Mid-Coast. This report considers areas of ecological importance to include those identified by OCS as well as areas for which the Mid-Coast Watersheds Council has completed a Limiting Factors Assessment and Restoration Assessment. Identifying areas of ecological importance does not assume priorities for restoration, which the Partnership has not yet established. **Exhibit 1** presents notable ecological characteristics of the major watersheds in the Mid-Coast.

Exhibit 1. Ecological Characteristics of Major Drainage Areas in the Mid-Coast

Watershed	Miles of Streams	Areas of Ecological Importance	Species of Interest	Sources of City Water Supplies
Salmon River Drainage Area	104.5	• Salmon River Estuary	• Pacific Lamprey • Chum • Fall Chinook • Coho • Winter steelhead • Cutthroat trout	
Siletz Bay-Ocean Tributaries		• Schooner Creek • Drift Creek • Devil's Lake Watershed • Moolack Frontal	• Coho • Fall Chinook • Pacific Lamprey • Winter Steelhead	City of Lincoln City: Schooner Creek Kernville-Gleneden-Lincoln Beach Water District
Siletz River Drainage Area	458	• Siletz Bay • Siletz River (lower, upper, and middle) • Mill Creek	• Fall Chinook • Spring Chinook • Chum • Coho • Summer Steelhead (Only coastal origin population of summer steelhead in Oregon) • Winter Steelhead • Cutthroat Trout • Pacific Lamprey • Green Sturgeon • White Sturgeon	City of Newport: Siletz River City of Toledo: Siletz River and Mill Creek Watershed City of Siletz: Siletz River
Depoe Bay-Ocean Tributaries		• Depoe Bay Estuary • Depoe Bay Area	• Coho • Winter Steelhead	
Yaquina River Drainage Area	294	• Yaquina River (upper and lower) • Mill Creek • Big Elk Creek Yaquina Bay	• Fall Chinook • Chum • Coho • Pacific Lamprey • Winter steelhead • White Sturgeon • Green Sturgeon	
Beaver Creek-Ocean Tributaries		• Beaver Creek Estuary • Beaver Creek Watershed	• Fall Chinook • Coho • Pacific Lamprey • Winter Steelhead	
Alsea River Drainage Area	517	• Alsea River Estuary • Alsea River Watershed (designated as critical habitat for coast coho) • Alsea River • Lobster Creek • Drift Creek	• Fall Chinook • Spring Chinook • Chum • Coho • Pacific Lamprey • Summer Steelhead • Winter Steelhead • Green Sturgeon • Coastal cutthroat	City of Waldport: Eckman Creek, North and South Weist Creeks
Yachats River-	58	• Yachats River Estuary	• Fall Chinook • Coho	City of Yachats: Salmon and Reedy Creek

Watershed	Miles of Streams	Areas of Ecological Importance	Species of Interest	Sources of City Water Supplies
Ocean Tributaries		• Yachats River (designated as critical habitat for coast coho)	• Pacific Lamprey • Winter Steelhead • Coastal Cutthroat	

2.5.3 Ecology in the Mid-Coast

2.5.3.1 Approach

2.5.3.1.1 Report Objectives

- To gain a general understanding of ecology in the study area
- To have an understanding of species requirements and existing habitat quality, such as:
  - Species and areas of ecological importance
  - Species in decline
  - Major sources of habitat degradation
  - Habitat restoration priority areas
- To identify data gaps
- To ensure that potential water management solutions consider ecological needs
- To identify efforts to improve species populations and habitat
- To identify invasive species of concern

2.5.3.1.2 Report Organization

This report begins with a general description of aquatic, riparian, and estuary habitats and their characteristics as well as a summary of habitat assessments that examine the current status of habitat elements and overall ecological function. After introducing the major habitats in the Mid-Coast, this report provides an overview of the biological requirements of fish in the Mid-Coast as well as the factors that affect fish health. The species of interest, areas of ecological importance, restoration, monitoring, and funding needs are discussed for the eight major drainage basins in the Mid-Coast and major estuaries. . Data gaps are identified and summarized to inform future research priorities and recognize limitations of available information.

2.5.3.1.3 Report Data Sources (See Appendix A)

2.5.3.1.4 Terminology (See Appendix B)

2.5.3.1.5 Study Area

The Partnership defines the Mid-Coast as eight major drainage basins. From north to south, these include Salmon River Watershed, Siletz-Bay Ocean Tributaries, Siletz Watershed, Depoe Bay-Ocean Tributaries, Yaquina Watershed, Beaver Creek-Ocean Tributaries, Alsea Watershed, and Yachats Watershed. In addition to spanning most of Lincoln County, the study area extends northward into Tillamook County and eastward into portions of Benton County and Polk County, and Linn County to include the upper Salmon River, upper Siletz, and upper Alsea

River watersheds. The Partnership has prioritized the understanding of water resource characteristics of the creeks that flow directly into the Pacific Ocean and that serve as current or potential public water systems. The Water Quantity report contains more information about surface water and groundwater resources.

2.5.3.2 Relevant Regulations Overview

2.5.3.2.1 Land Use Overview

The Mid-Coast is approximately 96.5 percent forested (NRCS, 2005). The majority of urban development along the coast and rural development along the valley floors of major rivers (see Exhibit 7 in the Context report). The coastal areas of the Mid-Coast have multiple land uses, including urban areas, commercial areas, and residential areas. The Yaquina Bay area in the City of Newport is the most developed estuary in the Mid-Coast. Lowland areas along the Salmon, Siletz, Yaquina, Alsea, and Yachats Rivers also have multiple land uses, including rural residential development and farming. Approximately half of the forested areas are privately owned, the majority of which is managed as industrial forestland. Public forestlands in the Mid-Coast are owned by the U.S. Forest Service (USFS), U.S. Bureau of Land Management, and Oregon Department of Forestry. The Confederated Tribe of Siletz Indians owns forest land in the middle portion of the Siletz Watershed (NRCS, 2005).

2.5.3.2.2 Oregon's Statewide Planning Goals and Guidelines: Estuaries

Goal 16 of Oregon's Statewide Planning Goals and Guidelines deals with estuarine resources (OAR 660-015-0010(1)). The goal directs the Land Conservation Development Commission to work with local governments and state and federal agencies to specify the level of development allowed to occur within the state's estuaries. Goal 16 also requires inventories of each estuary that include information on the physical, biological, social, and economic resource of each estuary. Comprehensive plans are created for estuaries that describe development limits, classify each estuary into management units, and consider cumulative impacts of development. Goal 16 outlines three major classifications for estuaries: (1) natural estuaries, which are managed to preserve natural resources, (2) conservation estuaries, which are managed to conserve natural resources and benefits, and(3) development estuaries, which are designed to provide navigation, commercial, and industrial water-dependent uses. For a more detailed list of estuary classifications, see Oregon Revised Statutes Division 17: Classifying Oregon Estuaries (OAR § 660-015-0010).

2.5.3.2.3 Endangered Species Act (ESA)

The purpose of the federal ESA is to "protect and recover imperiled species and the ecosystems upon which they depend" (USFWS[2], 2017). The focus on ecosystems means that the ESA has an important influence on water management when threatened or endangered species require certain water quality, quantity, and timing of flows for their lifecycle. An endangered species is "any species which is in danger of extinction throughout all or a significant portion of its range" (ESA §3(6)). A species listed as "threatened" is "likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range" (ESA §3(20)). Section 9 of the ESA prohibits the "take" of threatened and endangered species, which means to "harass,

harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect" (ESA§3(19)). Section 7 of the ESA requires federal agencies to consult with U.S. Fish and Wildlife Service (USFWS) and/or National Marine Fisheries Service (NMFS) when they believe that a threatened or endangered species may be present in an area where they are carrying out a project that includes the expenditure of any federal funds, federal licenses, or federal contracts. If a listed species is present within the action area of a project, the action agency will determine if the listed species is likely or not likely to be adversely affected by the project or its critical habitat. If the action agency determines the project is not likely to adversely affect listed species, USFWS and/or NMFS will issue a letter of concurrence to the action agency. However, if the action agency determines a listed species or its critical habitat will be adversely affected by a project, then the services will issue a Biological Opinion (BiOp). The biological opinion includes an incidental take statement that discusses the amount of take anticipated, the effect of take, reasonable and prudent measures (as appropriate), and terms and conditions to minimize adverse impacts. An act causes jeopardy when it is likely to decrease the likelihood of both survival and recovery of a listed species in the wild by reducing the reproduction numbers, or distribution of that species (50 CFR §402.02). BiOps may establish instream flow requirements, ramping rates for dam operations, fish passage, or other actions to avoid harming threatened and endangered species. Section 10 of the ESA allows for states, counties, local governments, and private landowners to apply for an incidental take permit with the submission of a habitat conservation plan. Habitat Conservation Plans (HCP) are designed to offset harmful effects a proposed activity might have on a listed species. Conservation plans can provide additional conservation benefits and flexibility for landowners by including planning for unlisted species and the plans can provide partnership opportunities between local governments and the private sector.

The Bull Run Water Supply Habitat Conservation Plan is an example of an HCP related to public water supply and can be found on Portland Water Bureau's website here: https://www.portlandoregon.gov/water/46157

Oregon's Sensitive Species Rule (OAR 635-100-0040) also provides protection for species at the state level. The State keeps a list of Threatened and Endangered Species as well as a list of "Sensitive Species." Sensitive species are defined as having "small or declining populations, are at-risk, and/or are of management concern," (ODFW, 2018). Species may also be listed as "Sensitive-Critical," if they "current or legacy threats that are significantly impacting their abundance, distribution, diversity, and/or habitat [and] they may decline to the point of qualifying for threatened or endangered status if conservation actions are not taken," (ODFW, 2018). The Sensitive Species List lists species based on their "Species Management Units" (SMU) or "Evolutionarily Significant Units" (ESU). The Sensitive Species list is primarily a non-regulatory tool that is used to promote and guide conservation actions (ODFW, 2018).

2.5.3.3 Overview of Habitats

2.5.3.3.1 Stream Habitats

Healthy stream habitats in the Mid-Coast are characterized as having: cool temperatures, high dissolved oxygen, low turbidity, riparian vegetation, and stream channel complexity. Pools, riffles, and large wood provide shelter, feeding habitat, and spawning habitat for various aquatic species. A diversity of habitat is important because different species favor different habitats and a single species may have different habitat needs depending on its life history

stage. For example, some higher-gradient streams in the Mid-Coast support steelhead populations while some low-gradient streams are preferred by coho salmon.

Stream health benefits from watersheds that store precipitation in springs, wetlands, beaver ponds, and in the streambanks/floodplains. In healthy streams, streamflow often overtops streambanks during flood events. When this occurs, floodwaters are slowed by streamside vegetation, providing refuge for aquatic species from high flows. Finer sediments, larger cobble, and boulders suspended in floodwaters are deposited in floodplains and store water that is later released into the stream channel.

Stream health also benefits from a diversity of disturbances in the watershed, such as fire, debris slides, wind storms, and floods that increase habitat diversity. Along the riparian corridor, there may be patches of young deciduous trees (e.g., red alder, vine maple, and big leaf maple) and stretches of large, tall conifers (e.g., hemlock, Douglas fir, and cedar). Floods move large substrate and large woody debris from upper reaches and tributaries to lower reaches within the watershed and undercut some banks, causing large trees to topple into the channel.

Topography and Stream Channels

Local geology influences the natural variability in substrate. For example, geology affects the presence of bedrock substrate. Watersheds that are dominated by sandstone and siltstone will tend to have finer sediments than watersheds that are dominated by volcanic rocks, such as basalt. The slope of the watershed also influences substrate size and a stream's interaction with the surrounding landscape. The upper portions of coastal watersheds are steeper, have narrow valley walls, and have streams that are more likely dominated by boulders and large cobbles and receive large inputs of woody debris from surrounding steep slopes. In contrast, lower portions of coastal watersheds are more gradual and receive large woody debris from both upstream and the surrounding landscape. Lower watersheds tend to have fewer boulders, more fine substrates, and wider valley bottoms.

Landslides and Stream Channel Complexity

Healthy, high-functioning streams in the Mid-Coast region contain numerous logs and/or boulders, which promote stream channel complexity and sediment sorting (to hydrologists, all the mineral particulates and chunks carried by a streams is "sediment," whether it is silt, sand, gravel, cobbles, or even boulders). Large wood and sediment is delivered to the stream channel by landslides and from the riparian areas through stream channel migration. Wood and boulders breakup and redirect streamflow, creating pockets of high velocity and low velocity flow. Because the sediment that the stream carries is dependent on water velocity to keep it moving, breaking the flow into segments with different velocities causes these materials to sort out by size, based on velocity (for instance, boulders move only in the strongest currents during high-water events). Sorted sediments provide different habitats for stream animals, including aquatic insects and other invertebrates, and as spawning habitat for fish.

Through time, the presence of large logs and boulders tends to force the stream to establish multiple channels (to become "braided"), which further improves habitat, by dividing the channel onto numerous distinctive microhabitats, including pools of several types, glides, and backwater alcoves. This also divides the stream channel substrate into microhabitats with boulders in the steepest riffles, gravel beds and bars where the current velocity begins to decrease, and fine sediments in pool bottoms and off-channel shallows.

In forested areas of western Oregon, typically about half of the large wood in streams comes from upslope areas via landslides, and half from adjacent riparian areas, the latter typically by the toppling of trees undercut by migrating stream channels. This ratio varies depending on topography: on flat valley floors more large wood comes from the riparian area and in steep-walled canyons more large wood comes from upslope areas. When the supplies of these materials are reduced, stream channels become more simplified and can become incised, offering fewer ecological benefits.

Stream Channel Incision

When a stream channel becomes incised, the flow tends to coalesce into a single powerful stream that moves the accumulated streambed downstream and incises the channel deeper and deeper within its banks. Pools and off-channel habitats are reduced, and eventually the stream may incise down to bedrock. Channel incision can cause a stream to lose access to its floodplain, meaning that during high flow events the channel does not overtop its banks and bring sediment and nutrients to the floodplain. Incised channels also tend to be flashier (responsive to precipitation events) because flows are confined to their channel, rather than dissipated across the floodplain. Removal of large woody debris can increase bedload transport (the movement of large bedrocks) during high flow events.

Stream Temperature

Stream temperature affects water chemistry and species survival. Healthy streams are able to maintain summer temperatures below levels that are unhealthy for the biota of interest.

The main factors moderating temperature are shade, hyporheic flow (i.e., cool groundwater discharges into the stream), and streamflow (i.e., water quantity). In streams, the extent to which solar radiation heats streams is affected by type of riparian vegetation, topography, season, flow, channel form, as well as natural disturbances (e.g., fire, windthrow, storms), and human activities. Bedrock substrates tend to be warmed by air temperatures faster than gravel substrates, which interact with subsurface flow (Garono & Brophy, 2001). Deep pools that are fed by cool, subsurface flow provide good habitat for salmon. Riparian vegetation, large woody debris, and gravel substrates that connect groundwater with surface water also help to reduce stream temperatures. Water temperature is also volume-dependent, in the sense that as flows decrease in summer, the same amount of exposure to direct sunlight and high ambient air temperatures warms them more rapidly. The impact of reduced streamflow, such as from drier weather conditions or water withdrawals, on stream temperature vary locally depending on: groundwater inputs, base flow volume, riparian vegetation, and stream channel shape. Temperature and dissolved oxygen concentration are linked, and both parameters are critical to the reproduction and survival of anadromous fish. Stream temperature affects biological triggers for salmon migration, spawning, and egg hatching. High stream temperatures and low dissolved oxygen, as well as high turbidity can threaten fish survival at various life stages.

In lakes, water temperature is influenced by lakeside vegetation, lake depth, and lake elevation. Temperature in lakes stratifies, creating layers of water with similar temperature gradients. This happens as cold water sinks and warmer water floats. Temperature stratifications do not always follow this simple pattern, however, and depend on seasonal temperatures and lake depth (USGS, 2017).

Aquatic Habitat Inventories

Several different agencies and organizations create benchmarks for aquatic habitat to assess the overall quality of the habitat (see **Exhibit 2**). **Appendix C** provides a more detailed explanation of habitat benchmarks and monitoring in the Mid-Coast. Different benchmarks are partly a result of different agency regulations, land use jurisdictions, and land ownership types. The quality of stream habitat affects all riparian and aquatic species and is a potential factor influencing the survival and recovery of species of concern.

Example Measures of Overall Aquatic Habitat Health

- Presence, size, and amount of large wood in the stream channel
- Density of deep pools
- Amount of stream area comprised of pools
- Percent of substrate area with fine sediments in riffles
- Percent of substrate area with gravel in riffles
- Presence of invasive species
- Presence of large conifers in riparian area
- Percent of the stream channel with canopy shade cover from riparian trees

Exhibit 2. Aquatic Habitat Inventory Organizations and Guiding Documents

Organization	Guiding Documents	Monitoring
Oregon Department of Fish and Wildlife; Oregon Watershed Enhancement Board	Oregon Plan for Salmon and Watersheds Oregon Coastal Salmon Restoration Initiative; Oregon Department of Fish and Wildlife	Aquatic habitat and species monitoring; designation of "core areas" that support salmon habitat; designate benchmarks for habitat suitability
United States Forest Service	Forest Ecosystem Management Assessment Team	Aquatic habitat inventories; identify watersheds of ecological importance on USFS or BLM Land.
NOAA Fisheries-Northwest Fisheries Science Center (NWFSC)	NWFSC Strategic Science Plan; Western Regional Action Plan, NOAA Fisheries Climate Science Strategy; Final ESA Recovery Plan for Oregon Coast Coho Salmon	Research divisions: Conservation Biology; Environmental and Fisheries Sciences; Fish Ecology; Fishery Resource Analysis and Monitoring. Research themes: habitats, species, ecosystem science, and seafood safety.

2.5.3.3.2 Riparian Habitats

Riparian habitat is at the interface between land and a river or stream. Plant and animal species may use all riparian habitats, or may specialize on a particular geomorphic surface within the riparian area. In their natural state, rivers are constantly changing, eroding surfaces, and depositing material to create new surfaces. Similarly, vegetation communities in riparian areas change as they become inundated by flood waters, dried out because of a shift in the direction of streamflow, or fall into the stream channel from bank erosion. Upland and riparian habitat influences instream health, and upstream health influences downstream characteristics.

Riparian Vegetation

Plant habitats and communities along the river margins and banks are called riparian vegetation and are characterized by hydrophilic plants. Riparian areas tend to have higher plant diversity, including species that require streamside conditions and are not found in upland areas. Large conifers as well as deciduous trees along stream banks provide shade, which stabilizes stream temperatures. Large conifers in particular contribute to the future addition of large wood in the stream channel. Common riparian vegetation in the Mid-Coast includes both deciduous trees and conifers, as well as native and nonnative shrubs and grasses, and sometimes invasive plants adapted to riparian habitats. Riparian habitats dominated by invasive species (such as Himalaya Blackberry or Asian Knotweed), tend to provide fewer ecosystem benefits, less diverse habitats, and may exhibit poorer water quality (ODA, 2000).

Marine Nutrient Transport.

Salmon and other anadromous fish are important for sport and commercial fishing, but they also play an important ecological role in nutrient transport. . As they migrate upstream to spawn and die, they transport the biomass they accumulated at sea into their spawning streams (Gende et al., 2002). They become food for a wide range of terrestrial and freshwater animals, and "fertilize" the surrounding forest. Studies using stable isotopes have demonstrated that these marine-derived nutrients augment the growth of forest vegetation in riparian areas and well upslope (Helfield and Naiman 2001, cited by Gende et al., 2002). Thus, large salmon returns are ecologically beneficial, even when those returns are far larger than the minimum necessary to provide eggs for the next generation of salmon.

2.5.3.3.3 Estuary Habitats

Estuaries provide a transition zone between freshwater and saltwater, and as a result contain unique habitats that support a diversity of plants and animals adapted to a balance of saltwater and freshwater. Estuaries also serve to filter pollutants, stabilize shorelines, and buffer communities from storm surges. Estuaries are especially important for salmon during key points in their lifecycle.

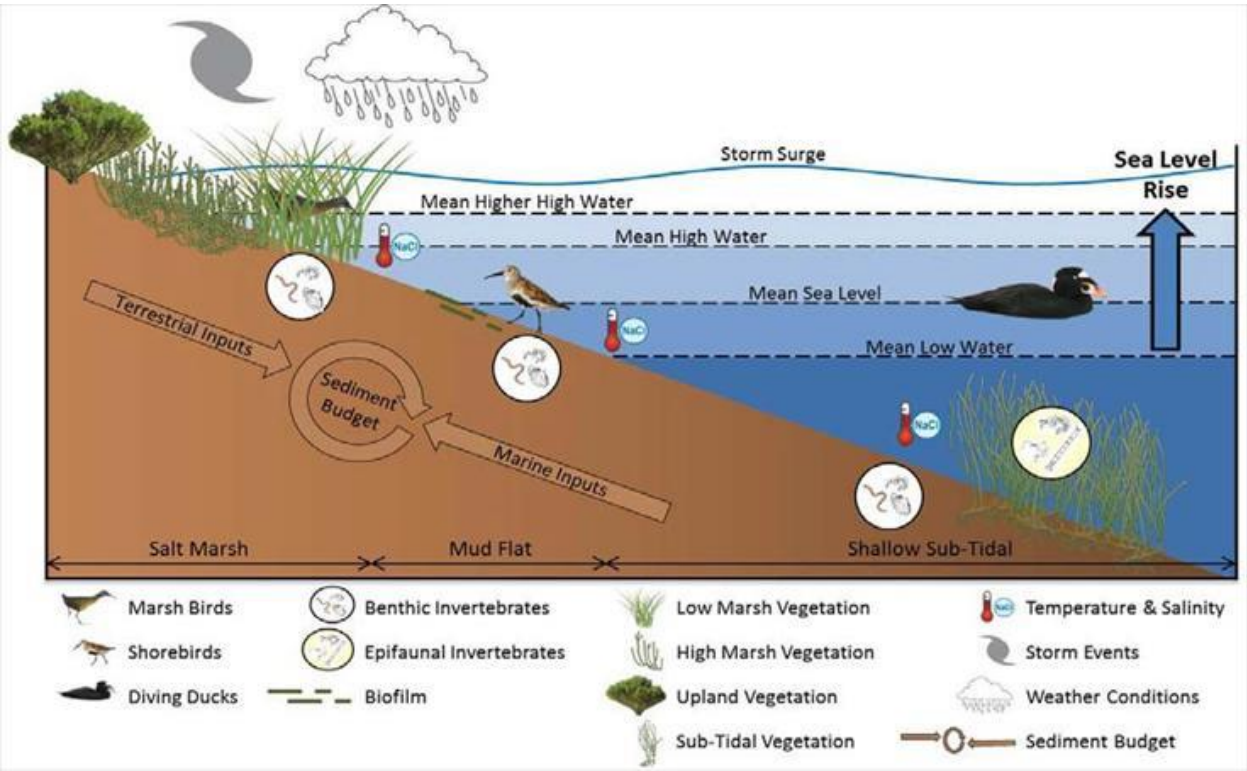
Estuary habitats are influenced by a number of variables, including:

- Watershed size
- Geology
- Ocean tides
- Freshwater-saltwater mixing

In some estuaries, saltwater and freshwater mix extensively due to tidal activity, whereas in other estuaries there is less saltwater-freshwater mixing. Water circulation in estuaries transports organisms, circulates nutrients and oxygen, and transports sediments and wastes (NOAA[5], 2017). Freshwater is less dense than saltwater, causing freshwater from coastal streams to float on salt water. The extent of mixing depends on "the direction and speed of the wind, the tidal range (the difference between the average low tide and the average high tide), the estuary's shape, and the volume and flow rate of river water entering the estuary," (NOAA[5], 2017). While estuaries are dynamic systems that change with high tide and low tide, they are also sensitive to changes. Plant and animal communities in each estuaries are adapted to a specific range of salinity. Changes to sea level, ocean currents, or freshwater inputs from streamflow can alter the balance of saltwater and freshwater and sediment dynamics, impacting plant and animal communities.

Estuary habitats are dynamic, and change with the tides, storm events, and sediment inputs and outputs (see **Exhibit 3**).

Exhibit 3. Dynamic Elements of Estuary Habitats



Source: USGS

Types of Estuaries

There are several different ways to classify estuaries. Classifications are made based on soil type, plant communities, bottom-dwelling or floating animal communities, geology and water circulation, or a combination thereof. Classification by water circulation and geology are commonly used (C. Moffet, personal communication, 11/30/17).

The five main types of estuaries-classified by water circulation-include: (1) salt-wedge, (2) fjord, (3) slightly stratified, (4) vertically mixed, and (5) freshwater (Levinson, 1995; USEPA, 1993). For animations of these estuary types, visit: https://oceanservice.noaa.gov/education/kits/estuaries/estuaries05_circulation.html

1. Salt-wedge (highly-stratified): Most stratified (least mixed) of all estuaries. Occur when a rapidly flowing river discharges into the ocean where tidal currents are weak. Freshwater floats above seawater and a boundary is created with freshwater forming a wedge of saltwater below the freshwater. The location of the wedge varies based on weather and tides, (NOAA[5], 2017).
2. Fjord: Water circulation with the open ocean is restricted by a narrow sill and dense seawater seldom flows up over the sill into the estuary. Typically, only the less dense

fresh water near the surface flows over the sill and out toward the ocean. Saltwater and freshwater in Fjords remains stratified (NOAA[5], 2017).

3. Slightly-mixed: Saltwater and freshwater mix at all depths; however, the lower layers of water typically remain saltier than the upper layers. Salinity is greatest at the mouth of the estuary and decreases as one moves upstream (NOAA[5], 2017).
4. Vertically mixed: Occurs when river flow is low and tidally generated currents are moderate to strong (Ross, 1995). The salinity of water in a vertically mixed estuary is the same from the water's surface to the bottom of the estuary. Strong tidal currents eliminate the vertical layering of fresh water floating above denser seawater, and salinity is typically determined by the daily tidal stage. The estuary's salinity is highest nearest the ocean and decreases as one moves up the river, (NOAA[5], 2017).
5. Freshwater estuaries: rivers flow into large freshwater lakes (e.g. the Great Lakes) creating unique combinations of river and lake water that have unique chemical characteristics (NOAA[5], 2017).

The five major types of estuaries classified by their geology include: (1) coastal plain, (2) bar-built, (3) deltas, (4) tectonic and (5) fjords. For animations of these estuary types, visit: https://oceanservice.noaa.gov/education/kits/estuaries/media/supp_estuar04_techtonic.html

1. Coastal plain (drowned river valley): Formed at the end of the last ice age between 10,000-18,000 years ago as glaciers receded and melted and sea levels rose and inundated low-lying river valleys (NOAA[5], 2017).
2. Bar-built (restricted-mouth): Formed by sandbars or barrier islands are that are built up by ocean waves and currents along coastal areas fed by one or more rivers or streams. The streams or rivers flowing into bar-built estuaries typically have a very low water volume during most of the year. As sand bars grow, the estuary can become permanently blocked, forming a protected area called a lagoon (NOAA[5], 2017).
3. Deltas: Formed at the mouth of large rivers where sediments and silt accumulate rather than being washed away by currents or ocean waves. Over time, a complex set of channels, sand barriers and marshes form at the mouth of the river (NOAA[5], 2017). Tectonic: Formed when rapid movement of the Earth's crust causes a large piece of land to sink, or subside, producing a depression or basin. If the depression sinks below sea level, ocean water may rush in and fill it. Natural channels that drain fresh water from nearby rivers and streams into these newly formed basins may also form during this process. Tectonic estuaries are typically deep and surrounded by mountainous areas, (NOAA[5], 2017).
4. Fjord: Formed by receding glaciers that left narrow, deep channels with a shallow barrier or sill near the ocean.

More Information:

- Estuary Data Viewer (classifies estuaries by geoform, substrate, biotic, and aquatic components): http://www.coastalatlas.net/estuarymaps/
- Oregon Estuary Plan Book (1987) (overview of planning requirements, habitat classification, and individual estuary management plans): http://library.state.or.us/repository/2015/201506170951093/index.pdf

2.5.3.3.4 Wetland Habitats

Wetlands are areas where water covers the soil, or is present either at or near the surface of the soil all year or for varying periods during the year, including during the growing season. Water saturation (hydrology) largely determines how the soil develops and the types of plant and animal communities living in and on the soil. Wetlands may support both aquatic and terrestrial species. The prolonged presence of water creates conditions that favor the growth of specially adapted plants (hydrophytes) and promote the development of characteristic wetland (hydric) soils. (USEPA, 2017).

Wetlands can be influenced by local geologic conditions that provide the parent material for soils, influence groundwater chemistry, and affect wetland vegetation. Wetlands in the Mid-Coast have either organic soils (muck, mucky peats, fibrous peats, or combinations of these) that are saturated perennially or mineral soils (sand, silt, and silty loams, sandy loams, or clay loams) that may be flooded in the winter and moist or dry in the summer. The main types of wetlands in the Mid-Coast, each with unique soils and vegetation communities, are:

- Aquatic beds
- Marshes
- Peatlands
- Wet prairies
- Shrub swamps
- Forested swamps

Local wetland inventories are conducted to determine where wetlands lie within city limits to ensure that cities incorporate wetlands into their comprehensive plans. In Oregon, the Department of State Lands conducts wetland inventories and reviews wetland inventories conducted by other organizations (DSL, 2017). Local governments conduct local wetland inventories for planning and wetland protection purposes. Several local wetland inventories have been conducted in the planning area.

Local Wetland Inventories:

- Lincoln City
- Toledo
- Depoe Bay
- Waldport

More Information:

- Institute for Applied Ecology, Final Report: Yaquina and Alsea River Basins Estuarine Wetland Site Prioritization Project: Link.
- Soil type can be an indicator of wetland habitats. For more information about soils in the Mid-Coast: NRCS's Web Soil Survey[1].

[1] Make sure you have the current version of Google Earth Pro. You can download Google Earth Pro from https://www.google.com/earth/desktop/
Download the SoilWeb App for SoilWeb Earth. If this link doesn't work, go to: https://casoilresource.lawr.ucdavis.edu/soilweb-apps/ and then click on "SoilWeb Earth." Open Google Earth Pro and test to see if the soil layers display. Explore the data available by clicking on the soil types and graphs to get different soils tables, series, and lots of other useful data (such as plants and forest productivity).

For more information about estuary and wetland locations and types in the Mid-Coast: Coastal Atlas: http://www.coastalatlas.net/estuarymaps/

Upland and Other Terrestrial Habitats

There are large portions of upland habitats in the Mid-Coast that support an array of species, including state and federally listed species. The eastern portion of the Mid-Coast is largely upland habitat, containing steep, forested mountain slopes. Upland habitats are important for delivering large woody debris and sediments to stream channels. Forested upland habitats also help to absorb moisture from precipitation events and contribute to groundwater recharge and subsurface flow.

Portions of upland habitats in the Mid-Coast are late successional (old growth) mixed conifer forests, which are have been identified as a strategy habitat by ODFW. These forests have a diverse range of tree ages, including large-diameter trees, shade-tolerant species in the undergrowth, dead and downed wood, and a diversity of plants and shrubs in the understory. Sitka spruce forests occur along the coast where fog and salt spray from the ocean provide moisture. These forests tend to have deep, acidic, and well-drained soils, where a variety of trees species grows: western hemlock, western red cedar, Douglas fir, big leaf maple, red alder, and the dominant species, Sitka spruce (ODFW[3], 2017). Douglas fir forests dominate the uplands that are farther from the coast and are similar to Sitka spruce forests, but are dominated by Douglas fir.

Areas of Ecological Importance

ODFW established the Oregon Conservation Strategy (OCS) which identifies areas of ecological importance (see **Exhibit 4**). The areas identified in the OCS are large and are identified for general habitat types provided (ODFW[4], 2017).

Exhibit 4. Areas of Ecological Importance in the Mid-Coast

Areas of Ecological Importance[1]	
Location Name	**Habitat Provided**
Alsea Estuary-Alsea River	Overwintering habitat for migrating waterfowl and rearing habitat for coastal salmonids
Beaver Creek	Diverse habitat from beach to old-growth forests
Depoe Bay Area	Productive rocky shore for fish and wildlife use
Devil's Lake	Peat marsh near mouth of Rock Creek, an important coho rearing stream
Salmon River Estuary-Cascade Head	Diverse habitats; includes Cascade Head Scenic Research Area; Habitat for three threatened and endangered species
Siletz Bay	Siletz estuary provides diverse and complex habitat
Siletz River	Sandstone/basalt river system with flashy winter river flow and private forestland
Yachats River Area	Narrow river channel with wide shallow mouth at ocean; steep coastal mountains

Notes:
[1] Areas identified by the Oregon Conservation Strategy (ODFW4, 2017) Visit: http://www.oregonconservationstrategy.org/conservation-opportunity-areas/

2.5.3.3.5 Sources of Habitat Degradation

Historical and current land use practices can lead to habitat degradation and stream channel simplification. In 1997, the Oregon Plan for Salmon and Watersheds (the Plan) was established by the Oregon Legislature and Governor to organize actions to address factors that contribute to the decline in fish populations and watershed health. The Plan includes voluntary restoration actions, coordinated state and federal agency and tribal actions, monitoring, and scientific oversight (OWEB, 2005). According to the Plan, major challenges with aquatic habitat health in the Mid-Coast include high levels of silt and low levels of large woody debris in watersheds (Flitcroft et al., 2002). According to the Sixth Field Watershed Assessment completed for the Mid-Coast Watershed Council (Garono & Brophy, 2001) the main threats to aquatic habitats in the Mid-Coast include reduction in stream complexity, barriers to fish passage, reduced water quality, and reduced water quantity or alterations in streamflow. Specific factors influencing regional habitat quality and decline of salmon include: ocean conditions, land use practices, landslides, fish hatcheries, and major flood events. NMFS has also attributed human-induced factors, such as habitat degradation, water diversions, land use practices, and artificial propagation, to the decline of coho salmon. The ESA Recovery Plan for Oregon Coast Coho Salmon (NMFS, 2016) outlines four primary limiting factors for coastal listing status today: (1) reduced amount and complexity of habitat, (2) degraded water quality, (3) blocked/impaired fish passage, and (4) uncertainty that there is an adequate combination of voluntary and regulatory mechanisms to ensure success. The Partnership believes that what is good for salmon is good for other aquatic species, and also for human uses of aquatic habitat and water resources. As habitat becomes degraded, its ability to support large populations of salmon is decreased. Salmon populations in streams with water quantity or water quality limitations or simplified stream channels may be more susceptible to further habitat degradations that result in additional stress.

Stream Channel Simplification and Incision

In many Mid-Coast streams, past logging practices included logging the riparian zones right to the streambank, removing this source of wood. Current forest practices protect some of these riparian zones. As a result of past practices, in many places it will be decades before large enough trees will grow to be fully functional when they fall into the streams. Valley-bottom roads tend to intercept debris torrents, preventing delivery of upslope logs to the streams. In recent decades, forest owners have been replacing valley-bottom roads with ridge-top roads, which reduces this interception, but commonly the debris-torrent source areas have been logged recently and lack large wood to deliver to the streams. According to the Mid-Coast Sixth Field Watershed Assessment (Garono & Brophy, 2001), many small tributaries in the Mid-Coast have simplified channel structure. Some stream channels have been intentionally modified and others have been degraded due to land use practices.

Warm Stream Temperatures

Several streams in the Mid-Coast are listed as having water quality impairments because they are too warm (see Water Quality report). Warm stream temperatures can result from a lack of riparian vegetation, reduced streamflow, and stream channel simplification. Solar radiation is and groundwater inputs are important factors controlling stream temperatures. Riparian vegetation reduces solar radiation and groundwater contributes cool water to streams. In the Mid-Coast, summer streams flows are mostly based on the previous winter's precipitation, and

are affected by the capacity of the landscape to retain water from the winter into the summer. Common impairments to stream habitats, including removal of riparian vegetation, channel simplification and channel incision can reduce the local capacity of streambanks to store precipitation, leading to reduced summer flows downstream. Water quantity is also related to stream temperatures, however the impact of reduced streamflow on stream temperature vary locally, depending on groundwater inputs, base flow volume, riparian vegetation, and stream channel shape. Restoration projects that reverse incision, increase channel complexity, and restore floodplain connectivity can increase the capacity of stream banks to store precipitation into the summer, and thus increase summer streamflow and reduce stream temperatures.

Altered Streamflow Timing and Watershed Function

Summer streamflow in the Mid-Coast are affected by the capacity of soils to retain water from the previous winter's precipitation. In general, simplified stream channels have less ability to retain water. A variety of land use practices also affect streamflow. Most directly, covering the soil with a hard surface (pavement, roofs) prevents infiltration into the soil, and directs the precipitation into the streams in winter, increasing winter flows at the expense of summer flows. Agricultural practices have a variety of effects on soil water capacity. Ditching and tiling of fields and pastures is done to efficiently remove water in winter, thus reducing storage into the summer. On the other hand, field terracing and development of swales can increase infiltration and storage. Withdrawals of streamflow for multiple uses also reduces flows. The amount of water that is returned to the stream after it is withdrawn depends on the purpose of the water withdrawal and the use of the water.

Peak Streamflow and Excess Turbidity

In the sedimentary landscapes of the Mid-Coast region, bedrock is easily eroded, making fine sediment readily available for stream transport, and peaks of turbidity are normal during seasonal rainstorms. Turbidity (fine sediment suspended in the water) can cause problems both ecologically and for human use of water. Excess turbidity clogs filters in water treatment plants and interrupts their function. Ecologically, fine sediment can infiltrate gravel beds used for fish spawning and suffocate developing eggs, and also can affect the gills of fish, freshwater mussels, and other aquatic animals. Ecological damage from turbidity is closely related to the relationship between turbidity and streamflow. Following rainstorms, turbidity tends to peak during the flow peak as the rainwater runs off the landscape. In a properly functioning stream, the turbidity will decline and the water will clear while flows are still fairly high. If the turbidity persists after the stream returns to base flows, it is ecologically more damaging because at those slower, lower flows fine sediment can infiltrate gravel beds, whereas at higher flows the gravel is protected by the water velocity keeping the sediment in suspension.

2.5.3.3.6 Restoring Degraded Habitats

According to NMFS, management actions that improve habitat quality include restoring watershed and estuarine processes to increase rearing habitat quality and capacity, ensuring long-term ecosystem functions, and implementing adaptive management processes to track progress, assess results, and evaluate key information needs (NOAA, 2016). Specific restoration efforts to improve aquatic habitats focus on the following habitat improvement actions:

- Increasing the presence of large woody debris, including "key" pieces of very large wood.
- Increasing off-channel rearing and shelter opportunities (gravel bars and deep pools).
- Reducing fine sediments, lowering summer water temperature, and providing additional streamflow in the summer months.
- Removing barriers to fish passage or retrofitting existing structures to allow passage.
- Road improvements and decommissioning roads to reduce sediment inputs.
- Encouraging formation of beaver dams and beaver dam analogues.

For a list of restoration projects completed in the Mid-Coast, see **Appendix D**).

Streamflow Restoration Priorities

To meet aquatic habitat goals, ODFW has identified priority areas for summer streamflow restoration for the recovery of anadromous salmonids. The Oregon Water Resources Department (OWRD) also has established priority streamflow restoration areas (see **Appendix E**).

Restoration Projects

The most comprehensive data set available for describing restoration projects in the Mid-Coast is the Oregon Watershed Restoration Inventory, a database managed by the Oregon Watershed Enhancement Board (OWEB), which includes an inventory of both OWEB-funded and voluntarily reported restoration projects[2]. The database includes funding information and project completion details. OWEB categorizes restoration projects by type. Types of restoration projects reported include:

- Estuarine
- Fish passage
- Fish screening
- Instream
- Instream flow
- Riparian
- Road
- Upland
- Urban
- Wetland

A list of restoration projects completed in the Mid-Coast and the cost of each project is presented in **Appendix D** and sorted by watershed.[3]

[2] The database does not include all restoration projects in the Mid-Coast because of privacy issues. Some private landowners that work with local watershed councils prefer their project information to remain private. Other landowners may choose not to report their private restoration and enhancement projects for other reasons.
[3] Information regarding road projects was not included because of the large number of road restoration projects, including numerous culvert replacements. For more information about road restoration, see http://tools.oregonexplorer.info/OE_HtmlViewer/Index.html?viewer=owrt/

2.5.3.4 Species of Interest and Habitat Needs

2.5.3.4.1 Ecological Impairments/Reason for Listing

Many species of interest inhabit in the Mid-Coast, including seven species of salmon, green and white sturgeon, beaver, and three species of lamprey. The following section provides an introduction to species of interest in the Mid-Coast, but does not cover every species. There are several non-aquatic species in the Mid-Coast that are listed and there are additional unlisted aquatic species that are important to the ecology of the Mid-Coast. The OCS identifies species of interest and areas of ecological importance in the different regions of the state. For a list of those species of interest in the Mid-Coast, see **Appendix F.**

Invasive species also are considered species of interest because they can have a disproportionate effect on the ecosystem. Invasive species are non-native species that are able to distribute quickly. Some invasive species form single-species "stands" or "monocultures" where they outcompete native species and reduce overall species diversity. For a list of invasive species that spend all or part of their lifecycle in or near freshwater, see **Appendix G.** For more information about plant and animal species in the Mid-Coast, see the Oregon Conservation Strategy, Oregon Department of Fish and Wildlife, or National Oceanic and Atmospheric Administration websites or reference data sources in **Appendix A**.

2.5.3.4.2 Native Fish

Salmonids

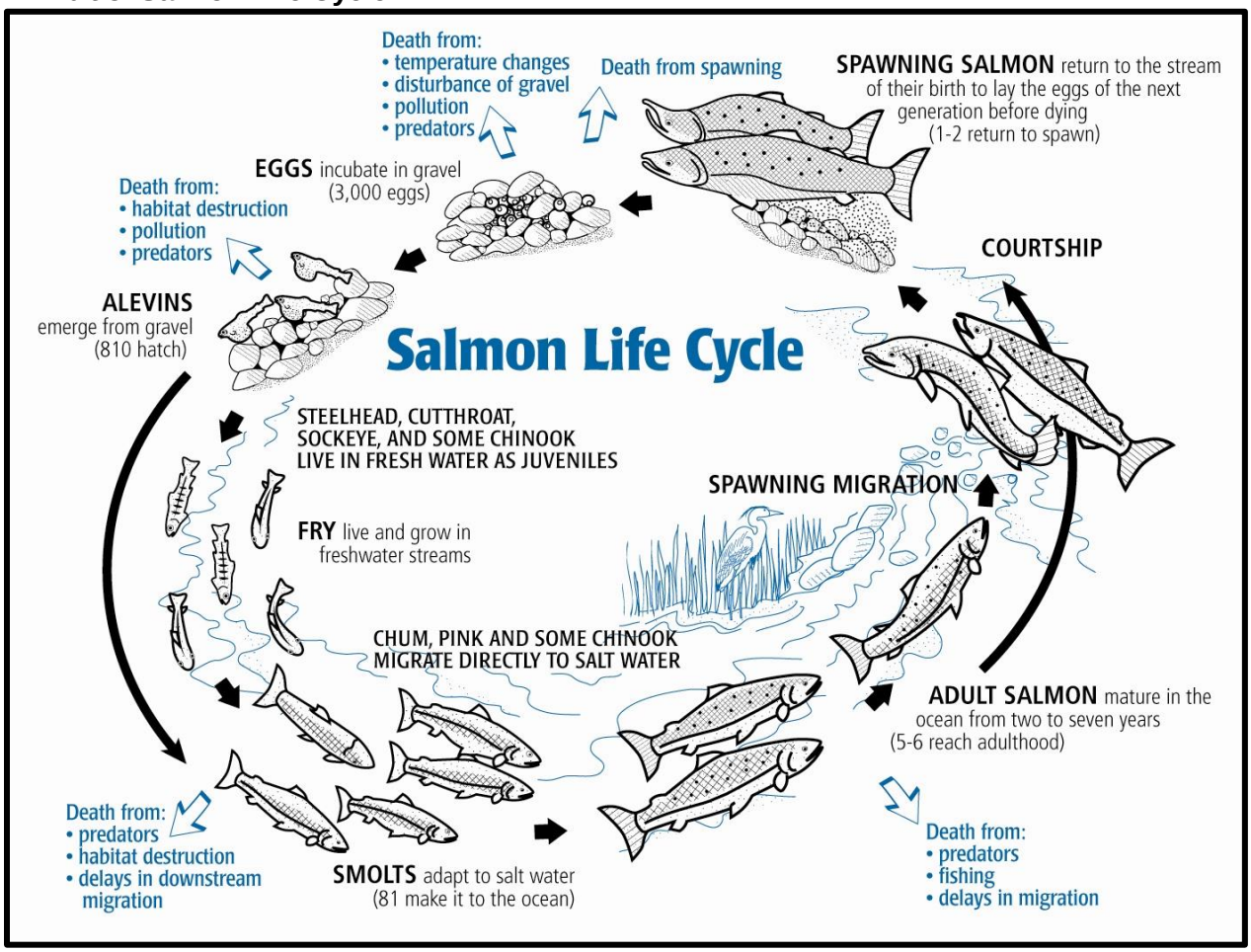
Salmon are considered a keystone species in the Mid-Coast, which means that they have an important role in the ecosystem that affects other plant and animal species. When keystone species are removed from an ecosystem, other species are affected and relationships between habitat and species can change drastically. Salmon in the Mid-Coast die after they spawn (lay eggs), creating a food source for other species and adding marine-sourced nutrients to riparian areas. They also serve as an indicator species for habitat health because they require a diverse range of quality habitats throughout their lifecycle that other species also require.

Anadromous fish live part of their life in freshwater and part of their life in saltwater. They have a complex life history and encounter challenges to survival at every life stage (see **Exhibit 5**). Salmon in the Mid-Coast emerge from eggs as tiny alevins then live in freshwater streams as fry. These fry eventually migrate downstream and undergo drastic biological transformation that allows them to live in saltwater. At this life stage, which lasts about 8 to 10 days, salmon are called smolts. When the smolts enter saltwater, they are adult salmon that live in the ocean for about 1 to 4 years. Adult salmon that survive marine life will then return to the stream where they were born to lay eggs (spawn). For an adult salmon to lay her eggs, she must prepare a nest (redd) in the gravel with her tail at a location in the stream channel that will provide sufficient oxygen flow through the nest (redd), but will not be subject to excessive siltation or to high flows that might wash out the nest or the male salmon's sperm (milt) during fertilization. Salmon use external fertilization, meaning that the female's eggs are fertilized outside her body by the male salmon. This process happens in just 30 seconds.

Biological Requirements for Salmonids. In general, salmonids require complex stream channels (e.g., backwater channels, alcoves, large woody debris structures), cool stream temperatures, clean spawning gravel, and passage between nearshore marine habitat (e.g.,

estuaries) and upstream spawning grounds. Not all salmon species will always use the same habitat characteristics and fish may have alternative life histories. All anadromous fish require passage from upstream spawning grounds to the ocean. Healthy nearshore habitats and estuaries are important for providing food for juvenile fish and assisting the transition between freshwater and saltwater (smolting).

Exhibit 5. Salmon Life Cycle



Source: Skagit Fisheries Enhancement Group

Presence in Watersheds
Exhibit 6 shows the salmonids present in major watersheds in the Mid-Coast.

Exhibit 6. Presence of Salmonid Types by Major Watershed

Presence of Salmonid Types by Major Watershed							
Watershed	**Coho**	**Chum**	**Fall Chinook**	**Spring Chinook**	**Winter Steelhead**	**Summer Steelhead**	**Sea-Run Cutthroat**
Salmon R.	X	X	X		X		X
Siletz R.	X	X	X	X	X	X	X
Yaquina R.	X	X	X		X		X
Alsea R.	X	X*	X	X	X		X
Yachats R.	X	X*	X		X		X

Notes:
On occasional observations; not a consistent run or population (J. Spangler (ODFW), personal communication, Nov 13, 2017).

- **Coho.** Juvenile coho rear in low-gradient streams in the winter and summer. In the winter, they require complex stream structure, including side channels and cover that offer shelter, forage, and escape from high streamflow. Deep pools also may offer refuge from high velocity streamflow. Some juvenile coho have alternative life histories and leave their natal streams and spend time living in other habitats before they smolt (head out to the ocean). While juvenile coho tend to prefer small streams, they also use larger streams and slow water marshes, such as lower marshes in Beaver Creek (Garono & Brophy, 2001).

  Status: Listed as threatened by NMSF and listed as sensitive by ODFW in the Oregon Coast ESU (ODFW[6], 2017; NOAA[1], 2017)

- **Winter Steelhead.** Winter steelhead spawn in small, moderate-gradient tributary streams as well as larger streams and prefer gravel-to cobble sized substrate with low levels of fine sediments for spawning (Garono & Brophy, 2001). However, many steelhead also spawn in larger streams and river mainstems. The Siletz River has a component of winter steelhead that spawn in the mainstem (J. Spangler, (ODFW) personal communication, Nov 13, 2017).

  Status: Listed as an OCS strategy species (ODFW[6], 2017; NOAA[1], 2017).

- **Summer Steelhead.** The only coastal-origin population of summer steelhead is in the Siletz River Watershed. Summer steelhead require streams with clean gravel, complex habitat, and cool temperatures for spawning and rearing (ODFW[6], 2017).

  Status: Listed as a species of concern by NMFS and listed as sensitive in the Coastal SMU by ODFW (ODFW, 2018; NOAA[1], 2017).

- **Spring Chinook.** Chinook Salmon require clean gravel substrate, complex stream habitat, and productive nearshore marine habitat where juveniles can grow and develop. Spring Chinook, unlike Fall Chinook, also require cool, deep pools for refuge in summer (ODFW[6], 2017).

  Status. Listed as sensitive in the Coastal SMU by ODFW (ODFW[6], 2017).

- **Fall Chinook.** Chinook salmon require clean gravel substrate, complex stream habitat, and productive estuary and nearshore habitat where juveniles can grow and develop (ODFW[6], 2017). Spawning occurs mid-October through December when water temperature is typically not a concern (J. Spangler, personal communication, Nov 13, 2017).

  Status: Listed as an OCS strategy species, (ODFW[6], 2017; NOAA[1], 2017).

- **Chum.** Chum salmon require gravel bars with subsurface flow and side channels near tidewaters for spawning. Fry migrate to the ocean soon after they emerge (ODFW[6], 2017).

  Status: Listed as sensitive-critical in the Coastal SMU by ODFW (ODFW[6], 2017; NOAA[1], 2017).

- **Coastal Cutthroat Trout.** Coastal cutthroat trout require clean gravel for spawning and rearing. They also require large woody debris that creates instream structures and vegetation that provides protection. Juveniles prefer side channels, backwaters, or pools for rearing (ODFW[6], 2017).

  Status: Listed as a species of concern by NMFS and listed as an OCS strategy species (ODFW[6], 2017; NOAA[1], 2017).

More Information:

- **Coastal Multi-species Conservation and Management Plan**
  http://www.dfw.state.or.us/fish/CRP/coastal_multispecies.asp
- **Pacific Coast Salmon Fishery Management Plan**
  https://www.pcouncil.org/salmon/fishery-management-plan/current-management-plan/
- **Oregon Native Fish Status Report, 2005**
  http://www.dfw.state.or.us/fish/ONFSR/report.asp

Factors Affecting Fish Populations

- **Passage Barriers.** There are several natural barriers to fish passage on streams and creeks in the Mid-Coast, some of which have been laddered to provide passage and open up additional reaches of riparian habitat. Adequate instream flow is required to assist fish passage over small waterfalls and barriers and structures (such as culverts) need to be designed to allow fish passage. In 2013, ODFW identified high-priority fish passage barriers throughout the state. For a list of high-priority fish passage barriers in the Mid-Coast, see **Appendix H.** In the Siletz-Yaquina Basin, ODFW identified 11 priority barriers: 10 culverts and 1 dam, the Valsetz Lake Sills Dam, which was removed in 2014. Priority passage areas in the Alsea River include 5 culverts and 3 dams. Tide gates, in addition to altering the saltwater-freshwater balance in estuarine waters, can also be passage barriers for some species (Giannico & Souder, 2005).

  More Information: ODFW's interactive mapping tool: Oregon Fish Habitat Distribution and Barriers

- **Water Availability.** Water quantity, ecological health, and fish requirements are tightly linked. Sufficient water flow is necessary to keep water temperatures cool and to allow fish to pass over riffles and small waterfalls. According to ODFW's Mid-Coast Environmental Investigation, flow deficiencies usually occur in late summer and fall when precipitation is low (Smith & Lauman, 1972). High flows are also important for maintaining saltwater-freshwater balance in estuaries and for stimulating upstream migration of adult salmon and steelhead. This balance varies greatly between seasons and storm events. Estuaries also remove silt from spawning gravel and create new gravel bars for spawning. The velocity of flows (how fast water is moving) also affect habitat suitability for fish species. **Appendix I** provides a map of significant surface water points of diversion in the Mid-Coast identified by OWRD, ODFW streamflow restoration priorities, and OWRD streamflow restoration priorities (ODFW[1], 2017).

- **Water Quality.** Warm stream temperatures are one water quality problem affecting salmon in the Mid-Coast. According to the Mid-Coast Environmental Investigation (Smith & Lauman, 1972), salmon and trout require water temperatures of 42 to 55 degrees Fahrenheit and not warmer than 65 degrees Fahrenheit for extended periods during spawning because water temperature affects the rate of incubation of eggs. Higher temperatures also favor competing species, diseases, and cause decreased available oxygen. Eggs require higher concentrations of dissolved oxygen (8 parts per million [ppm]) than fry or adults (5 ppm), low turbidity, and neutral water chemistry (not alkaline or acidic). High turbidity affects spawning gravels, can injure gills, and reduces oxygen for fish food sources (Smith & Lauman, 1972).

- **Spawning Gravel.** Salmon and trout have specific habitat requirements for spawning. According to ODFW's Mid-Coast Environmental Investigation (Smith & Lauman, 1972), these fish require gravel in streambeds and bars that range in size between ¼ inch and 6 inches in diameter. Chinook salmon prefer slightly larger gravel and cutthroat and resident trout prefer smaller gravel. Too much sand and silt or too little flow in gravel creates low oxygen conditions for eggs and fry or blocks fry emergence. Gravels also need to be deep enough (0.5 to 1.2 feet) for female salmon to deposit eggs. Chinook salmon prefer deeper gravel than coho salmon and steelhead (Smith & Lauman, 1972).

- **Habitat Complexity.** Habitat complexity refers to the various habitat features found within an area and the diversity of those features. For example, different types of pools provide different habitat functions for fish species. Deep pools provide temperature refuge in the summer, back channels and sloughs can provide refuge from high-velocity flows in the winter, and bank overhangs can provide shelter from predators. Large woody debris in stream channels affect the formation of deep pools, as flows scour around logs, reduce stream flow velocity, reduce bank erosion in some areas and increase erosion in other areas, add nutrients to the stream, and accumulate and store sediment and spawning gravel. Large woody debris enters stream channels through wind throw events, beaver activity, and bank erosion, causing trees to topple into the channel, and through debris slides from steep hillslopes (Wood-Smith & Swanson, 1997). The removal of large woody debris, straightening of channels, and channel incision (cutting down) all decrease habitat complexity.

Other Native Species of Interest

- **White sturgeon.** White sturgeon are long-lived fish, primarily found in large freshwater streams and estuaries along the Pacific coast. They will occasionally undertake extensive ocean travels migrating between the ocean and freshwater (ODFW[7], 2017). Sturgeon can live to be over 100 years old, growing to four to six feet in length.

  Status: White Sturgeon are an OCS strategy species (ODFW[6], 2017).

- **Green Sturgeon.** Green sturgeon spend the majority of their life in the ocean and require large rocks, cobble, and gravel in deep eddies or backflows in estuaries with clean, cold water. Adults spawn several times during their lifetime. Spawning occurs in freshwater between April and June. Juveniles spend one to four years in freshwater before migrating to the ocean (NOAA[2], 2017).
  Status: Southern Distinct Population Segment (DPS) (a genetically unique green sturgeon population) is listed as threatened by the NMFS. Critical habitat is designated for "all tidally influenced areas of Yaquina Bay" (CFR § 226.219). Yaquina Bay. The Southern DPS Freen sturgeon are listed as sensitive-critical in the coast range by ODFW and the northern DPS are listed as sensitive in the coast range by ODFW (ODFW, 2018; NOAA[1], 2017).

- **Pacific, River, and Brook Lamprey.** Lamprey spawn in riffle/gravel areas close to pools or silt deposits, burying eggs beneath sand and gravel. Egg incubation is influenced by temperature, lasting 10 to 20 days, with colder water leading to longer incubation times. Young, hatched larvae burrow in fine silt deposits with mild currents. Most female lamprey die after spawning; however, some may out-migrate and spawn in successive years. The ammocete (juvenile) life stage lasts 3 to 7 years, when they remain in silt burrows and feed on algae. As they grow, lamprey gradually move downstream, usually at night, to find coarser sand/silt substrates, accumulating at lower reaches of river systems. Transformation to adulthood lasts an additional 2 to 8 months, during which the lamprey do not eat. Outmigration may occur in intense episodes, with many lamprey migrating all at once. Length of time spent in the ocean is unknown (Kostow, 2002). Species declines in the North Umpqua occurred in the 1970s after construction of Winchester Dam, suggesting that dam construction has caused declines in other areas; however, population numbers and distribution are not well known. Passage is a known challenge for lamprey, specifically around dams and road culverts (Kostow, 2002).

  Status: Western Brook Lamprey, Western River Lamprey, and Pacific Lamprey are listed as sensitive by ODFW throughout their range (ODFW, 2018). Pacific lamprey and Western River Lamprey are listed as a species of concern by USFWS (USFWS[2], 2017).

  More Information: Oregon Lampreys: Natural History Status and Problem Analysis, ODFW 2002

  https://nrimp.dfw.state.or.us/CRL/reports/info/2002-01.pdf

- **Beavers.** Beavers are herbivores, feeding on cottonwood, alder, willow, and also shrubs, grasses, and aquatic plants. Beavers were historically widespread throughout Oregon, but populations declined sharply because trapping in the 1800s. According to ODFW, beavers are common in many areas and while the overall beaver population trend is not known, the Mid-Coast Watershed Council has documented local declines in the number

and size of beaver ponds since the 1990s (Wayne Hoffman, personal communication, September 11, 2017).

Beavers are keystone species, meaning that they can influence relationships between plants and animals along the food chain. They are also called "ecosystem engineers" because they alter habitat conditions to suit their needs. Beaver ponds, which beavers create for protection from predators and underwater entrances to their dens, serve as habitat for salmon, trout, and other wildlife and promote primary productivity (plant growth), nutrient cycling, flow moderation (flood reduction and flow velocity reduction), and groundwater recharge (Pollock, Heim, & Werner, 2003). Beaver ponds provide refuge from high winter flows, woody debris retention, and winter pool habitat for cutthroat and coho (ODFW[2]. 2017.). Beaver ponds also provide habitat for mink, river otters, muskrats, turtles, frogs, and salamanders. Beavers are classified as a "protected furbearer" on public lands (ORS 496.004), but are classified as a "predatory animal" on private land (ORS 610.002) and may be killed or removed without a permit on private land. One reason for this is that beaver activities may be inconsistent with site-specific management objectives, such as culvert maintenance or farming of plants that beaver will eat.

Amphibians. Amphibians are important because of their role as indicator species. Amphibians undergo metamorphosis from egg to juvenile in the water, making them susceptible to water quality. In adult stages, amphibians breathe through their skin, making them susceptible to water quality as well as toxins in the soil and air. Amphibians often reside in headwater streams where fish are not present. Most amphibians spend their time near cold, clear water bodies, including springs and seeps in older coniferous forests (ODFW[9], 2017). Amphibians typically breed during late winter to early summer and tadpoles and juvenile amphibians reside in the water during summer months. Amphibian surveys as part of native fish investigations project (similar survey design and stats to Oregon Plan survey). Data about the distribution of amphibians is available at the ecoregion scale, but not stream-scale, so these species are not discussed on a watershed level in this report (ODFW, 2011). Different amphibian species have specific needs that are not discussed in depth in this report. For example, the coastal tailed frog prefers rocky substrates with low levels of silt and lives in cold, clear, fast running perennial streams and the southern torrent salamander also prefers permanent, cold and clear water bodies, including springs and seeps. Both species live in older coniferous forests, but the southern torrent salamander can tolerate relatively dry conditions (ODFW[9], 2017). In the Mid-Coast, there are several amphibians that are listed as sensitive by ODFW and two species that are federally listed.

- **Southern torrent salamander:** federally listed as species of concern and listed as sensitive in the coast range by ODFW (ODFW[6], 2017)
- **Coastal tailed frog:** federally listed as species of concern and state listed as sensitive (ODFW[6], 2017).
- **Clouded salamander:** listed as sensitive in the coast range by ODFW
- **Columbia torrent salamander:** listed as sensitive in the coast range by ODFW (ODFW, 2018).
- **Cope's giant salamander:** listed as sensitive in the coast range by ODFW (ODFW, 2018).

- **Del Norte salamander:** listed as sensitive in the coast range by ODFW (ODFW, 2018).
- **Foothill yellow-legged frog:** listed as sensitive-critical in the coast range by ODFW (ODFW, 2018).
- **Northern red-legged frog:** listed as sensitive in the coast range by ODFW (ODFW, 2018).
- **Western toad:** listed as sensitive in the coast range by ODFW (ODFW, 2018).

Western pond turtle. Western pond turtles are an OCS strategy species. They live in marshes, streams, rivers, ponds, and lakes and require areas with sparse vegetation where they can dig nests and bask on logs. Non-native snapping turtles and bullfrogs are among the reasons for decline in Western pond turtle populations (ODFW[6], 2017).
Status: Western pond turtles are federally listed as a species of concern and are listed as sensitive-critical in the coast range by ODFW (ODFW[6], 2017).

Western painted turtle. Western painted turtles are an OCS strategy species. They inhabit ponds, small lakes, slow-moving streams, and river side-channels. They also require logs and vegetation for basking and save movement between aquatic and terrestrial habitat. Threats to the Western painted turtle include habitat loss and fragmentation, road mortality, competition with invasive turtles, and predation (ODFW[6], 2017).
Status: Western painted turtles are listed as sensitive in the coast range by ODFW (ODFW[6], 2017).

2.5.3.4.3 Invasive Species

There are several invasive species in the Mid-Coast that all pose similar challenges for native species (see **Appendix G**). These invasive species compete with native species for habitat and food sources. Invasive species are generalists and can survive in a range of habitat conditions, allowing them to tolerate conditions that stress native species. Some invasive species also prey on native species and others can be toxic to humans or livestock, and can create degraded water conditions.

2.5.3.5 Ecological Summaries of Major Drainage Basins

The following section provides a brief ecological summary of each watershed, including species of interest present in the watershed and areas of ecological importance. **Exhibit 7** shows species and habitat assessments that have been completed in the Mid-Coast that contribute to knowledge of the ecology of the Mid-Coast. Each watershed summary also includes a table of species and habitat assessments completed within that watershed.

Exhibit 7. Mid-Coast Species and Habitat Assessments[1]

Mid-Coast Species and Habitat Assessments[2]		
Organization	**Type of Survey/Information**	**Link or Report Title**
NOAA	Salmon population trend summaries and coho salmon status review	Oregon Coast Coho
Independent Multidisciplinary Science Team	Evaluations of research priorities, salmon and seabird population abundance, aquatic habitat monitoring	IMST Reports
Oregon Watershed Enhancement Board	Statewide framework for restoration and conservation of the state's watersheds and fish and wildlife habitats.	Oregon Plan for Salmon and Watersheds
ODFW	Habitat assessment-based assessment of coho salmon production potential and spanner escapement needs	Information Report, 1998
ODFW	Status of coho salmon	Annual Progress Report, 2009
ODFW	Physical habitat and rearing potential in coho-bearing streams	Annual Progress Report, 2009
ODFW	Population assessment of Oregon coast coho salmon	Information report, 2001
ODFW	Coast coho spawning surveys	Information Report, 1990-1995
ODFW	Abundance monitoring of juvenile Salmonids	Annual Progress Report, 2000-2008
ODFW	Winter rearing habitat assessment for coho salmon	Annual Progress Report, 2008
ODFW	Assessment of adult winter steelhead-redd surveys	Annual Progress Report, 2008
ODFW	Status and biology of Columbia River white sturgeon	Information Report, 2014
ODFW	Amphibian distribution in wadeable streams and ponds	Information Report, 2010
ODFW	Life cycle monitoring	Annual Progress Report, 2006
ODFW	Coho habitat assessment	Annual Progress Report, 2005
MCWC	Habitat assessment	Sixth Field Watershed Assessment

Notes:
[1] Post-1990 studies only.
[2] To access specific reports, visit: Oregon Plan for Salmon and Watersheds Annual Progress Reports, Oregon Department of Fish and Wildlife Information Reports, and Mid-Coast Watersheds Council Landowner Toolbox.

2.5.3.5.1 Salmon River Drainage Area

The Salmon River drains 75 square miles and has 104.5 miles of streams (OWRD[1], 2017). Tributaries to the Salmon River include Bear Creek, Little Salmon River, Salmon Creek, Slick Rock Creek, Treat River, and Trout Creek (LSWCD, 2017). The average slope in the basin is 14 degrees and less than 1 percent of the basin is above 3,000 feet in elevation. Average annual precipitation is 118 inches with some areas of the watershed receiving higher average annual precipitation. Fog drip contributes to as much as 20 inches of precipitation during the dry summer months (LSWCD, 2017).

Ecological Overview

The Salmon River Watershed has basalt geology and an important estuary, which is used by juvenile salmon and has been the site of major restoration. There are several significant surface water points of diversion in the Salmon River Watershed.

Areas of Ecological Importance:

- Salmon River Estuary
  - Salmon River Estuary-Cascade Head Conservation Opportunity Area (ODFW[4], 2017)
- Salmon River
  - Designated as critical habitat for Oregon coast coho
  - Large portions of the watershed are within the Salmon River Estuary-Cascade Head Conservation Opportunity Area (ODFW[4], 2017)

More information: http://oregonconservationstrategy.org/conservation-opportunity-area/salmon-river-estuary-cascade-head/

Species of Interest:

- Pacific lamprey
- Chum
- Fall chinook
- Coho
- Winter steelhead
- Coastal cutthroat trout

Exhibit 8 summarizes species and habitat monitoring occurring in the Salmon River Watershed.

Exhibit 8. Salmon River Drainage Area: Species and Habitat Monitoring

Organization	Type of Species/Habitat Monitoring	Location	Year
ODFW	Life history variability, habitat use, and migratory behavior of coastal cutthroat trout	Salmon River	Oregon Plan Annual Progress Report, 2012
ODFW	Chinook spawner escapement	Salmon River	Information Report, 2012

2.5.3.5.2 Siletz Bay-Ocean Tributaries

Ecological Overview

The Drift Creek watershed is part of the Siletz River COA and drains approximately 41 square miles and 63 miles of streams into the Siletz Bay. Drift Creek is a source water for Kernville-Gleneden-Lincoln Beach Water District. Stream flow restoration is a high priority in the Drift Creek watershed, according to the MCWC 6th Field Assessment (Garono & Brophy, 2001). Devil's Lake Watershed is also an area of ecological importance in the Siletz Bay-Ocean Tributaries drainage basin. The watershed provides coastal coho rearing and spawning habitat. Protected areas in Devil's Lake Watershed include D River State Recreation Site and Devil's Lake State Recreation area. Rock Creek flows into Devil's Lake and is "one of the most important coho producing streams on the coast," according to ODFW. The mouth of the creek contains several acres of peat marsh.

Areas of Ecological Importance.

- Devil's Lake Watershed
  - Devil's Lake Conservation Opportunity Area (ODFW[4], 2017)
- Schooner Creek
- Moolack Frontal
- Drift Creek

More information:

- http://oregonconservationstrategy.org/conservation-opportunity-area/devils-lake/
- http://oregonconservationstrategy.org/conservation-opportunity-area/siletz-river/

Species of Interest:

- Coho
- Fall Chinook
- Pacific Lamprey
- Winter Steelhead

Exhibit 9 summarizes species and habitat monitoring occurring in the Siletz Bay-Ocean Tributaries Drainage.

Exhibit 9. Siletz Bay-Ocean Tributaries: Species and Habitat Monitoring

Organization	Type of Species/Habitat Monitoring	Location	Year
MCWC	Habitat assessment	Rock Creek (tributary to Devil's Lake)	2003

2.5.3.5.3 Siletz River Drainage Area

The Siletz River drains 305 square miles and includes 458 miles of stream length (OWRD, 2017). Portions of the watershed lie within the Siuslaw National Forest. The watershed geology is a mixture of volcanic rocks and sandstone. Tributaries to the Siletz River include Cedar Creek, Euchre Creek, Gravel Creek, North and South Fork Siletz, Rock Creek, and Sunshine Creek (LSWCD, 2017). The average annual precipitation in the Siletz River Watershed is 104 inches. Higher up in the watershed, precipitation increases and slope increases. Precipitation in the Gravel Creek watershed is 144 inches per year and slope increases from 17 percent at the mouth of the Siletz River to 20 percent in the Gravel Creek watershed (OWRD, 2017). Several municipalities withdraw water from the Siletz River Watershed (see Water Quantity report). The northern two-thirds of the Upper Siletz (North Fork sub-watershed) generally has streams with high gradients while the southern third the watershed mostly consists of broad, flat alluvial bottom that was once logged and homesteaded (South Fork sub-watershed) (OWRD, 2017).

Ecological Overview

The Siletz River drainage area has a diversity of species and a large restoration project and study in the Mill Creek watershed to improve fish habitat and monitor the outcomes of stream restoration. The watershed has several significant surface water points of diversion.

Areas of Ecological Importance. A large portion of the Siletz River Watershed is a Conservation Opportunity Area (ODFW[4], 2017).

- Siletz River (lower, upper, and middle)
  - Critical habitat for Oregon coast coho
- Mill Creek

More Information: http://oregonconservationstrategy.org/conservation-opportunity-area/siletz-river/

Species of Interest:

- Fall chinook
- Spring chinook
- Chum
- Coho
  - NMFS has identified the Siletz River, Middle Siletz, and Lower Siletz as critical habitat for Oregon coast coho salmon.
- Summer Steelhead
  - The Siletz River Watershed has the only coastal origin population of summer steelhead in Oregon.
- Winter steelhead
- Cutthroat trout
- Pacific lamprey

Exhibit 10 summarizes species and habitat monitoring occurring in the Siletz River Watershed.

Exhibit 10. Siletz River Drainage Area: Species and Habitat Monitoring

Organization	Type of Species/Habitat Monitoring	Location	Year
ODFW	Escapement goals for fall chinook based on stock and recruitment analysis	Siletz River	Information Report, 2000
ODFW	Population assessment of Oregon coast coho salmon	Mid-Coast	Information report, 2001
Watersheds Research Cooperative	Fish populations	Mill Creek Watershed	Ongoing

2.5.3.5.4 Depoe Bay-Ocean Tributaries

Ecological Overview

The northern portion of the Depoe Bay-Ocean Tributaries drainage area is located within the Depoe Bay Conservation Opportunity Area. Rocky Shores in the Depoe Bay Area are nesting sites for wildlife species.

Areas of Ecological Importance.

- Depoe Bay Area
  - Depoe Bay Area Conservation Opportunity Area (ODFW[4], 2017)

Species of Interest:

- Coho
- Winter Steelhead

More Information: http://oregonconservationstrategy.org/conservation-opportunity-area/depoe-bay-area/

2.5.3.5.5 Yaquina River Drainage Area

The Yaquina River drains 210 square miles and has 294 miles of streams (OWRD, 2017). Tributaries to the Yaquina River include Depot Creek, Big Elk Creek, Little Elk Creek, Mill Creek, Olalla Creek, and Thornton Creek (LSWCD, 2017). The average slope in the basin is 14.7 degrees and the mean elevation is 535 feet with almost no area above 3,000 feet. The watershed receives a mean annual precipitation of 80 inches (OWRD[2], 2017). The geology in the Yaquina Watershed is predominantly Tyee sandstone.

Ecological Overview

The Yaquina River drainage area supports industrial fishing, including the largest commercial fishing center in the Mid-Coast (the City of Newport). The geology is primarily sandstone geology, which provides an abundant fine sediment supply to the watershed. Yaquina Bay provides habitat for white and green sturgeon. There are several significant surface water points of diversion in the lower portions of the watershed below the confluence of the Yaquina River and Big Elk Creek.

Areas of Ecological Importance. Yaquina Bay is designated as critical habitat for green sturgeon. The Upper Yaquina River, Lower Yaquina River, Big Elk Creek, and Yaquina Bay are all designated as critical habitat for Oregon coast coho. Mill Creek is has the most southern, stable population of Chum salmon on the coast (J. Spangler (ODFW), personal communication, Nov 13, 2017).

- Mill Creek
- Big Elk Creek
- Yaquina Bay
- Yaquina River (upper and lower)

Species of Interest:

- Fall chinook
- Chum
- Coho
- Pacific lamprey
- Winter steelhead
- White sturgeon
- Green sturgeon
- Coastal cutthroat trout

The watershed is home to several federally listed species, including the marbled murrelet, western snowy plover, Northern spotted owl, coho salmon, and Oregon silverspot butterfly. Chum salmon and white sturgeon also are present in the watershed. In addition, The Wetlands Conservancy (Bauer et al. 2011) has indicated several species of conservation concern in the Yaquina River Watershed, including the northern red-legged frog, mountain quail, purple martin, green and white sturgeon, and steelhead, which are all listed as species of concern (USFWS[2], 2017).

Exhibit 11 summarizes species and habitat monitoring occurring in the Yaquina River Watershed.

Exhibit 11. Yaquina River Drainage Area: Species and Habitat Monitoring

Organization	Type of Species/Habitat Monitoring	Location	Year
ODFW	Analysis of factors affecting marine survival estimates of coho salmon	Mill Creek (Yaquina River)	Information Report, 2006
MCWC	Habitat assessment	Olalla Creek (tributary to Yaquina Estuary)	2003

2.5.3.5.6 Beaver Creek-Ocean Tributaries

Ecological Overview

The Beaver Creek watershed is an area of ecological importance in the Beaver Creek-Ocean Tributaries Drainage Basin. Beaver Creek Watershed is larger than the Yachats River, draining 64 square miles (OWRD[1], 2017). Its tributaries include North Fork and South Fork Beaver Creek, Oliver Creek, Elkhorn Creek, Bowers Creel, and Peterson Creek (LSWCD, 2017). The creek drains directly into the Pacific Ocean at Ona Beach and has 42 miles of streams (OWRD[1], 2017). The Beaver Creek Watershed is a Conservation Opportunity Area and is ecologically important due to extensive peat bog wetlands, late successional forest on USFS property, and bald eagle nesting sites. Protected areas within the Beaver Creek Conservation Opportunity Area include the Beaver Creek State Natural Area, Drift Creek Wilderness, Estella Matilda Happ Preserve, Ona Beach State Park, Seal Rock Wetland Preserve, and Siuslaw National Forest (ODFW[4], 2017).

Areas of Ecological Importance.

- Beaver Creek Estuary
- Beaver Creek Watershed
    - Beaver Creek Conservation Opportunity Area (ODFW[4], 2017)

More Information. http://oregonconservationstrategy.org/conservation-opportunity-area/beaver-creek/

Species of Interest:

- Fall Chinook
- Coho
- Winter Steelhead
- Pacific Lamprey

2.5.3.5.7 Alsea River Drainage Area

The Alsea River drains 459 square miles and has 517 miles of streams (OWRD, 2017). Tributaries to the Alsea River include Canal Creek, Drift Creek, Fall Creek, Five Rivers, Lobster Creek, and the South Fork Alsea (LSWCD, 2017). Portions of the watershed are in the Siuslaw National Forest. The City of Waldport uses Eckman Creek, a tributary to Alsea Bay, as one of its drinking water sources. Eckman Creek is dammed near Highway 34, creating Eckman Lake. The average slope in the watershed is 20 degrees and the mean elevation is 1,024 feet. Less than 1 percent of the watershed is above 3,000 feet. The Alsea River Watershed receives an average annual precipitation of 87.47 inches.

Ecological Overview

The Alsea River drainage area includes a large river with a small bay and supports a large diversity of species. Alsea Bay supports abundant salmonids and small populations of green sturgeon. Valley floors in the watershed support agriculture and rural development. There are several significant surface water points of diversion in the upper portion of the Alsea River.

Areas of Ecological Importance. The entire watershed is designated as critical habitat for Oregon coast coho. Portions of Drift Creek flow through a designated wilderness area in the Siuslaw National Forest.

Portions of the watershed are within the Alsea Estuary-Alsea River Conservation Opportunity Area (ODFW[4], 2017).

- Alsea River
- Lobster Creek
- Drift Creek

More Information:

- Drift Creek Wilderness: https://www.fs.usda.gov/recarea/siuslaw/recreation/recarea/?recid=42399
- http://oregonconservationstrategy.org/conservation-opportunity-area/alsea-estuary-alsea-river/

Species of Interest:

- Fall chinook
- Spring chinook
- Chum
- Coho
- Pacific lamprey
- Summer steelhead
- Winter steelhead
- Green sturgeon
- Coastal cutthroat trout

Exhibit 12 summarizes species and habitat monitoring occurring in the Alsea River Watershed.

Exhibit 12. Alsea River Drainage Area: Species and Habitat Monitoring

Organization	Type of Species/Habitat Monitoring	Location	Year
ODFW	Habitat and salmon life cycle monitoring*	East Fork and Upper Mainstem Lobster Creek	Annual Progress Report:1988-2002
ODFW	Assessment of status of winter Steelhead	Alsea Watershed	Information Report, 2002
Mid-Coast Watersheds Council	Coho population monitoring.	Alsea Watershed.	
Mid-Coast Watersheds Council	Habitat assessment and restoration plan	Preacher Creek (tributary to Lobster Creek)	2006
Watersheds Research Cooperative (Alsea Watershed Study)	Effects of forest practices on flow, water quality, aquatic habitat, and fish (e.g., long-term hydrologic recovery, sediment and bedload transport)	Needle Branch, Deer Creek, Flynn Creek	Ongoing

Notes:
*According to ODFW, spawning coho have been monitored in the Alsea River Watershed since the 1950s and coho harvests have been monitored since the late 1800s.

2.5.3.5.8 Yachats River and Ocean Tributaries

The Yachats River drains 43 square miles and has 58 miles of streams (OWRD, 2017). Tributaries to the Yachats River include the North Fork Yachats, School Fork, and Stump Creek (LSWCD, 2017). The average slope of the watershed 18 degrees and the average elevation is 696 feet. None of the Yachats River Watershed is above 3,000 feet. The watershed receives an average annual precipitation of 91 inches, which does not vary significantly throughout the watershed (OWRD, 2017). The City of Yachats receives its water supply from Salmon Creek and Reedy Creek, but has an emergency intake on the Yachats River. Portions of the Yachats River Watershed are within the Siuslaw National Forest.

Ecological Overview

The Yachats River drainage area is characterized by basalt geology, habitat for steelhead, and a small estuary. There are several significant surface water points of diversion in the lower portions of the watershed.

Areas of Ecological Importance. The Yachats River Watershed is a Conservation Opportunity Area (ODFW[4], 2017).

- Yachats River
  - Designated as critical habitat for Oregon coast coho
  - Yachats River Conservation Opportunity Area by ODFW (ODFW[4], 2017).

More Information: http://oregonconservationstrategy.org/conservation-opportunity-area/yachats-river-area/

Species of Interest:

- Fall chinook
- Coho
- Pacific lamprey
- Winter steelhead
- Coastal cutthroat trout

The Yachats River Watershed is also home to marbled murrelet and spotted owl nesting sites (ODFW[4], 2017).

Exhibit 13 summarizes species and habitat monitoring occurring in the Yachats River Watershed.

Exhibit 13. Yachats River Drainage Area: Species and Habitat Monitoring

Organization	Type of Species/Habitat Monitoring	Location	Year
MCWC	Habitat assessment	North Fork Yachats	2003
Department of Environmental Quality	Habitat assessment: channel morphology, vegetation, and channel substrate measurements	Yachats River	2005

2.5.3.5.9 Other Streams

The Mid-Coast has many small streams and unique watersheds. For example, ocean tributaries in the Mid-Coast support genetic diversity of cutthroat trout and Brook lamprey and provide habitat for some dependent populations of coho. Additional information was gathered for a few unique watersheds, including the Devil's Lake, Schooner Creek, Mill Creek (Siletz), Olalla Creek (Yaquina) and Big Creek (Yachats) watersheds. For this additional information, see **Appendix J.**

Estuaries

The Mid-Coast estuaries, with the exception of the Depoe Bay Estuary (which is small), are moderate in size and have large areas of salt marsh, eelgrass, and tidal flat habitat (Oregon Coastal Atlas, 2017).

Salmon River Estuary. Salmon River Estuary is classified as a Natural Estuary and has little residential, commercial, and industrial development (OAR 660-015-0010(1)). The entire estuary and its associated wetlands are part of the Cascade Head Experimental Forest and Scenic Research Area, which is owned and managed by USFS. The entire Cascade Head area is 11,890 acres, the estuary comprises 205 acres.

Areas of Ecological Importance and Critical Habitat Designations. Habitat areas include wetlands, mudflats, emergent herbaceous wetlands, and intertidal marsh. The estuary provides transitional habitat between freshwater and saltwater for upstream spawning migrations for anadromous fish and rearing areas for juveniles and smolts.

The Salmon River Estuary is part of the Salmon River Estuary-Cascade Head Conservation Opportunity Area (ODFW[4], 2017).

More Information: http://oregonconservationstrategy.org/conservation-opportunity-area/salmon-river-estuary-cascade-head/

Species of Interest. The Salmon River Estuary was nominated as an Important Bird Area for brown pelican, bald eagle, and peregrine falcon, and for its abundance of shorebirds, including western sandpipers (ODFW[6], 2017).

Exhibit 14 summarizes species and habitat monitoring occurring in the Salmon River Estuary.

Exhibit 14. Salmon River Estuary: Species and Habitat Monitoring

Organization	Type of Species/Habitat Monitoring	Location	Year
ODFW*	Rearing of juvenile salmon, salmon habitat recovery, juvenile salmon life history, development of restoration projects	Salmon River Estuary	Information Report, 2001

Notes:
* ODFW is a collaborator on the Salmon River Estuary Project, a research project aimed at evaluating estuarine fish and prey community responses to restored wetland habitats. The project, which is funded by the Oregon Sea Grant, is part of the ODFW Aquatic Inventories Project.

Habitat Restoration Projects. Much of the Salmon River Estuary was previously diked and drained to support agriculture. Diking reduced the tidal influence on estuary lands and

agricultural practices altered plant species and fish habitat. Since 1978, USFS has removed several dikes in the Salmon River Estuary and returned approximately 70 percent of the estuary into tidal influence. Dike removal projects were completed every 9 years, creating opportunities to research various stages of habitat recovery following restoration.

Dike removal and restoration of the estuary is ongoing. In 2012, The Salmon Drift Creek Watershed Council (LSWCD, 2017) completed the Crowley Creek Marsh Restoration Project to improve habitat where artificial dikes, an undersized culvert, and invasive species had degraded habitat. SDCWC also has been involved in restoring the Salmon River Estuary, and helped to remove infrastructure at the former Pixieland Amusement Park. SDCWC also placed large woody debris in Bear Creek to improve pool frequency, floodplain interaction, and spawning gravel recruitment.

Siletz Bay. Siletz Bay is classified as a Conservation Estuary (OAR 660-015-0010(1)). It that lacks jetties or channels, but is near the City Lincoln City, which has altered some of the shoreline near the estuary. USFWS manages a 568-acre portion of the bay as a national wildlife refuge. The Siletz Bay Refuge includes coastal conifer and hardwood forest, estuarine tidelands, and freshwater riparian habitats. What is now currently a refuge for a variety of estuary-dependent birds and fish species formerly was diked to drain land for raising dairy cows (USFWS[3], 2017). USFWS is managing the refuge to allow the salt marsh to return to its natural state, where tides inundate the refuge twice daily (USFWS[3], 2017).

The Siletz Bay is a Conservation Opportunity Area (ODFW[4], 2017).

More Information: http://oregonconservationstrategy.org/conservation-opportunity-area/siletz-bay/

Species of Interest. The Siletz Bay Wildlife Refuge provides nursery habitat for coho and chinook salmon, steelhead and cutthroat trout, and other anadromous species. Spring chinook salmon usually arrive to the refuge in May, and American shad arrive between late April to the end May. The refuge is also home to red-tailed hawks, bald eagles, barn owls, red-shouldered hawk, osprey, turkey vulture, merlin, and peregrine falcon as well as estuary-dependent birds including great blue heron, great egret, Virginia rail, eared grebe, brown pelican, bufflehead, common merganser, wood duck, northern shoveler, American wigeon, green-winged teal, and double-crested cormorant. Mammals at the refuge include Roosevelt elk, black-tailed deer, harbor seals, mink, river otter, muskrat, and beaver. Siletz Bay has native, common eelgrass as well as exotic *Zostera japonica* that was introduced on non-native oysters.

Exhibit 15 summarizes species and habitat monitoring occurring in Siletz Bay.

Exhibit 15. Siletz Bay: Species and Habitat Monitoring

Organization	Type of Species/Habitat Monitoring	Location	Year
ODFW	Natural resources inventory	Siletz Estuary	Information Report, 1979

Habitat Restoration Projects. In 2000, USFWS completed a small tidal marsh restoration project, which was followed by another restoration project in 2003 to restore 86 acres of tidal marsh at Millport Slough. The 2003 project, which was completed in collaboration with Ducks

Unlimited and the Confederated Tribes of the Siletz Indians, involved breaching 220 feet of dike, removing 9,300 feet of dike; filling 1,200 feet of artificial ditches; and placing large woody debris in the marsh to improve fish habitat (USFWS[3], 2017).

Depoe Bay. Depoe Bay estuary is approximately 25 acres. The estuary is landlocked, with the exception of the harbor entrance, which was developed to support fishing, tourism, lumber, and agriculture (Oregon Coastal Atlas, 2017). The bay supports bald eagle nesting sites and black oystercatchers, among other species.

Depoe Bay is a Conservation Opportunity Area (ODFW[4], 2017).

More Information: http://oregonconservationstrategy.org/conservation-opportunity-area/depoe-bay-area/

Yaquina Bay. Yaquina Bay is a 4,300 acre estuary located in the City of Newport. It is classified as a Development Estuary (OAR 660-015-0010(1)) and has been used by humans for more than a century. Current uses of Yaquina Bay include fishing and fish processing, logging, shipping, tourism, aquaculture, and agriculture (Oregon State University, 2017). The estuary has been dredged and filled at several locations to support these uses and to allow for development. Oregon State Parks owns the Yaquina Bay State Recreation Site, a 32-acre parcel of land overlooking the mouth of Yaquina Bay (Oregon State Parks, 2017). Hatfield Marine Science Center, Oregon State University's major marine laboratory and the Oregon Coast Aquarium also are located in the Yaquina Bay area.

There are large cultivated shellfish operations in the Yaquina estuary (ODA[1], 2017). The shellfish industry in Oregon has been impacted by ocean acidification and low oxygen levels. In 2015, House Bill 2209 was passed, establishing a state policy to enhance and expand cultivated shellfish production and to conserve, protect, and restore wild populations of native shellfish and improve water quality and the health of aquatic and marine habitats (ODA[1], 2017). The Bill also created the Oregon Shellfish Initiative to carry out these policy recommendations.

Areas of Ecological Importance and Critical Habitat Designations. Yaquina Bay is listed as critical habitat for the green sturgeon. Yaquina Bay State Recreation site is a spruce and pine forested bluff (Oregon State Parks, 2017). Lower Yaquina Bay has little freshwater influence and is popular for shellfishing (ODFW[8], 2017). The Wetlands Conservancy has identified high salt marsh, tidal Sitka spruce swamp, and non-tidal Sitka spruce swamp as the highest priorities for habitat restoration (Bauer et al., 2011). The estuary also has eelgrass beds, and nesting eagles and osprey (ODFW[4], 2017). Spruce swamps are located in the upper estuary along Elk Creek and Little Elk Creek and areas for potential restoration of high salt marsh are located in Boone Slough and Nute Slough. Currently, there is an eelgrass mitigation project in the eastern portion of Marina Bed (ODFW[4], 2017). Yaquina Bay is a Conservation Opportunity Area (ODFW[4], 2017).

More Information: Yaquina Bay Conservation Opportunity Area: http://oregonconservationstrategy.org/conservation-opportunity-area/yaquina-bay/

Species of Interest. Green sturgeon, federally listed as threatened, inhabits Yaquina Bay.

Exhibit 16 summarizes species and habitat monitoring occurring in Yaquina Bay.

Exhibit 16. Yaquina Bay: Species and Habitat Monitoring

Organization	Type of Species/Habitat Monitoring	Location	Year
Oregon State University	Zooplankton	Yaquina Bay and near Toledo	Ongoing
EPA	Benthic habitat data (e.g., aerial photos, topography, seagrass, macroalgae, and shrimp abundance) Benthic invertebrate abundance and distribution Benthic vegetation abundance and distribution Benthic habitat characteristics Distribution of sand content in sediments	Yaquina Bay	Ongoing

Data Gaps. The Yaquina Estuary Conservation Plan identified several data and research needs for the Yaquina Basin, including information about sedimentation delivery. Specifically, the plan stated that no basin-wide stream reach level inventory of streambank erosion currently exists, surface erosion has not been modeled on a watershed scale, and sediment accretion rates in mudflats, eelgrass beds, and salt marshes are not included in models of sea level rise (Bauer et al., 2011).

Alsea Bay. Alsea Bay is designated as a Conservation Estuary (OAR 660-015-0010(1)) and is one of only four estuaries in Oregon that is managed for conservation under the CZMA and does not have jetties at the ocean entrance. Recreational fishing and clamming is allowed in Alsea Bay and species present include cockles and purple varnish clams, softshell clams, and Dungeness crabs. There are two public boat launches at Alsea Bay, including the Port of Alsea boat launch and McKinley's Marina (ODFW[8], 2017).

Species of Interest. Alsea Bay supports green sturgeon, as well as a diversity of other species.

Areas of Ecological Importance and Critical Habitat Designations. The east side of Alsea Bay has more than 400 acres of undisturbed marsh habitat and additional marsh habitat in the lower reaches of Drift Creek, a FEMAT-designated key watershed (Brophy, 1999). Additional tidal high marsh habitat that is recovering from previous grazing disturbance is found west of Barclay Meadows and east of Eckman Lake. The Bayview Oxbow has roughly 150 acres of diked former tidal marsh and Barclay meadows contains small areas of diked former tidal marsh. Bain Slough is a forested wetland located at River Mile 9 that has well-developed remnant tidal channels. A tidegate, ditching, and residential development all reduce tidal influences at Bain Slough, which was likely a spruce tidal swamp at one time.

Alsea Bay has been identified as a Conservation Opportunity Area (ODFW[4], 2017).

More Information: http://oregonconservationstrategy.org/conservation-opportunity-area/alsea-estuary-alsea-river/

Exhibit 17 summarizes species and habitat monitoring occurring in Alsea Bay.

Exhibit 17. Alsea Bay: Species and Habitat Monitoring

Organization	Type of Species/Habitat Monitoring	Location	Year
Mid-Coast Watersheds Council	Tidal wetland habitat survey	Alsea Bay	1999

Habitat Restoration Projects. There was a $565,000 restoration project in Lint Slough to remove a salmon rearing research facility that was built in 1963 and dammed the upper and lower areas of the slough to create a ¾-mile-long rearing pond. In 2009, ODFW removed the dam, canal outlet, and water control structures and excavated built-up areas to historical marsh height. Restoration goals of the project included restoring natural processes to sustain the slough as an intertidal habitat, preserving 40 acres of saltmarsh and 80 acres of mudflat habitat, restoring passage for anadromous fish, and increasing habitat for birds (Kocourek, 2009). Lint Slough also contains the only population of western marsh-rosemary in Oregon. Currently, the Mid-Coast Watersheds Council is planning restoration activities on South Beaver Creek and Walker Creek, tributaries to Alsea Bay.

Yachats River Estuary. The Yachats River Estuary is about 40 acres and is classified as a Conservation Estuary (OAR 660-015-0010(1)). The Yachats River Estuary is part of the Yachats River Area Conservation Opportunity Area (ODFW[4], 2017); it is a designated Important Bird Area of Oregon and includes marbled murrelet and spotted owl nesting sites.

More Information: http://oregonconservationstrategy.org/conservation-opportunity-area/yachats-river-area/

2.5.3.6 Finances

There is a large effort to restore aquatic and upland habitats in the Mid-Coast to reverse the impacts of historical land use practices and improve conditions for native plant and animal species. For information regarding cost of restoration projects in the Mid-Coast, see **Appendix D.** For more information regarding sources for restoration funding, visit OWEB's Oregon Watershed Restoration Inventory.

In addition to information provided by OWEB, the Oregon Invasive Species Council has provided estimates of its funding, expenditures, and funding needs. Invasive species removal requires many resources and is a constant battle to reduce invasive species numbers and protect native habitats from future invasion. The Council spent approximately $11,800 in 2016 on invasive species monitoring and an additional $350,000 on invasive species control. The Oregon Invasive Species Council is seeking $5 million to establish an invasive species emergency fund.

Lincoln County SWCD supports several restoration projects Lincoln County. The amount of restoration completed by Lincoln County SWCD depends on aligning the timing and availability of willing landowners, grant funding, and staff time for grant writing and project work. The SWCD produces annual reports that outline revenues and expenditures for each fiscal year as well as revenues and expenditures by funding source.

Lincoln County SWCD annual reports: http://www.lincolnswcd.org/annual-reports.html

2.5.4 Data Gaps

Exhibit 18 summarizes data gaps identified by the Oregon Conservation Strategy (ODFW[6], 2017) and NOAA.

Exhibit 18. Data Gaps in the Mid-Coast: Species of Interest

Species	Data Gaps
Chum salmon	Population dynamics; population genetics; distribution and abundance in marine waters.
Coastal cutthroat trout	Breeding and genetic relationships; distribution and abundance; population trends; marine distribution and survival limitations.
Coho salmon	Net change in key habitat features (e.g., elements of habitat complexity) and habitat status. Most effective locations and strategy to restore coho salmon. For a complete list of data gaps, consult Oregon Coast Coho Conservation Plan and Coastal Coho Assessment.
Chinook salmon	Conservation effectiveness; mechanisms affecting marine survival; utilization of nearshore marine waters.
Winter steelhead	Water temperature, high water velocity, and deep water habitat availability.
Brook lamprey	Lifecycle timing; detailed distribution; population trends over time; saltwater tolerance; basic life history, biology, and habitat use.
Pacific Lamprey	Lifecycle timing; detailed distribution; population trends over time; saltwater tolerance; basic life history, biology, and habitat use; detailed distributions, life history, and basic biology; data collected incidentally to salmonid data collection; population trends over time; life history across species.
River Lamprey	Limited data on life history, limiting factors, and conservation efforts.
Sturgeon	Life history, migration, diet of sub-adults and juveniles; movements and habitat use in estuaries and nearshore; recreational impacts (ODFW[6], 2017). Effects of contaminant exposure, ocean energy projects, predation, and species distribution, migrations, and spawning habitat utilization (NOAA[2], 2017).
Southern torrent salamander	Distribution; response to forest management activities.
Beaver	Population trends unknown
Coastal tailed frog	Habitat requirements; growth rates; abundance and distribution in headwater streams; dispersal timing and age; effects of forest management practices, fertilizers, and herbicides.
Western pond turtle	Basic life history information; population dynamics; genetics; impacts of raccoons and invasive species; effects of herbicides, fertilizers, and other chemicals on eggs and hatchlings; hatchling ecology.
Western painted turtle	Life history; impacts from disease; population dynamics; genetics; impacts of predation and invasive species; effects of herbicides, fertilizers, and other chemicals.

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Appendix A

Data Sources

Several organizations categorize, study, and work to restore important habitats in the Mid Coast. This report uses information regarding habitats identified in the Oregon Coastal Restoration Initiative, Northwest Forest Plan, Oregon Conservation Strategy, Coho Biological Opinion, Oregon's Coastal Coho Conservation Plan, and Limiting Factors Assessments (LFAs) prepared for the MidCoast Watersheds Council. It is important to note that some of the LFAs were produced several years ago and conditions may have changed due to recent restoration or changes in land use practices. However, these assessments were used because they provide a comprehensive review of conditions at small watershed scales. This report also uses information from the Lincoln County Soil and Water Conservation District (LSWCD), the U.S. Forest Service (USFS), the U.S. Bureau of Reclamation (USBOR), StreamNet, and Aquatic Inventory Project Stream Reports from the Oregon Department of Fish and Wildlife (ODFW).

Estuaries are a unique habitat in the Mid Coast that provide rearing habitat for salmonids and support local economies. Information about wetlands was gathered from academic sources, the Siuslaw Estuary Partnership, the Oregon Coastal Management Program, the MidCoast Watersheds Council, the U.S. Forest Service, U.S. Fish and Wildlife Service, and ODFW. Wetlands and lakes also have unique ecological functions that affect water quality, water quantity, and aquatic species. Information about wetlands was retrieved from the National Wetlands Inventory, the Oregon Wetland Planning Guidebook, and the Department of State Lands. The Nature Conservancy, in cooperation with the Pacific States Marine Fisheris Commission, completed an Inventory and Classification of U.S. West Coast Estuaries in 2014 for which they conducted outreach to experts for guidance on resources and methodologies and inventoried estuaries not included in previous efforts using the National Wetlands Inventory. This inventory was used for basic information on estuary characteristics in the Mid Coast.

Useful Tools and Resources		
Topic	**Link to Tool**	**Purpose**
Invasive Species	Oregon iMap Invasives	Tool for online invasives species data management where you can view county or watershed distributions of invasive species.
Invasive Species	WeedMapper	Tool provided by the Oregon Department of Agriculture to map weeds and invasive species distribution throughout the state.
Species and Habitats	Compass	Online interactive map created by the Oregon Conservation Strategy and the Western Association of Fish and Wildlife Agencies. The Map includes information on habitat assessments, conservation opportunity areas, habitats, key conservation issues, and strategy species.

Landslides	SLIDO: Statewide Landslide Information Layer for Oregon	Interactive map that includes historic landslide data and landslide hazard areas. The map shows the age and size of each historic landslide. There is a search tool on the map that allows the user to search by address.
Environmental Hazards, Geology, Topography	Interactive Maps & Geospatial Data	DOGAMI interactive maps of interest include Hazards, Tsunami Evacuation, Lidar Imagery, and Geology maps.
Habitat (Barriers)	Oregon Fish Habitat Distribution and Barriers	Interactive tool with watershed boundaries that shows Oregon fish habitat distribution and fish barriers.
Species Population Information	StreamNet	Database with detailed information about fish counts, hatchery returns, red counts, harvest, and barriers. Interactive database automatically creates graph showing species abundance during each year sampled.
Habitat Restoration	Oregon Watershed Restoration Tool	Interactive mapping tool with information from OWEB's restoration database. This database contains information about grants funded by OWEB. Sort by restoration project type or location and download GIS data.
Habitat (Estuaries and Wetlands)	Estuary Data Viewer	Interactive mapping tool with flood maps, wetland maps, estuary maps, and beaches and dunes. Includes both regulatory and ecological boundaries.
Marine Habitats	Oregon Coastal Atlas	General information about Oregon's coastal areas. Links to useful tools and resources.

Appendix B

Terminology

- **Ecology:** The study of the relationships between living organisms and their environment. Ecology includes the study of the past and present relationships between plants, animals, and the landscape (Townsend, Begon, & Harper, 2003).

- **Ecosystem:** A community of plants and animals and their environment. Ecosystem refers to populations of species, rather than individual species. An ecosystem encompasses the processes of energy and nutrient exchange over a landscape with similar characteristics (Townsend, Begon, & Harper, 2003).

- **Geomorphology:** The study of the structure of landscapes (e.g. river channel shapes, hillslopes, valleys, etc.) and how they change, or morph, over time.

- **Riparian:** Refers to the terrestrial environment surrounding a stream. Vegetation in streamside areas shades the streambeds and can reduce algae in the streambed. When streamside vegetation sheds leaves, it contributes to the food source of aquatic organisms (Townsend, Begon, & Harper, 2003).

- **Spawning:** When adult salmon return to the stream where they were born to lay the eggs of the next generation. Adults die after spawning and contribute nutrients to the stream and riparian areas.

- **Nutrient cycling:** Nutrient cycling is the process by which nutrients such as nitrogen, phosphorous, potassium, sodium etc. are exchanged between living and nonliving components of the ecosystem. Nutrients are exchanged between land and water through human activities and natural processes. Aquatic systems receive energy in the form of nutrients from river inputs and from groundwater or subsurface water welling up into the stream channel. Streams also contribute nutrients to their surrounding environment through the birth, death, movement of organisms in the stream and during flood events when nutrient-rich soil is deposited in the floodplain.

- **Temperature:** Oregon Department of Environmental Quality establishes temperature criteria to support beneficial uses of water. See Appendix B in the Water Quality Report for more information on temperature.

Season	Criteria	Temperature Threshold
Year-round (Non-Spawning)	Rearing	17.8 Celsius (67 Fahrenheit)
Year-Round (Non-Spawning)	Salmon and trout rearing and migration	18.0 Celsius (64.4 Fahrenheit) 7-day-average maximum
Summer	Rearing	17.8 Celsius (64 Fahrenheit)
October 15-June 15	Spawning	12.8 Celsius (55 Fahrenheit)
Year-Round (Non-Spawning)	Core cold water habitat	16.0 Celsius (60.8 Fahrenheit) 7-day-average maximum
October 1-June 15	Salmon and Steelhead spawning	13.0 Celsius (55.4 Fahrenheit) 7-day-average maximum
September 15-June 15	Salmon and Steelhead Spawning	13.0 Celsius (55.4 Fahrenheit) 7-day-average maximum
September 15-June 15	Spawning	12.8 Celsius (55 Fahrenheit)

- **Turbidity:** the amount of solid particles that are suspended in water and that cause light rays shining through the water to scatter. Thus, turbidity makes the water cloudy or even opaque in extreme cases. Turbidity is measured in nephelometric turbidity units (NTU) (USGS, 2017).

- **Instream water right:** A water right issued by the Oregon Water Resources Department that protects a certain amount of flow instream. Instream rights are commonly for providing recreation, fish and wildlife use, and pollution abatement. Instream water rights have a place of use (they are protected at a point or along a reach of stream) a rate (e.g. cfs), and a priority date just like other water rights.

- **Significant point of diversion:** Diversions that are located in watersheds designated as high priority for fish restoration. Statewide, significant diversions represent about 10 percent of all diversions, but account for about 50% of all water withdrawals.

- **Floods:** Periods of high streamflow that have high energy and transport sediment and other particles. Larger floods have more energy and can transport bigger particles. Logs and boulders swept into streams can erode and damage standing shrubs and trees, undercut banks can collapse, and streamflow can be rerouted into new channels. As flow decreases, particles carried by floodwaters drop out, starting with the largest particles and ending with the smallest particles (USDA, 2004).

- **Subsurface flow:** Water that has infiltrated the soil and percolates downward and moves laterally toward a stream. Subsurface flow may move at a slow pace or a rapid pace, contributing to baseflow of streams.

- **Drought:** The word drought has many different definitions. In hydrology, a drought is an extended period of decreased precipitation and streamflow (USGS, 2017).

- **Invasive species:** Animals and plants that are not native to an ecosystem and that cause economic or environmental harm. While not all non-native species are invasive, many become a serious problem. They damage Oregon's habitats and can aggressively compete with native species for food, water and habitat. Visit the Oregon Department of Agriculture website to learn about invasive plants.

- **Substrate**: A word for silt, sand, gravel, cobble, boulder, or bedrock that lie on the bottom of a river. Silts are fine texture, high in moisture and nutrient holding capacity. Sands are gritty, dry, and poor in fertility. Gravels, cobbles, and boulders make up bars and banks (USDA, 2004). For purposes of surveying stream habitat conditions, substrates are often categorized into size classes.

- **Wetlands:** Can be defined based on the plant communities that live in a given area. The U.S. Army Corps of Engineers defines wetlands based on a complex set of regulations, but one important element is the presence of 50% or more of species that occur in wetlands (USDA, 2004). Wetlands also have unique soil types that may be anaerobic (having no oxygen) due to water logging. Wetland soils are generally referred to as "hydric" soils.

- **Colluvial**: Rocks and soil that are sharp, angular, and originate from hillslopes.

- **Alluvial**: Rocks that are smooth, rounded, and have been eroded by water.

- **Fluvial:** Processes that are the result of a river or stream.

- **Debris flows**: Masses of mud, rocks, and sticks, or even trees that are transported down a hillslope during or after a period of heavy rainfall. Debris flows are fast-moving landslides that gain momentum until the hillslope flattens (usually near a stream) or a large object blocks the path. Debris flows can enter a stream channel and be carried by high floodwaters, or can spread out over a broad area.(USGS, 2017)

- **Stream channel complexity:** The diversity of stream channel shape and characteristics. Complex stream channels include multiple features such as pools, riffles, and runs as well as backwater channels and alcoves. These different channel features each offer different habitat characteristics that serve a diversity of plants and animals during different times of the year and different levels of streamflow and velocity.

- **Earth flow:** An earth flow is a large mass of soil that moves at a slow or moderate rate downhill. There is an active earth flow that intersects Highway 101 near Carmel Knoll.

Appendix C

Habitat Benchmarks and Monitoring

In 1998, Oregon Department of Fish and Wildlife established a monitoring program to identify salmon core areas and the Oregon Coastal Restoration Initiative designated "core areas," for salmon habitat. These are defined as "reaches or watersheds within individual coastal basins that are judged to be of critical importance to the sustenance of salmon populations that inhabit those basins," (OCSRI, 1997).

Watersheds with the Greatest Length of Salmon Core Areas		
Watershed Name	**Major Basin**	**Total Core Area (km)**
Sunshine	Siletz	41.7
Elk	Siletz	26.7
M. Five	Alsea	26
Digger	Alsea	25.1
Yaquina Headwaters	Yaquina	18.8
North Yachats	Yachats	18.6
Cerine	Siletz	17.6
L. Buck	Alsea	15.6
Birch	Alsea	15.4
U. Drift2	Alsea	14.6
Mill	Yaquina	14.3
Wildcat	Siletz	14.1
Crab	Alsea	13.9
Long Prairie	Siletz	13.7
M. Drift	Alsea	12.3
Green River	Alsea	12
North Beaver 2	Ocean Tribs	12
Upper Farm	Siletz	11.9
Gopher	Alsea	11.8
Euchre	Siletz	11
Horse	Alsea	10.9
Ryder	Alsea	10.6
Tangerman	Siletz	10.5
Simpson	Yaquina	10.5
Middle Lobster	Alsea	10.4

Between 2006 and 2010 the Oregon Department of Fish and Wildlife monitored stream habitat conditions in Western Oregon at 207 sites. Monitoring was focused on habitat for coastal Coho salmon, a federally threatened species. The streams listed in the table below were monitored for habitat suitability and do not include all of the streams that have suitable habitat for Coho salmon or other native fish and other species. The Alsea River has the most steam length with habitat that is suitable for Coho salmon (81 km; 50 mi), followed by the Yaquina River (70 km; 43 mi) and the Siletz River (68 km; 42 mi). Of the habitat monitored in the Yaquina River, 22% was labeled high quality habitat for Coho salmon. A third of monitored

habitat in Beaver Creek was high quality habitat. The Oregon Plan for Salmon and Watersheds defines high quality habitat as habitat that is capable of supporting sustainable coho populations (≥2,800 smolts/mile).

Coho Salmon Habitat Suitability				
Stream	**Kilometers with Coho Salmon**	**Number of Sites with High Quality Habitat**	**Kilometers with High Quality Habitat**	**Percent High Quality Habitat**
Alsea River	569	4	81	14%
Salmon River	108	3	13	13%
Siletz River	441	4	68	15%
Yaquina River	324	5	70	22%
Beaver Creek	65	2	22	33%

*Data from Oregon Plan for Salmon and Watersheds (Annlauf-Dunn & Jones, 2012).

The Forest Ecosystem Assessment Team (FEMAT) also identifies watersheds of ecological importance by designating areas within the Northwest Forest Plan that have good quality habitat and healthy fish populations (Reeves et al., 2006). FEMAT key watersheds are located on land that is managed by the USFS or the BLM.

FEMAT Key Watersheds	
Key Watershed Name	**Area (ac)**
DRIFT CREEK (ALSEA)	43162
CUMMINS/TENMILE/ROCK/BIG CREEKS	41027
YACHATS RIVER	27760
DRIFT CREEK (SILETZ)	26544
UPPER LOBSTER CREEK	26391
N. FORK SILETZ FIVE R/WARNICKE CREEK	11547
N. FORK BEAVER CREEK	7547
MILL CREEK	2899
TOBE CREEK	1856

Appendix D

Restoration Projects and Expenditures in the Mid-Coast
Reported to the Oregon Watershed Enhancement Board

Restoration Projects and Expenditures in the Mid Coast[1]

Salmon River Restoration Projects, Funding & Expenditures						
Project Name	**Project Year**	**Stream Name**	**Project Description**	**Landowners**	**Cost**	**In-Kind Contributions**
Pixieland Phase I - Restoration	2011	Salmon R	Main stream channel modified / created; Estuarine connection restored by dike or berm modification / removal	USFS	$203,816	$99,070
Prairie Creek Bridge	2012	Prairie Cr	Culverts/structures/fords replaced with bridges; Road obliterated, decommissioned, or vacated; Culverts/structures/fords removed and not replaced	Miami Corporation	$89,700	$15,200
Pixieland Phase I - Riparian Planting	2011	Salmon R	Wetland treated for non-native or noxious plant species; Estuary treated for non-native or noxious plant species	USFS	$42,263	$30,070
Pixieland Restoration Phase II	2014	Salmon R	Estuarine connection restored by dike or berm modification / removal; Existing estuary improved by channel modification; Tidegate removed and not replaced	USFS	$251,135	$99,070

[1] According to OWEB, the 2011 to 2015 data set is currently the most comprehensive 5-year dataset. Between 2011 and 2015, $4,477,394 was spent on restoration projects in the Mid Coast with an additional $1,155,216 for in-kind contributions for a total of $5,632,610.

Salmon River Restoration Projects, Funding & Expenditures						
Project Name	**Project Year**	**Stream Name**	**Project Description**	**Landowners**	**Cost**	**In-Kind Contributions**
Salmon River Fish Carcass Placement (Re: 2006/2007 MOA Between ODF&W & ODEQ) - 2014	2014	^Deer Cr, Sulfur Cr, Alder Brook, Prairie Cr, Indian Cr, Slick Rock	Salmon carcasses placed	Miami Corporation	$0	$1,000
Lower Salmon River Lessons Learned Report and Crowley Creek Restoration	2014	Crowley Cr	Estuarine connection restored by dike or berm modification / removal; Wetland vegetation planted; Wetland treated for non-native or noxious plant species; Culverts/structures/fords replaced with culverts placed embedded or flat	ODFW; USFS	$99,529	$38,247
Boat Basin Salmon River and Mink Creek Restoration	2014	Salmon R	Estuary treated for non-native or noxious plant species; Estuarine vegetation planted; Existing estuary improved by channel modification; Estuarine connection restored by dike or berm modification / removal	USFS	$133,543	$14,727
Salmon River Fish Carcass Placement (Re: 2006/2007 MOA Between ODF&W & ODEQ) - 2015	2015	^Prairie Cr, Sulfur Cr, Deer Cr	Salmon carcasses placed	Miami Corporation	$0	$1,000

Siletz River Restoration Projects, Funding & Expenditures						
Project Name	**Project Year**	**Stream Name**	**Project Description**	**Landowners**	**Cost**	**In-Kind Contributions**
Ojalla Creek Instream Habitat Restoration	2011	Ojalla Cr	Large wood placed	Private Landowner; Private Landowner; Private Landowner	$24,940	$8,960
630 Road/170 Road Connector - 2011	2011	North Fork Siletz R	Culverts/structures/fords removed and not replaced	Miami Corporation	$28,200	$0
1000 Road East Pipe	2011		Culverts/structures/fords replaced with culverts placed embedded or flat	Forest Capital Partners, LLC	$23,102	$0
1000 Road West Pipe	2011		Culverts/structures/fords replaced with culverts placed embedded or flat	Forest Capital Partners, LLC	$16,415	$0
1000 Road West Pipe	2011		Culverts/structures/fords replaced with culverts placed embedded or flat	Forest Capital Partners, LLC	$9,600	$0
Kelty Loop Pipe	2011		Structures replaced to meet 50+ year flow requirements	Forest Capital Partners, LLC	$9,464	$0
Schooner Creek Dam Removal	2011		Dam removed	Forest Capital Partners, LLC	$5,857	$0
Lost Name Fill Removals	2011		Stream crossings with log fills/culverts removed and not replaced	Forest Capital Partners, LLC	$17,744	$0

Siletz River Restoration Projects, Funding & Expenditures						
Project Name	**Project Year**	**Stream Name**	**Project Description**	**Landowners**	**Cost**	**In-Kind Contributions**
700 Road Decommissioning	2011		Road obliterated, decommissioned, or vacated; Stream crossings with log fills/culverts removed and not replaced	Forest Capital Partners, LLC	$4,700	$0
Meat Loaf North Reconstruction	2011		Grass seeding and mulching; Structures replaced to meet 50+ year flow requirements; Road durable rocking or quality hard road rocking prior to haul; Permanent cross-drains added above stream crossings	Forest Capital Partners, LLC	$73,060	$0
Kosydar Streambank Restoration	2012	Siletz R	Stream bank stabilized: log revetment installed; Stream bank stabilized: bank resloped; Stream bank stabilized: bioengineering	Private Landowner	$92,200	$17,700
Siletz Tidal Salt Marsh Connectivity and Fish Passage	2013	Cutler City Area Tidal Marsh	Culverts/structures/fords replaced with culverts placed embedded or flat; Estuarine connection restored by estuarine culvert modification / removal; Large wood placed	ODOT	$900,765	$3,200

Siletz River Restoration Projects, Funding & Expenditures						
Project Name	**Project Year**	**Stream Name**	**Project Description**	**Landowners**	**Cost**	**In-Kind Contributions**
Hooper Rain Water Harvest Project	2013	Baker Cr	Other irrigation practice improvement (for instream flow)	Private Landowner/Operator	$11,711	$7,307
Valsetz Dam Removal	2012	South Fork Siletz R	Dam removed	Hoskins Valley Timber LLC	$62,857	$0
Green Acres Manure Facility Project	2014	Sied Cr, Rock Cr	Livestock manure management	Private Landowner	$29,959	$15,945
Lower Schooner Creek Fish Passage Improvement Project	2014	Schooner Cr	Culverts/structures/fords replaced with culverts placed embedded or flat	Hancock Timber Resources Group	$31,905	$11,240
Troyer Pump	2013	Siletz R	New fish screens installed on diversions (where no screen had existed previously)	Private Landowner	$3,898	$0
Big Rock LW Placement	2014	Big Rock Cr	Rootwads placed; Stream bank stabilized: log revetment installed	Private Landowner	$0	$4,689
				Total:	$1,346,377	$69,041

Yaquina River Restoration Projects, Funding & Expenditures						
Project Name	**Project Year**	**Stream Name**	**Project Description**	**Landowners**	**Cost**	**In-Kind Contributions**
West Olalla Passage	2011	West Olalla Cr	Culverts/structures/fords replaced with culverts placed embedded or flat	Private Landowners (multiple)	$16,493	$5,000
NE0962, Jack Creek Salmon Enhancement	2011	Jack Cr	Culverts/structures/fords replaced with culverts placed embedded or flat; Road relocated to reduce washout potential; Road durable rocking or quality hard road rocking prior to haul	Hancock Forest Management	$41,000	$0
Althea Springs Riparian Restoration Project	2012	Spout Cr	Riparian treated for non-native or noxious plant species; Riparian trees planted: conifer	Private Landowner	$1,585	$2,375
Poole Slough Upland Enhancement	2012	Poole Slough	Upland trees planted; Upland treated for non-native or noxious plant species	Private Landowner	$4,412	$12,088
Feagles Creek Channel Restoration	2012	Feagles Cr	Main stream channel modified / created; Riparian trees planted: conifer and hardwood	Thompson Gates Timber	$14,790	$5,060
Slack Creek LW Placement	2012	Slack Cr	Large wood placed	Plum Creek Timberlands	$5,309	$700

Yaquina River Restoration Projects, Funding & Expenditures						
Project Name	**Project Year**	**Stream Name**	**Project Description**	**Landowners**	**Cost**	**In-Kind Contributions**
Big Elk Sediment Reduction	2012	Big Elk Cr	Structures replaced to meet 50+ year flow requirements; Road durable rocking or quality hard road rocking prior to haul	Private Landowner	$12,627	$2,430
Yaquina River Beaver Habitat Restoration	2012	Trib X	Beaver management; Riparian trees planted: hardwood	Private Landowner	$40,912	$2,680
Feagles Creek Riparian Restoration	2012	Feagles Cr	Riparian fencing; Riparian trees planted: conifer and hardwood	Private Landowner	$81,670	$19,760
S Edwards Leave Tree to RMA	2011	Ramsdall Cr	Voluntary riparian tree retention	Starker Forests, Inc.	$0	$0
Beaver Creek Restoration Project	2013	Beaver Cr	Large wood placed; Riparian treated for non-native or noxious plant species; Riparian shrubs or herbaceous vegetation planted/reseeded; Existing grass/herb meadow wetland improved; Wetland vegetation planted; Riparian trees planted: conifer and hardwood	Sitka Springs Farm	$69,510	$17,460

Yaquina River Restoration Projects, Funding & Expenditures						
Project Name	**Project Year**	**Stream Name**	**Project Description**	**Landowners**	**Cost**	**In-Kind Contributions**
Upper Yaquina Restoration Phase I	2013	Yaquina R, & Yaquina R, tribs of	Large wood placed; Riparian trees planted: conifer and hardwood; Culverts/structures/fords removed and not replaced; Culverts/structures/fords replaced with bridges; Culverts/structures/fords replaced with culverts placed embedded or flat; Culverts with r	Private Landowner; Private Landowner; Private Landowner; Hull-Oakes Lumber Co.; Private Landowner; Private Landowner; Private Landowner; Private Landowner	$236,580	$17,400
Peterson Cr LW & Fish Passage	2012	Peterson Cr	Large wood placed; Culverts/structures/fords replaced with culverts placed embedded or flat	ODF	$36,268	$8,140
Davidson Riparian Restoration Project	2014	Yaquina R	Upland fencing; Riparian trees planted: conifer and hardwood; Riparian treated for non-native or noxious plant species	Private Landowner	$10,731	$1,184
Upper Spout Fish Passage	2013	Spout Cr	Culverts/structures/fords removed and not replaced; Culverts/structures/fords replaced with culverts placed embedded or flat	Thompson Tree Farm & Cooper Tree Farm	$16,394	$4,000

Yaquina River Restoration Projects, Funding & Expenditures						
Project Name	**Project Year**	**Stream Name**	**Project Description**	**Landowners**	**Cost**	**In-Kind Contributions**
Upper Big Elk LW Placement	2013	Big Elk Cr	Large wood placed; Rootwads placed	Van Eck Forest Trust	$7,660	$6,200
Bear LW Placement	2012	Big Elk Cr	Large wood placed; Rootwads placed	Private Landowner	$12,020	$10,500
Wolf LW Placement	2014	Wolf Cr	Large wood placed	ODF	$11,159	$23,652
Big Elk Creek Riparian Project	2015	Big Elk Cr	Stream bank stabilized: bioengineering; Riparian fencing; Riparian trees planted: conifer and hardwood; Riparian shrubs or herbaceous vegetation planted/reseeded; Off-channel watering sites developed	Private Landowner	$14,271	$4,608
Valentine Ranch Water Quality Project	2015	Big Elk Cr	Riparian treated for non-native or noxious plant species; Livestock stream access/crossing created or improved; Riparian fencing; Riparian trees planted: conifer and hardwood; Water gap constructed; Livestock manure management; Mud management / Heavy use	Private Landowner	$41,172	$1,544

Yaquina River Restoration Projects, Funding & Expenditures						
Project Name	**Project Year**	**Stream Name**	**Project Description**	**Landowners**	**Cost**	**In-Kind Contributions**
Upper Yaquina Restoration Phase II	2015	Yaquina R	Large wood placed; Riparian treated for non-native or noxious plant species; Livestock stream access/crossing created or improved; Riparian fencing; Riparian trees planted: conifer and hardwood; Off-channel watering sites developed	Private Landowner; Private Landowner; Private Landowner; Private Landowner; Starker Forests, Inc.	$276,881	$75,187
Kingery Bridge	2015	Big Elk Cr	Structures replaced to meet 50+ year flow requirements	Private Landowner	$32,765	$600
Lower Yaquina and North Fork Beaver Creek Watershed Restoration - EF Mill Creek	2014	East Fork Mill Cr	Large wood placed	Plum Creek Timber Company	$49,013	$56,430
Lower Yaquina and North Fork Beaver Creek Watershed Restoration - Wright Creek	2015	Wright Cr	Large wood placed; Riparian treated for non-native or noxious plant species; Riparian trees planted: conifer and hardwood; Other riparian vegetation management	Van Eck Forest Foundation	$108,702	$13,242

Yaquina River Restoration Projects, Funding & Expenditures						
Project Name	**Project Year**	**Stream Name**	**Project Description**	**Landowners**	**Cost**	**In-Kind Contributions**
Lower Yaquina and North Fork Beaver Creek Watershed Restoration - Poole Slough	2014	Poole Cr	Large wood placed	The Wetlands Conservancy	$133,645	$1,088
				Total:	$1,275,569	$291,328

Alsea River Restoration Projects, Funding & Expenditures						
Project Name	**Project Year**	**Stream Name**	**Project Description**	**Landowners**	**Cost**	**In-Kind Contributions**
Richardson Water Source Development	2015	Alsea R	Off-channel watering sites developed	Private Landowner	$10,277	$3,200
Simonson riparian fencing, livestock water	2012	Baker Cr	Riparian fencing; Off-channel watering sites developed	Private Landowner	$11,822	$2,123
Zahn SW	2012	Baker Cr	Voluntary riparian tree retention	Weyerhaeuser Company	$0	$0
Bummer Creek Restoration	2012	Bummer Cr	Large wood placed; Riparian trees planted: conifer; Riparian treated for non-native or noxious plant species; Riparian fencing; Nursery operation; Culverts/structures/fords replaced with culverts placed embedded or flat; Previously filled or drained wetla	Private Landowner; Private Landowner; Private Landowner; Private Landowner	$150,527	$81,435
Easter Egg	2013	Easter Cr	Voluntary riparian tree retention	Weyerhaeuser Company	$0	$0
Fall Creek Tie	2012	unnamed trib	Voluntary riparian tree retention	Weyerhaeuser Company	$0	$0
Hayden Pond	2012		Voluntary riparian tree retention	Weyerhaeuser Company	$0	$0
Bluebird	2012		Voluntary riparian tree retention	Weyerhaeuser Company	$0	$0

Alsea River Restoration Projects, Funding & Expenditures						
Project Name	**Project Year**	**Stream Name**	**Project Description**	**Landowners**	**Cost**	**In-Kind Contributions**
Poked Again	2011	Alsea R, trib of	Voluntary riparian tree retention	Weyerhaeuser Company	$0	$0
Salmonberry Hayden	2013	Alsea R, trib of	Voluntary riparian tree retention	Weyerhaeuser Company	$0	$0
Canal Creek Stream Enhancement Project	2012	Canal Cr	Stream bank stabilized: log and rock revetment installed; Riparian trees planted: conifer and hardwood	Private Landowner; Private Landowner	$29,654	$30,200
City of Waldport	2013	Eckman Cr	New fish screens installed on diversions (where no screen had existed previously)	City of Waldport	$4,050	$0
Plum View Leave Tree to RMA	2012	Hayden Cr	Voluntary riparian tree retention	Starker Forests, Inc.	$0	$0
Mid S Pearl Leave Tree to RMA	2012	Hayden Cr	Voluntary riparian tree retention	Starker Forests, Inc.	$0	$0
Seeley Creek Pipe Replacement	2013	Seeley Cr	Culverts/structures/fords replaced with culverts placed embedded or flat	Weyerhaeuser Company	$55,000	$0
Cheeke Pump	2012	South Fork Alsea R	New fish screens installed on diversions (where no screen had existed previously)	Private Landowner	$4,462	$0
Hayden Headwaters	2013	Birch Cr, trib of	Voluntary riparian tree retention	Weyerhaeuser Company	$0	$0
Tom Hayden	2013	Birch Cr, trib of	Voluntary riparian tree retention	Weyerhaeuser Company	$0	$0

Alsea River Restoration Projects, Funding & Expenditures						
Project Name	**Project Year**	**Stream Name**	**Project Description**	**Landowners**	**Cost**	**In-Kind Contributions**
S Wilson Creek Leave Tree to RMA	2012	Wilson Cr	Voluntary riparian tree retention	Starker Forests, Inc.	$0	$0
Mid Nelson 2 Leave Tree to RMA	2012	Earnest Cr	Voluntary riparian tree retention	Starker Forests, Inc.	$0	$0
Flynn Creek Large Wood Placement	2013	Flynn Cr	Large wood placed	Plum Creek Timber Company	$11,240	$9,132
Five Rivers (Alsea) Sub-basin Restoration LFA Prescriptions Phase I	2015	^Alder Cr, Prindle Cr, Alder Cr, Crazy Cr	Large wood placed; Riparian treated for non-native or noxious plant species; Riparian trees planted: conifer and hardwood; Riparian shrubs or herbaceous vegetation planted/reseeded	Prindel Creek Farm; Private Landowner	$73,113	$30,060
Lobster & Preacher Creek Restoration Project - Lobster Creek Site	2014	Lobster Cr	Stream bank stabilized: bioengineering; Anchored habitat structures placed; Riparian trees planted: conifer	Private Landowner	$207,703	$41,699

Alsea River Restoration Projects, Funding & Expenditures						
Project Name	**Project Year**	**Stream Name**	**Project Description**	**Landowners**	**Cost**	**In-Kind Contributions**
Lobster & Preacher Creek Restoration Project - Preacher Creek Site	2014	Preacher Cr	Stream bank stabilized: bank resloped; Rootwads placed; Large wood placed; Riparian fencing; Riparian trees planted: conifer and hardwood	Private Landowner	$28,600	$22,410
Headrick Corner	2011	Headrick Cr, trib of	Voluntary riparian tree retention	Weyerhaeuser Company	$0	$0
Honey Head	2011	Headrick Cr, trib of	Voluntary riparian tree retention	Weyerhaeuser Company	$0	$0
Honey Comb	2011	Honeygrove Cr, trib of	Voluntary riparian tree retention	Weyerhaeuser Company	$0	$0
Honey Dew	2011	Honeygrove Cr, trib of	Voluntary riparian tree retention	Weyerhaeuser Company	$0	$0
Honeygrove Hobbit	2013	Honeygrove Cr, trib of	Voluntary riparian tree retention	Weyerhaeuser Company	$0	$0
Deer Cr LW Placement	2012	Deer Cr	Large wood placed	Plum Creek Timberlands	$2,920	$700
Bowers Creek Restoration Project	2013	Bowers Cr	Culverts/structures/fords replaced with culverts placed embedded or flat	Private Landowner	$5,619	$13,290
Lower Yaquina and North Fork Beaver Creek Watershed Restoration - Peterson Cr	2015	Peterson Cr	Large wood placed	Hitselberger Ranch	$6,535	$29,213

Alsea River Restoration Projects, Funding & Expenditures						
Project Name	**Project Year**	**Stream Name**	**Project Description**	**Landowners**	**Cost**	**In-Kind Contributions**
Van Horn West	2013	Salmonberry Cr, trib of	Voluntary riparian tree retention	Weyerhaeuser Company	$0	$0
Bell 300 Corner	2013	Peak Cr	Voluntary riparian tree retention	Weyerhaeuser Company	$0	$0
Trout Creek Basin Improvements	2011	Trout Cr	Riparian trees planted: hardwood; Large wood placed; Culverts/structures/fords replaced with culverts placed embedded or flat	Weyerhaeuser Company	$121,675	$81,276
Trout Creek 10	2013	Trout Cr, trib of	Voluntary riparian tree retention	Weyerhaeuser Company	$0	$0
				Total:	$723,197	$344,738

Yachats River Restoration Projects, Funding & Expenditures						
Project Name	**Project Year**	**Stream Name**	**Project Description**	**Landowners**	**Cost**	**In-Kind Contributions**
Upper Yachats River Restoration	2011	Yachats R	Riparian trees planted: conifer and hardwood; Riparian fencing	Private landowner - Property 2; Private landowner - Property 1	$10,282	$4,472
03-10-008 Mackall Riparian Planting	2011	Yachats R	Riparian fencing; Riparian trees planted: conifer; Riparian shrubs or herbaceous vegetation planted/reseeded; Riparian treated for non-native or noxious plant species	Private Landowner	$11,226	$7,526
Yachats Clematis Control	2012	Yachats R	Riparian treated for non-native or noxious plant species; Grass seeding and mulching; Riparian trees planted: conifer; Riparian shrubs or herbaceous vegetation planted/reseeded	Lincoln County	$12,343	$8,161
Lincoln County Clematis Control	2012	Yachats R	Upland treated for non-native or noxious plant species	Lincoln County Road Department	$4,060	$2,000

Yachats River Restoration Projects, Funding & Expenditures						
Project Name	**Project Year**	**Stream Name**	**Project Description**	**Landowners**	**Cost**	**In-Kind Contributions**
Triple D Water Quality Improvement Project	2014	Yachats R	Livestock manure management; Mud management / Heavy use area protection; Structures replaced to meet 50+ year flow requirements	Private Landowner	$9,699	$3,100
NE1068, Yachats Downhill	2011	South Beamer Cr	Riparian conifer restoration (hardwood conversion)	Hancock Forest Management	$0	$0
				Total:	$47,610	$25,259

Appendix E

ODFW and OWRD
Streamflow Restoration
Priorities in the Mid-Coast

N

5 0 5 10 15 20 Miles

Mid Coast Basin

SUMMER
(July - September)

Flow Restoration Priorities for Recovery of Anadromous Salmonids in Coastal Basins

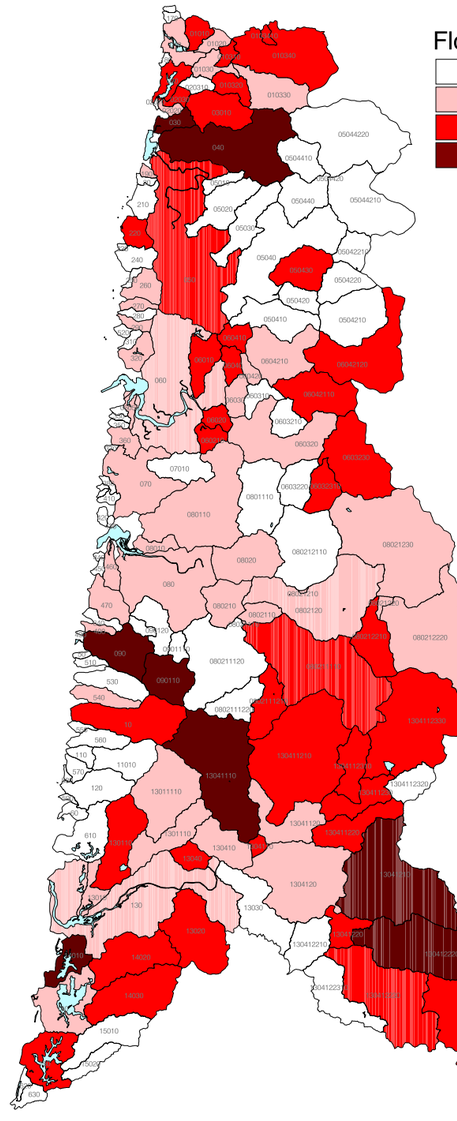
The Oregon Plan

Streamflow Restoration Priorities
Measure IV.A.8

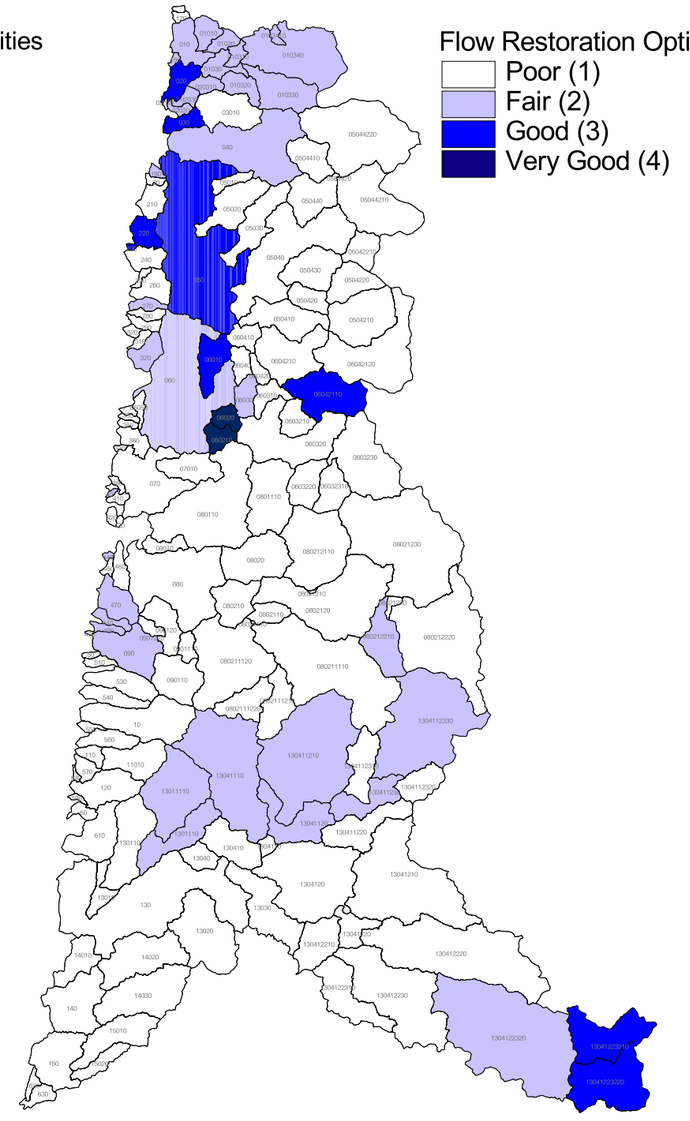
Instream Water Right Program
Habitat Conservation Division

Field and Technical
Services Division

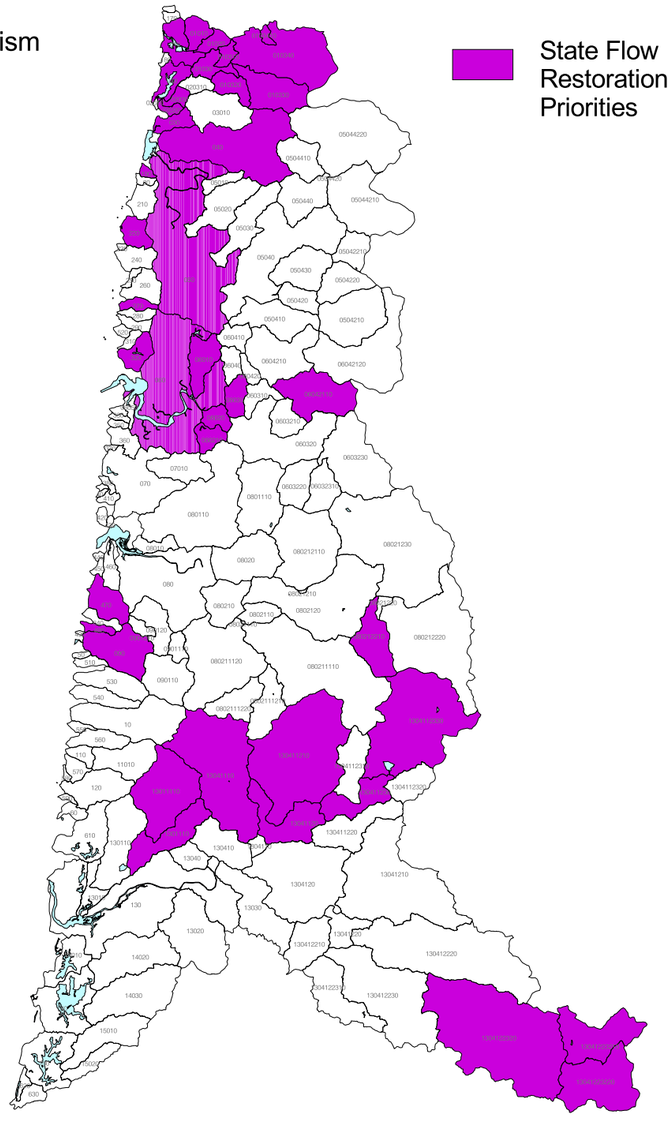
Location Map



Flow Restoration Priorities
- Low (1)
- Moderate (2)
- High (3)
- Highest (4)

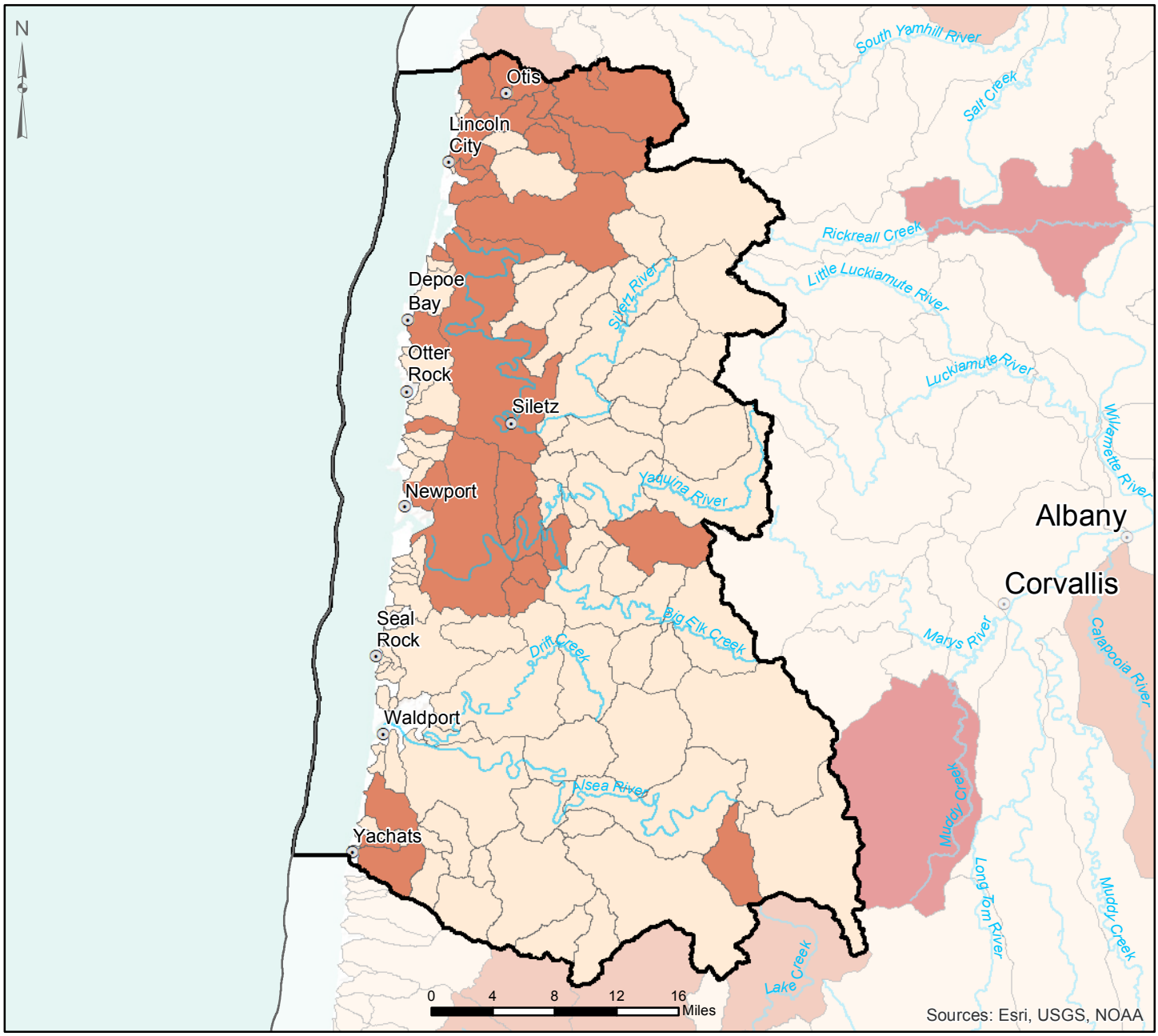


Flow Restoration Optimism
- Poor (1)
- Fair (2)
- Good (3)
- Very Good (4)



State Flow Restoration Priorities

Mid-Coast Region Study Area
Streamflow Restoration Priorities
Summer Season



Combined Priorities (Summer Season)

- Priority
- Current resources priority
- Not a priority

Description:

The Oregon Water Resources Department and the Oregon Department of Fish and Wildlife jointly identified priority areas for streamflow restoration in basins throughout the state. These priority areas represent watersheds in which there is a combination of need and opportunity for flow restoration to support fish recovery efforts under the Oregon Plan for Salmon and Watersheds. The Oregon Water Resources Department is focusing its efforts to aid in recovery of salmonids on these priority areas.

Map produced by:
Oregon Water Resources Department
725 Summer St. NE Suite A
Salem, OR 97301

Map date: October 24, 2016

Sources:
Stream flow restoration priorities, Oregon Water Resources Department, Oregon Department of Fish and Wildlife, 2003

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Appendix F

Species of Interest in the Mid Coast

Conservation Strategy Fish Species in the Mid Coast[1]					
Common Name	**State Listing Status**	**Federal Listing Status**	**Limiting Factors**	**Distribution**	**Life Cycle**
Chum salmon	Sensitive	N/A	Altered flow and watershed function; Fish passage; Loss of estuarine habitat.	Near tidewater in several streams	Spawning in streams tributary to estuaries.
Coastal cutthroat trout	Sensitive	Species of Concern	Habitat fragmentation; water quality; altered flow and watershed function; loss of estuarine habitat.	Nearly all streams and lakes	Present Mar.-Dec. Spawning Jan.-Mar.
Coho salmon	Sensitive	Threatened	Water quality; fish passage; altered flow and watershed function.	Most streams with sufficient flows	Enter freshwater Sept.-Nov. Spawning Nov.-Jan.
Spring chinook	Sensitive	N/A	Water quality; altered flow and watershed function; fish passage; riparian condition. Scarcity of pool habitat and warm summer water temperatures limit spring chinook abundance.	Salmon, Siletz, Yaquina, Alsea, and Siuslaw River Systems and Beaver Creek	Enter freshwater in Sept. and Oct. Spawning Oct.-Dec.
Fall chinook	Not listed in Mid-Coast	Not listed in Mid-Coast	Water quality; altered flow and watershed function; fish passage; riparian condition. Scarcity of pool habitat and warm summer water temperatures limit spring chinook abundance.	Salmon, Siletz, and Alsea River systems	Enter freshwater in spring months. Spawning Sept.-Oct.
Winter Steelhead	Not listed in Mid-Coast	Not listed in Mid-Coast	Migration barriers (specifically Alsea Falls, Siletz Falls, and Bear Creek falls);	Most streams with sufficient flows	Present Jan., and May-June. Spawning Feb.-Apr.
Summer Steelhead	Sensitive	Species of Concern	Altered flow and watershed function; migration barriers; riparian condition; marine survival.	Salmon, Siletz and Alsea Rivers	Present Jun.-Mar. Spawning Mar.-May.
Sturgeon	Sensitive	Threatened (Green Sturgeon Southern DPS)	Limited spawning habitat; water quality; dredging; incidental catch by trawl; poaching.	Lower sections of larger streams. Occasionally in Siltcoos Lake	Young and juveniles reside in freshwater. Adult migration to freshwater: Feb.; Spawning: Mar.-Jul.
Brook lamprey	Sensitive	N/A	Water quality; passage barriers (road culverts, dams); altered flow; dredging.	Several streams; sand/silt substrates near pools and coarser sand/gravel substrates.	Largely unknown.
Pacific lamprey	Sensitive	Species of Concern	Water quality; passage barriers (road culverts, dams); dredging; altered flow patterns; lack of lamprey-friendly screening of water diversions; urban and ag. Development of low-gradient floodplain habitat.	Most streams; sand/silt substrates near pools and coarser sand/gravel substrates.	Metamorphism probably Jul.-Nov.; outmigration to ocean Nov.-Jun., peaking in spring, possibly occurring in winter or fall; downstream movement at night.
River lamprey	Sensitive	Species of Concern	Unknown	Unknown	Unknown.

[1] Other native species include Kokanee salmon (present in several lakes), and Shad (present in Siuslaw River and small numbers in Siletz, Yaquina, and Alsea Rivers).

Other Conservation Strategy Species					
Common Name	**State Listing Status**	**Federal Listing Status**	**Concerns**	**Distribution**	**Life Cycle**
Western Snowy Plover	Threatened	Threatened	Dune stabilization using vegetation or fencing, construction of breakwaters and jetties, sand deposition, off-road vehicles, and other recreational activities that disturb plovers or attract predators. European beachgrass.	Nesting in flat, open areas that are sparsely vegetated with sandy or salty substrates. Forage in surf-cast kep in the intertidal zone, on salt pans, and on edges of salt marshes, salt ponds, and lagoons.	Nesting from early March through late September. Fledging through late September. Leve nests within hours of hatching.
Oregon Silverspot Butterfly	Threatened	Threatened	Reduction of suitable habitat, including salt-spray meadow habitat. Reduction of habitat is due to domestic animal grazing, off-road vehicles, and residential and business developments. Introduction of exotic species.	Grassland habitats, including marine terrace, coastal headland salt-spray meadows, stabilized dunes, and montane grasslands. Areas where blue violet flowers and red fescue grass are present.	Usually feeds and develops as larva on blue violets. Adults move out of the meadows into edge habitat with conifers and brush.

Conservation Strategy Amphibians and Reptiles			
Common Name	**State Listing Status**	**Federal Listing Status**	**Limiting Factors**
Southern torrent salamander	Sensitive	Species of Concern	Dispersal capability; flow alteration; drought conditions.
Coastal tailed frog	Sensitive	Species of Concern	Restricted range; reproductive rate; dispersal capability; sedimentation; water temperature.
Clouded salamander	Sensitive	N/A	Availability of microhabitat features (possibly large, cool, moist logs)
Columbia torrent salamander	Sensitive	N/A	Limited dispersal capability; sensitive to desiccation; larvae are vulnerable to changes in streamflow
Cope's giant salamander	Sensitive	N/A	Channel dewatering; barriers to stream connectivity; increases in temperature and sediment.
Del Norte salamander	Sensitive	Species of Concern	Requires closed-canopy forests with mixed hardwood/conifer; prefers late-seral forests.
Foothill yellow-legged frog	Sensitive-Critical	Species of Concern	Habitat loss; streamflow modifications; loss of gravel bars and low-flow nursery areas; possibly sedimentation and waterborne pathogens.
Western toad	Sensitive	N/A	Loss of breeding habitat; streamflow modification; siltation; road mortality; recreational impacts.
Western pond turtle	Sensitive	Species of Concern	Habitat loss; alteration of nesting sites (invasive species and habitat loss); road mortality; predation by raccoons, fish, and bullfrogs; competition with invasive turtles.
Western painted turtle	Sensitive	N/A	Habitat loss; alteration of nesting sites (invasive species and habitat loss); road mortality; predation by raccoons, fish, and bullfrogs; competition with invasive turtles.

Appendix G

Non-Native and Invasive Species in the Mid-Coast

Invasive Species in the Mid Coast[1]		
Common Name	**Status**	**Concerns**
Bull frog	Invasive	Outcompete native species; eat native species incl. fish, reptiles, small mammals, birds, amphibians, and insects; thrive in ponds, lakes, marshes, sloughs, irrigation ditches; tolerate wide range of temperature;
Asian carp or Silver carp	Invasive	Outcompetes native fish for food and space; eat phytoplankton, increasing algae.
Common snapping turtle	Invasive-prohibited	Compete with native turtles for food and shelter; found in ponds, lakes, sloughs, or slow moving rivers; eats aquatic vegetation, amphibians, crayfish, worms, birds, small mammals, and other turtles.
Red-eared slider turtle	Invasive-prohibited	See common snapping turtle.
Asian Knotweeds	Invasive-B noxious weed	No natural predators; competes with native vegetation along floodplains; increases soil erosion; contributes to low oxygen levels.
Policeman's Helmet	Invasive-B noxious weed	Invades forests along riparian areas; outcompetes native species during spring and summer; alter vegetation communities.
Yellow Flag Iris	Invasive-B noxious weed	Grows in wetlands and streams and outcompetes native vegetation; chokes waterways; alter flow regime; not a food source for wildlife.
Purple Loosestrife	Invasive-B noxious weed	Dispersed by moving water; decreased waterfowl and songbird production; endangers wetland plant and animal populations
Giant Hogweed	Invasive-A and T noxious weed	Health hazard to humans (severe burns).

[1] Table only includes species that spend a portion of their life cycle in or near freshwater. "---" indicates information was not obtained for this report.

Common Name	Status	Concerns
Yellow Floating Heart	Invasive-A and T noxious weed	Creates stagnant areas not suitable for other species; makes it difficult to fish, water ski, swim, or paddle; displaces native plants and animals; impedes flow in irrigation canals.
Reed Canarygrass	---	---
Canada Thistle	Invasive-B noxious weed	Displaces native vegetation.
Butterfly Bush (Buddleja davidii/B.variabilis)	Invasive-B noxious weed	Threat to dry-land meadows and open slopws; invades reforested sites and right-of-ways.
False Brome (Brachypodium sylvaticum)	Invasive-B noxious weed	Young tree damage; restricts native oak regeneration; toxic to livestock.
Herb Robert (Geranium robertianum)	Invasive-B noxious weed	Can be spread by water movement; outcompetes native plants.
Old Man's Beard (Clematis vitalba)	Invasive-B noxious weed	Can be spread by water movement; prevents native plant regeneration.
Spurge Laurel (Daphne laureola)	Invasive-B noxious weed	Threatens oak woodland habitat; toxic to humans.
English laurel	---	Outcompete native forest species; poisonous.
Sweet Fennel	---	Outcompetes native vegetation; threat to native grasslands.
Yellow Archangel	---	Outcompetes native vegetation; poor food and shelter for wildlife.
Japanese Dodder	Invasive-A noxious weed	Parasitic vine that kills host plants; impacts food supplies, nesting habitat, streamside shading, and erosion control; risk to commercial fruit and nut trees; host for several viruses.
Rock Snot	---	Affects stream habitat and sources of food for fish; spreads easily in water.

Common Name	Status	Concerns
Asian Grass Carp	Federally regulated: injurious wildlife	Competition for food; changes in macrophyte, phytoplankton, and invertebrate communities; interferes with reproduction of other fishes; modifies preferred habitat; decreases refugia for other fishes; predator when food is scarce; alters food web.
Northern Pike	---	Large-scale changes in fish communities, even species elimination; predation of native species; competition with native fish species for food and habitat.
Oregon iMapInvasives is a tool for online invasives species data management where you can view county or watershed distributions of invasive species.		
WeedMapper is a tool provided by the Oregon Department of Agriculture to map weeds and invasive species distribution throughout the state.		

Non-Native Fish Species in the Mid Coast	
Species Common Name	**Distribution**
Striped Bass	Siuslaw River and Siltcoos Lake
Largemouth Bass	Rare in Siletz River; Several Lakes
Bluegill	Several Lakes
Pumpkinseed	Triangle Lake
Carp	Cleawox Lake
Crappie (white and black)	Several Lakes

Appendix H

ODFW Fish Passage Priority List:

Mid-Coast Priority Fish Passage Barriers

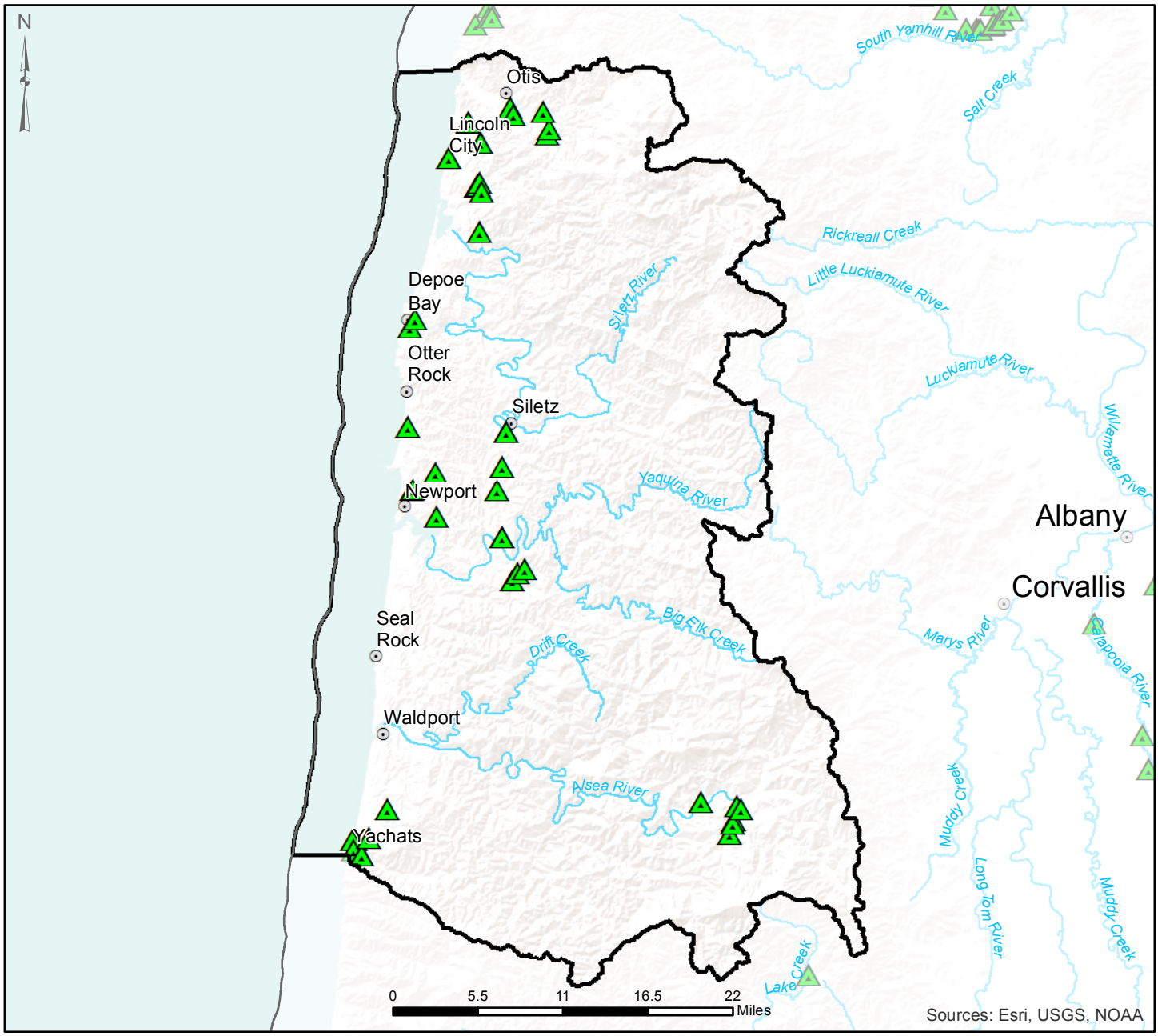
ODFW 2013 Statewide Fish Passage Priority List					
Owner	**Barrier Name**	**Type**	**Stream Name**	**Basin**	**Species blocked at barrier and biological status**
USFS	Unnamed culvert	Culvert	North Creek	Siletz	Fall Chinook, Coho (fT), Winter Steelhead, pacific lamprey
Cascade/ODFW	Valsetz Lake Sills Dam	Dam	South Fork Siletz River	Siletz (completed)	Summer Steelhead, pacific lamprey
Unknown	Bull Creek Culvert	Culvert	Bull Creek	Yaquina (completed)	Coho (fT), Winter Steelhead, cutthroat, pacific lamprey
	Unnamed culvert	Culvert	Unnamed trib to Deer Creek	Yaquina	Coho (fT), Winter Steelhead, cutthroat, pacific lamprey
Lincoln County	Unnamed culvert	Culvert	Unnamed Stream	??	Coho (fT), Winter Steelhead, cutthroat, pacific lamprey
Lincoln County	Unnamed culvert	Culvert	Unnamed Stream	??	Coho (fT), Winter Steelhead, cutthroat, pacific lamprey
	Unnamed culvert	Culvert	Parker Creek	Alsea	Coho (fT), Winter Steelhead, cutthroat, pacific lamprey
USFS	Unnamed culvert	Culvert	Branch Creek	Siletz	Coho (fT), Winter Steelhead, cutthroat
Lincoln County	Unnamed culvert	Culvert	Little Creek	pacific ocean trib.	Coho (fT), Pacific lamprey, cutthroat
Boise Cascade	Beaver Creek Culvert	Culvert	Beaver Creek	Siletz (completed)	Summer Steelhead, pacific lamprey

ODFW 2013 Statewide Fish Passage Priority List					
Owner	**Barrier Name**	**Type**	**Stream Name**	**Basin**	**Species blocked at barrier and biological status**
	Unnamed culvert	Culvert	Drift Creek	Siletz	Summer Steelhead, pacific lamprey
Lincoln County	Unnamed culvert	Culvert	Blair Creek	Alsea	Coho (fT), Winter Steelhead, cutthroat, pacific lamprey
	Unknown	Dam	Kelly Creek	alsea	Coho (fT), Winter Steelhead, cutthroat
Lane County	Unnamed culvert	Culvert	Lord Creek	Alsea	Coho (fT), Winter Steelhead, cutthroat, pacific lamprey
Lincoln County	Unnamed culvert	Culvert	Cougar Creek	Alsea	Coho (fT), Winter Steelhead, cutthroat
Gygi & Engel	Gygi & Engel Reservoir	Dam	Banton Creek	Alsea	Coastal cutthroat (historical), Coho (fT)
Unknown	Meadow Creek Log Pond (Mill Pond Dam)	Dam	Meadow Creek	Alsea	Coho (fT), Winter Steelhead, cutthroat, pacific lamprey
	Unnamed culvert	Culvert	Honey Grove Creek	Alsea	Coho (fT), Winter Steelhead, cutthroat, pacific lamprey
	Unnamed culvert	Culvert	Honey Grove Creek	Alsea	Coho (fT), Winter Steelhead, cutthroat, pacific lamprey

Appendix I

Significant Points of Diversion
Identified by OWRD

Mid-Coast Place-Based Planning Area
Significant Points of Diversion



Significant Points of Diversion

Description:

Significant points of diversions are diversions that are located in Priority Water Availability Basins (watersheds designated as a high priority for fish restoration). The Oregon Water Resouces Department has identified approximatelyr 2,300 "significant diversions" within 300 high priority watersheds. This represents about 10 percent of all diversions in these watersheds, but accounts for about 50 perecent of all water diverted in the state.

Map produced by:
Oregon Water Resources Department
725 Summer St. NE Suite A
Salem, OR 97301

Map date: October 24, 2016

Sources:
Significant Points of Diversions, Oregon Water Resources Department,2015

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Appendix J

Additional Ecological
Information on Select Watersheds

Devil's Lake Watershed

Wild Coho salmon, Cutthroat trout, stocked trout, bald eagles, and other wildlife all reside in the Devil's Lake, which has its own watershed that drains into the Pacific Ocean. Devil's Lake is designated as critical habitat for Coho salmon. The Lake has a history of residential development and other land use practices along the lake shore, as well as aging septic systems which contribute nitrogen and phosphorous to the lake. Non-native, invasive species are also present in Devil's Lake, including Eurasian milfoil, Brazilian elodea, and grass carp, which were introduced to suppress the growth of milfoil and elodea in 1987 and 1993.

There are several organizations with a special interest in the Devil's Lake watershed. Oregon State Parks owns wetlands adjacent to Devil's Lake in lower Rock Creek. The Devil's Lake Improvement District has a shoreline restoration program to encourage lake shoreline owners to plant native grasses and plants instead of turf grass and rock walls and Lincoln City has completed a wetland inventory for the areas surrounding Devil's Lake and is also involved in managing septic systems along the lake. Additionally, the MCWC and the SDCWC are involved in water quality monitoring and restoration in the Devil's Lake Watershed.

The MCWC has completed an LFA for Rock Creek, which is a tributary to Devil's Lake, in 2006 (Trask & Higley, 2006[3]). Overall, lower Rock Creek has fair Coho habitat, but great potential for improvements through increasing sinuosity, improving gravel quality through adding large woody debris, and increasing the amount of mature riparian vegetation. Middle Rock Creek has fair habitat and a moderate potential for improvements in sinuosity and gravel quality, however Upper Rock Creek is considered poor habitat for Coho.

Summer juvenile Coho currently use Rock Creek from its headwaters to 5.4 miles upstream. Upper Rock Creek is naturally constrained by V-shaped valleys while lower Rock Creek is constrained by valley terraces. The stream has riffle habitats, rapids, and pools. As the valley widens, the river has a gentler gradient and has a mix of riffles, beaver ponds, and pools. There is a large wetland 1.6 miles from the mouth or Rock Creek that has been modified by agricultural uses. The Assessment found that near the wetland, the stream channel is incised and cut off from its floodplain but access to the floodplain improves closer to the mouth at Devil's Lake. Upstream portions of the creek have reduced large woody debris, increased sediment, and a lack of complex pools, making it is less functioning Coho habitat. According to the LFA, upper wetlands have been channelized and incised, reducing meanders and overall channel complexity.

The freshwater marshes at the mouth of Rock Creek provide large areas of high quality winter habitat for salmonid juveniles. Above the bridge on East Devils Lake Road, habitat has been modified by historic agriculture, but still provides high quality winter and summer habitat for salmonids. Habitat from Devils Lake to river mile 1.6 has areas of the channels that are exposed to direct sunlight, (Trask & Higley, 2003[3]).

The Devil's Lake Watershed is a Conservation Opportunity Area (COA 020). More information: http://oregonconservationstrategy.org/conservation-opportunity-area/devils-lake/

Schooner Creek (Siletz Waterhsed)

Schooner Creek is a small watershed in the Oregon Coast Coho evolutionary significant unit (ESU) that flows directly into the Siletz Bay. The creek has been the focus of restoration activities including culvert repair, road decommissioning, erosion mitigation, large wood placement, riparian planting, and invasive species control. Stream flow restoration is also a high priority in the Schooner watershed, according to the MCWC 6th Field Assessment (Garono & Brophy, 2001). Partners involved in restoration in the Schooner Creek watershed include SDWC, USFS, and ODFW. One recent project is the decommissioning of Forest Service Road 1783 in 2016 to mitigate sedimentation in South Fork Schooner Creek. The USFS, which owns 77% of land above Lincoln City's water intake, is proposing the Schooner Rock Restoration Project, which would involve commercially thinning 2,368 acres in the Siuslaw National Forest to create wildlife habitat, increase forest diversity, and restore aquatic habitat (USFS). There have also been a number of restoration projects on private timberland in the Schooner Creek Watershed. In 2006, Green Diamond established 13 large woody debris structures on their property and in 2013 Hancock Forest Management partnered with SDWC to add 40 additional logs to the existing 13 restoration sites.

Mill Creek (Siletz Watershed)

Mill Creek is a tributary of the Siletz River that enters the Siletz River near Logsden. Mill Creek Watershed drains approximately 203 square miles and has approximately 316 miles of streams. The Mill Creek Watershed is an important restoration site in the Siletz River Basin. In the Fall of 2016, 57 large woody debris habitat structures were constructed in Cerine Creek, the South Fork and Main Stem Mill Creek, and Gunn Creek. Large woody debris was added to increase habitat complexity, provide shelter for fish, improve the retention of gravels that provide spawning grounds, and increase pool quality. The Mid Coast Watershed Council, with funding from OWEB, has been monitoring the effectiveness of large woody debris installations in Mill Creek to understand how the restoration project has impacted salmon populations. The site is also one of ODFW's seven Salmonid Life Cycle Monitoring Sites, which estimate abundance of salmonids, juvenile salmonids, marine and freshwater survival rates for Coho, and effects of habitat modification on juvenile salmonid populations.

Olalla Creek (Yaquina Watershed)

Olalla Creek is a tributary to the Yaquina River, and enters Olalla Slough, near Toledo. The Creek originates in the mountains, but flows through lowlands and wide valley floors where it has a gentle gradient. The creek is affected by a tide gate, which prevents salt water from flowing upstream. There are four distinct areas of ecological importance in the Olalla Creek watershed, including lower Olalla Slough, Upper Olalla Slough, Lower East Olalla Creek, and Upper East Olalla Creek and its tributaries.

A Limiting Factors Analysis was completed for Olalla Creek, Olalla Slough, and East Fork Olalla Creek to determine important habitat areas for Coho salmon that require restoration. Lower Olalla Slough is a salt water lagoon with tidally flooded marshlands. According to the 2003 LFA, the area has no riparian canopy and a simple channel (MCWC, 2003). Upper Olalla Slough has some riparian canopy, a simple channel, little woody debris, and is Lake-like due to influence from the tide gate. Lower East Olalla Creek has limited riparian canopy, a simple channel, little woody debris, and pool habitat that is occasionally stagnant, warm, and has low oxygen concentrations due to low flows. Upper East Olalla Creek also has a simple channel that is lacking adequate large woody debris and is entrenched in portions (Trask & Higley, 2003[2]). There is a high potential to reconnect the channel to its floodplain in Lower and Upper Olalla Creeks, and for the potential to recruit spawning gravel from one of the tributaries (Trask & Higley, 2003[2]).

Big Creek (Pacific Ocean)

Big Creek is an ocean tributary located between Waldport and Yachats that drains directly into the Pacific Ocean and serves as source water for the City of Newport. Big Creek drains just over 5 square miles and has 7.9 miles of streams. The City of Newport's Big Creek Dam is located on Big Creek. The Creek has extensive spruce wetlands and estuarine marsh habitats. Dicks Fork, South Fork Big Creek, and Reynolds creek all contribute flow to Big Creek. According to a Habitat Assessment for the Mid Coast Watersheds Council, the portion of the creek in the tidal zone is disturbed by Highway 101. There are three significant wetlands in the watershed, including one surrounding the estuary, a wetland near Placer Lake, and a wetland in lower South Fork Big Creek. MCWC's Habitat Assessment also found that the Big Creek system has zones of poorly flushed channels which have the potential to warm and become anoxic (Trask & Higley, 2006[3]).

USFS conducted an aquatic habitat inventory of Big Creek in 1994 and summer snorkel surveys to inventory fish species, age class, density, and distributions were completed during the summers of 2001, 2002, 2003, and 2005. The MCWC monitors Coho abundance in the Big Creek Basin and has recorded populations between 4,000 and 10,000 from 2001 to 2005. ODFW has also conducted seining inventories above Highway 101 and observed summer Coho parr (juvenile) rearing.