



Lower Columbia River Estuary Plan

Lower Columbia River Estuary Program
Comprehensive Conservation and Management Plan

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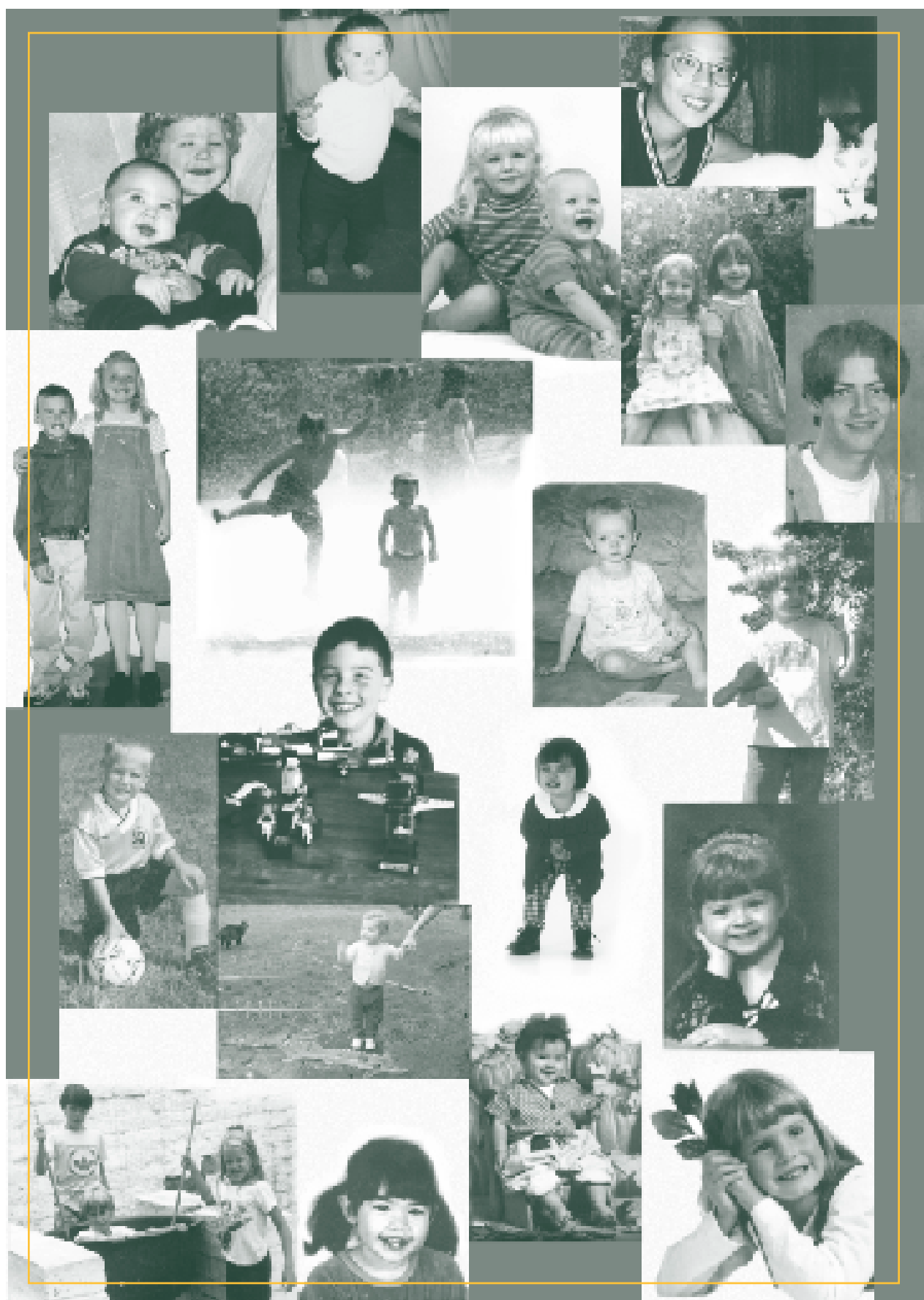
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*The Lower Columbia River Estuary Program is supported
by the States of Oregon and Washington
and the U.S. Environmental Protection Agency.*

Eventually, all things merge into one,
and a river runs through it.

Norman Maclean





For the seventh generation of
our children's children

THE LOWER COLUMBIA RIVER ESTUARY PROGRAM

Comprehensive Conservation
and Management Plan

VOLUME 1

JUNE 1999

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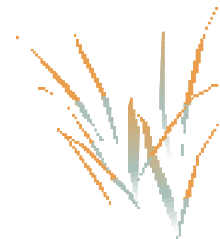
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PREFACE

This *Comprehensive Conservation and Management Plan* provides a broad framework for managing and protecting the lower Columbia River and estuary. It is a guide for preserving and enhancing water quality and habitat, to be implemented by federal, state, local, and tribal governments; river users; environmental interests; and citizens of the region.

As part of the National Estuary Program, the *Management Plan* focuses on the 146 miles of tidally influenced waters below Bonneville Dam. This river reach links ecosystems and economies north and south of the Oregon/Washington border, and east and west between the more heavily populated, wetter coastal valleys and mountains and the more sparsely populated, arid interior of the Columbia Basin. In addition to offering specific actions for the lower river and estuary, the plan provides a framework for coordinating the needs of the lower Columbia within broader, basin-wide considerations.

A diverse group of stakeholders participated on the Management Committee that prepared the *Management Plan*, with considerable input from the public. The plan is the product of a painstaking consensus process, which served not to dilute the decisions, but rather to create a better product. We tackled tough issues and make some bold decisions. The result is a plan that is ready for implementation, rather than requiring further debate.

The *Management Plan* defines specific actions for habitat, land use, and conventional and toxic pollutants. These actions will serve fish and wildlife habitat and water quality in three important ways: prevention of further loss, protection and enhancement of existing resources, and restoration where damage has already occurred. They focus both on solving existing problems and avoiding new ones. The goal is to achieve a net increase in water quality and habitat values.

The actions also address education and management. In our meetings with the public, we were told that education is key. Therefore, several actions call for the Estuary Program to provide hands-on education and technical and financial assistance to all parties as they work to implement this plan. Actions are also directed at both states and the federal agencies to increase consistency in setting standards, establishing regulations, and providing enforcement. Finally, the plan includes a long-term monitoring program so we can better identify problems and measure our progress.

This is an ambitious plan. Implementation of many actions can begin immediately. Success will not happen overnight, however. It will take years of diligence in many areas to see improvement. We will continually evaluate our efforts and adjust the plan to make sure it meets the river's needs. With the stewardship of all the citizens of the region, we can continue to enjoy the exemplary quality of life in the Pacific Northwest. We will be able to maintain the mutual regional goals of a vibrant economy and a healthy environment.

Glenn Vanselow, *Chair*
Lower Columbia River Estuary Program
Management Committee

PREFACE

The Lower Columbia River Estuary Program's *Comprehensive Conservation and Management Plan* is the work of the talented and highly dedicated members of the Management and Policy Committees. For 3 years, they have worked diligently, struggled tirelessly, and given much of themselves. The decisions did not always come easily, but after months and months of listening and learning, they make here a substantial contribution to the river and to future generations.

With completion of this *Management Plan*, we are well poised to solve problems in the lower Columbia River and estuary. Not only are the specific actions in place, they were developed in a collaborative process that will well serve their implementation. The goal has been to have the citizens guide this plan. We have often been frustrated by the size of the study area and the challenges posed by the range of cultural geography. The committee members worked very hard, using a number of innovative means, to make sure they were in fact listening to and representing all our citizenry. They took their role as representatives seriously, meeting with their constituents at critical milestones to seek guidance. While each wore a specific hat from 8:00 a.m. to 5:00 p.m., it was their 5:00 p.m. to 8:00 a.m. values that drove them. In all their public involvement efforts, the committee members never settled only for getting the public's review of their decisions; they asked for direction and guidance on issues still under debate. The plan they advance here reflects the struggles and the grace it takes to work collaboratively for a common good.

We were well served by every member, past and present. The Management Committee chair and vice-chair, Glenn Vanselow and Jim Bergeron, served as great role models in representing interests and working toward consensus. Like so many members, they gave generously of their time and energy. The faith and guidance of our facilitator, Carie Fox, made all the difference. We are indebted to Jessica Cogan and Jack Gakstatter from the U.S. Environmental Protection Agency, who were generous with their time, expertise, and resources. It is teamwork such as theirs that makes the National Estuary Program a model for dealing with any environmental issue. We appreciate the confidence and support of Marilyn Katz and Debora Martin of the U.S. EPA and Kate Kramer and the Western Center for Environmental Decision Making in helping us successfully integrate a risk ranking into our efforts. We are pleased to be on time with a quality *Management Plan* that was completed under budget, leaving program money available for additional grants and special projects. The program has benefited from a highly dedicated, talented, and fun staff.

We thank Governor John Kitzhaber of Oregon and Governor Gary Locke of Washington for their leadership in watershed management and effective government. That leadership will guide this plan and us through implementation.

To the many, many citizens beyond the committees—individual, municipal, and corporate—who joined us for workshops, participated in focus groups, gave us feedback, or planted trees: please know that this document reflects your work. We could not have done this without you.

And so, to the seventh generation of our children's children, we dedicate our work.

Debrah Richard Marriott, *Director*
Lower Columbia River Estuary Program

MISSION

The mission of the Lower Columbia River Estuary Program is to preserve and enhance the water quality of the estuary to support its biological and human communities.

VALUES

We value the biological diversity and the economic, social and aesthetic benefits of the Lower Columbia River.

We acknowledge our differences and value our ability to come together to ensure the long term prosperity and sustainability of the river.

We are united into one community by the river. Its flow carries our history, our multiple cultures, our prosperity, and our future.

We value a common sense of stewardship toward the river by all people.

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PROFILE OF THE LOWER COLUMBIA RIVER AND ESTUARY

Water likes to sing. If you leave it alone, even in quiet places, it'll talk a little to itself about old days it has known and the songs it composed.

William Stafford

The magnitude of the Columbia River is astounding. Beginning in the ice fields of the Canadian Rockies, the river flows for over 1,200 miles to reach the Pacific Ocean. It is the fourth largest watershed in the United States, draining 259,000 square miles and receiving waters from seven states and two Canadian provinces. The Columbia River has the second largest volume flow of any river in the United States.

Equally remarkable are the Columbia River's human story, natural wonders, and commercial contributions. The river provides a vitally important economic lifeline to the Pacific Northwest, and it offers some of the most spectacular scenery on the continent. It shares and imparts a long, important history to the nation.

The Lower Columbia River Basin, including the Estuary Program study area, is far more populated and industrialized than the rest of the Columbia River Basin, presenting both challenges and opportunities. The numerous tributaries that enter this reach of the Columbia have significant impacts because of the diverse activities that occur within their watersheds. In addition, water quality and habitat in the lower basin can be affected by runoff and land use activities from the 241,000 square miles upstream of Bonneville Dam.

A profile reveals the wide spectrum of resources and uses within the Estuary Program study area, and shows how the river system both shapes and is shaped by the region around it.

PHYSICAL GEOGRAPHY

With the exception of the Willamette River, most of the lower Columbia River's tributaries drain relatively small watersheds. Tributaries originating in the Cascades include the Willamette and Sandy Rivers in Oregon and the Washougal, Lewis, Kalama, and Cowlitz Rivers in Washington. Coast Range tributaries include the Elochoman and Grays Rivers in Washington and the Lewis and Clark, Youngs, and Clatskanie Rivers in Oregon.

The Columbia River runs a varied course along the 146 river miles from Bonneville Dam (river mile 146) to the Pacific Ocean. It is relatively narrow at the dam—as little as 925 feet wide directly below the dam. It emerges from its steep-walled gorge about 20 miles east of Portland. Below Washougal and Troutdale, the river valley widens to include a broad floodplain; elongated islands divide the river and form sloughs and side-channels in the formerly marshy lowlands. The floodplain expands around the river's confluence with the Willamette River, where the sloughs and lakes of North Portland, Sauvie Island, and the Vancouver lowlands

contain the metropolitan area's last major remnants of the swamp riparian system formerly nourished by annual flooding of the non-dammed rivers. Downstream from St. Helens, the Columbia cuts through the Coast Range, a passage marked by steep-shouldered bluffs and broad alluvial floodplains. The river channel, dotted with low islands of deposited sediments throughout its lower reaches, opens out below Skamokawa into several broad bays that extend more than 30 miles to the Pacific Ocean. At its mouth below Astoria, Oregon, the river passes between two jetties approximately 2 miles apart as it enters the Pacific Ocean.

The flow of the lower Columbia River is strongly influenced by climatic variations and tides. The tidal influence on water surface elevation is evident all the way to Bonneville Dam. During low-flow periods, tides may cause river flow to reverse up to about river mile 80. Tidal salinity normally extends upstream to approximately river mile 23; historically it has reached river mile 46.

The lowest river flows generally occur during September and October, when rainfall and snowmelt runoff are low. The highest flows occur from April to June, resulting from snowmelt runoff from the Cascade and Rocky Mountain Ranges to tributaries of the upper Columbia. High flows also occur between November and March, caused by heavy winter precipitation in the tributary basins of the lower river, primarily the Willamette in Oregon and the Cowlitz in Washington. The discharge at the mouth of the river ranges from 100,000 to 500,000 cubic feet per second, with an average of about 260,000 cubic feet per second.

SOCIAL AND CULTURAL HERITAGE

Native American Culture¹

Native Americans tribes flourished in the Columbia River Basin for thousands of years. The tribes moved seasonally from river to mountain, their existence inextricably linked to the area's vast water and land resources. The Native American culture relies heavily on natural resources. Stewardship is natural for the tribes, an extension of their belief that the whole of creation is important, and that nature will provide if properly cared for. It is a systems way of thinking, a discipline for seeing the whole, recognizing patterns, and learning to act accordingly.

The region's tribes are dependent on numerous natural resources. Of these many resources, none is more important than the basin's anadromous fish. Salmon historically were the primary source of subsistence, part of the people's spiritual and cultural identity, and the basis for a regional economy. During the height of the fall and spring salmon runs, tribes would gather, often near Celilo Falls, to exchange and barter salmon, goods, ideas, and stories.

Although the salmon economy no longer exists, the importance of salmon to Native American tribes is undiminished. Salmon numbers are, however, clearly diminished. To the extent practicable, tribal people continue to fish for ceremonial, subsistence, and commercial purposes. Salmon is still the dietary preference, its ceremonial role paramount, and its necessity for physical health and spiritual well-being unchallenged.

What often brings the tribes together today is the struggle to save the salmon. In 1977, the Columbia River Inter-Tribal Fish Commission (CRITFC) was formed by the four tribes with treaty rights to Columbia Basin salmon: the Nez Perce Tribe, the Confederated Tribes of the Umatilla Indian Reservation, the Confederated Tribes of the Warm Springs Reservation of Oregon, and the

¹ Much of this information is drawn from the CRITFC Salmon Restoration Plan, *Wý-Kan-Usb-Mi Wa-Kish-Wit: Spirit of the Salmon, 1995*

Confederated Tribes and Bands of the Yakama Indian Nation. Headquartered in Portland, CRITFC coordinates tribal efforts and provides technical support on issues related to habitat protection, fish production, harvest, and water quality, including the protection of human health. CRITFC's members are the fish and wildlife committees of each tribe.

Each of the four tribes has federally recognized reserved rights to cultural and natural resources in the Columbia River Basin, stemming from 1855 treaties with the United States. Among other things, the treaties ensure the tribes the right to fish at all their usual and accustomed places in the Columbia River and its tributaries. Each tribe is a sovereign government, and has an interest in natural resource management in the lower Columbia River and estuary.

The approximately 3,000 members of the Nez Perce Tribe reside on a 750,000-acre reservation with headquarters in Lapwai, Idaho. Land and natural resource management is of critical importance, and the tribe employs nearly 50 people to work on its fish program. The Nez Perce Tribe has co-management responsibilities with the other tribes for the Columbia River, where Nez Perce tribal members continue to fish.

The nearly 2,100 members of the Confederated Tribes of the Umatilla Indian Reservation live on a 172,000-acre reservation with headquarters in Mission, Oregon. For decades, the tribe's focus has been on the Umatilla and Grand Ronde rivers, where fish restoration has been the paramount activity. In 1984, the first fall chinook salmon in 70 years returned to the Umatilla River after the tribes, in partnership with the State of Oregon, reintroduced them. In addition to the reviving Umatilla River fishery and other fisheries, the tribe continues to have co-management responsibilities for the Columbia River, where many of its members still fish.

The 3,000 members of the Confederated Tribes of the Warm Springs Reservation of Oregon reside on an approximately 640,000-acre reservation headquartered in Warm Springs, Oregon. The tribe is actively involved in logging and farming, and also owns the Kah-Nee-Tah vacation resort. Fishing remains important, as well. The U.S. Fish and Wildlife Service operates a hatchery on the reservation, and the tribe has co-management responsibilities for the Columbia River, as well as important tributaries such as the John Day, Deschutes, and Hood Rivers. Tribal members continue to fish with dip nets, and set nets at the falls near Sherars Bridge on the Deschutes.

The nearly 8,400 members of the Confederated Tribes and Bands of the Yakama Indian Nation live on the 1.2 million-acre Yakama Indian Reservation in south central Washington. The Yakama tribe employs approximately 40 people in its fisheries program, which emphasizes an interdisciplinary and sustainable approach to natural resource management. In a key project, the Yakama Nation is working with the U.S. Department of Energy to use abandoned settling ponds at the Hanford Nuclear Reservation to acclimate juvenile fall chinook before releasing them into the Columbia River. The Yakama Nation co-manages the Columbia River, as well as important tributaries such as the Wind, White Salmon, and Klickitat Rivers. The tribe continues to fish at its usual and accustomed places in the Columbia River Basin.

In addition to the federated tribes, many other tribes live in the Lower Columbia River Estuary Program study area. These include the Chinook and Cowlitz Tribes.

The long, sustained use of the lower Columbia River and its tributaries by Native Americans has left a rich history of sites of cultural significance. As development continues in the study area (and beyond), the Estuary Program will consult with the Washington and Oregon State Historic Preservation Offices and the tribes to ensure proper treatment of their cultural treasures.

Non-Native Settlement

Captain Robert Gray and the first European-Americans arrived at the mouth of the Columbia in 1792. Even while the territory was under European claim at this time, Thomas Jefferson envisioned a scientific and geographic expedition that would link the young United States to the Pacific Ocean. Jefferson eventually commissioned Meriwether Lewis to undertake the mission, sharing the leadership with William Clark. Experienced explorers, Lewis and Clark were nevertheless



overwhelmed by the Columbia River. In their journals, they call it “incredible” and “remarkably Clear and Crowded with Salmon.” Alone among western rivers, they describe it as “great.” The successful expedition, nearly 2 years long, pioneered the route to the Pacific Ocean and opened up the vast new territory to further exploration and intense commerce.

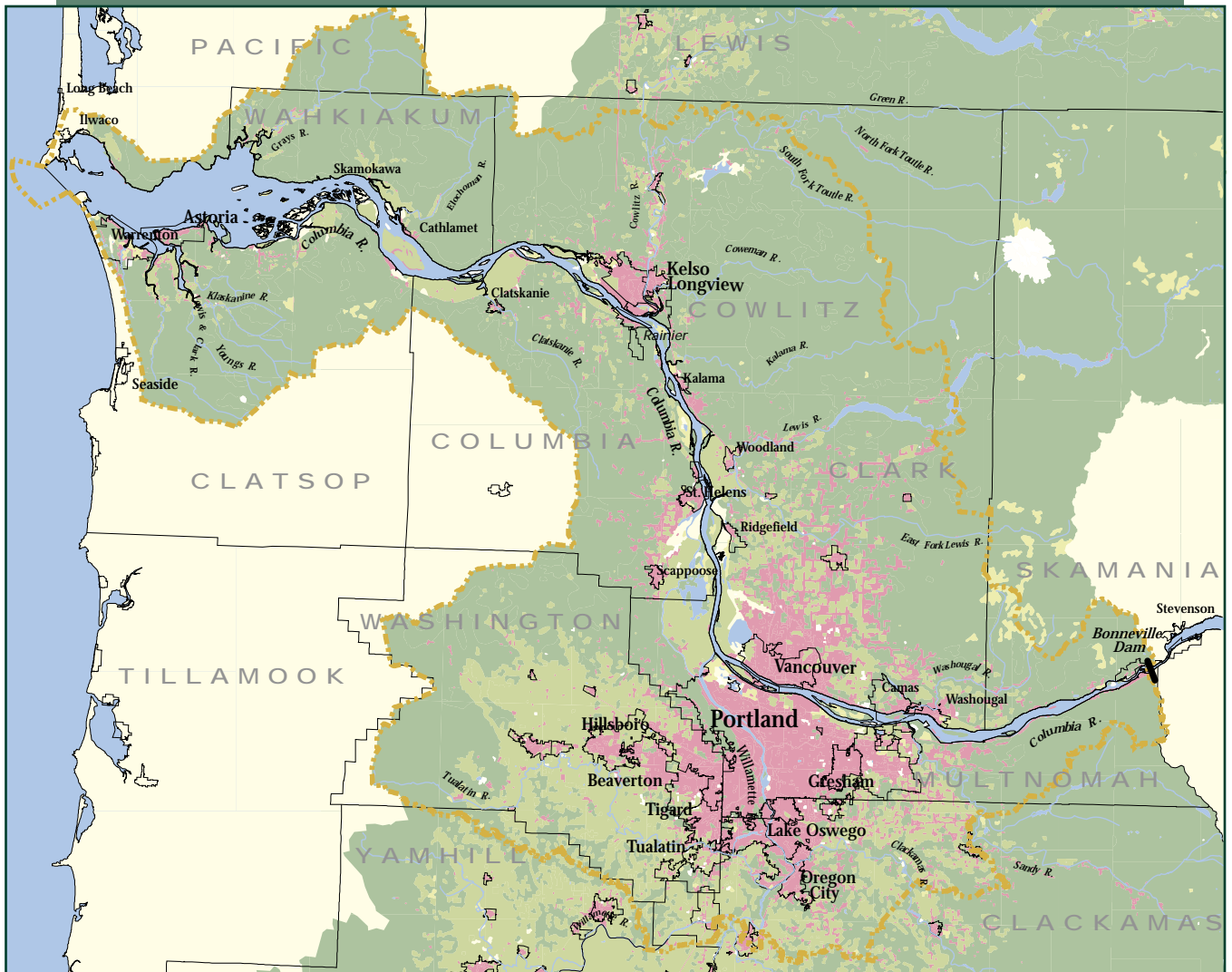
The advent of the fur trade and other commerce around 1810, and the subsequent development of the river as a major transportation route, brought dramatic changes to the area. Fort Vancouver served as the headquarters of the fur trade and the base for the Hudson Bay Company, which attempted to trap out the entire area. Established in 1825 near present-day Vancouver, the fort became a major regional hub and a settlement in itself, with 40 buildings, 1,500 acres under cultivation, schools, churches, and a community of hundreds. Soon, many more people would come to the area.

During the 1840s, 1850s, and 1860s, nearly one-half million people traveled from settled America to the Pacific Northwest. These new inhabitants relied on the river for its bounty of salmon and its readily available water for irrigation. Fish and food processing, agriculture, timber mills, and wood pulping and papermaking plants were established in the basin. Oregon gained statehood in 1859, and Washington followed in 1889.

Extensive dredging, diking, and filling of portions of the river began as early as 1885. The impacts have been greatest in the broad estuarine portion of the lower river, where over half of the tidal swamp and marsh areas have been lost since 1870. Beginning in the 1930s, development of the Columbia River dam system for hydropower, flood control, irrigation, and river transportation has also had profound effects on the river’s flow, habitat, and resources.

Many changes have occurred over the years, some for better, some for worse. Yet, some things remain constant. People are still drawn to the varied resources and opportunities of the lower river. They look to it for sustenance and pleasure. Today more than ever, those who live, work, and play along the Columbia must balance and sustain the river’s many uses in order to preserve its heritage and secure its future.

Lower Columbia River Basin Land Use Cover



Legend

- | | | | |
|--------------|--------------|----------|---------------------|
| Water Bodies | Agricultural | Sand | County Lines |
| Urban | Rangeland | Barren | Rivers |
| Forest | Wetland | Snow/Ice | Study Area Boundary |



Scale 1:600,000

Land Uses Along the Lower Columbia River



When we tug at a single thing in Nature, we find it attached to the rest of the world.

—John Muir

LAND USE AND POPULATION

The Lower Columbia River Estuary Program study area encompasses multiple population centers and political jurisdictions. It contains 28 cities, including the largest population center in Oregon (Portland) and the fourth-largest population center in Washington (Vancouver). Nine counties have jurisdiction in the study area, and there are 14 port districts, whose jurisdictions overlap with city or county boundaries.

The Portland/Vancouver metropolitan area has grown from a population of 100,000 in 1890 to more than 1.7 million in 1997.² That figure is estimated to increase by almost 30 percent to nearly 2.2 million by the year 2010. Most of that population is within the study area. The population of the entire Lower Columbia River Basin is approximately 2.5 million.

The extent of human activity over the last 100 years has taken its toll on the river, resulting in habitat loss, harm to plant and animal populations, pollution, and reduced river access. The need to manage land uses, land development practices, and population growth is recognized as a priority issue in the Lower Columbia River Estuary Program. This issue is discussed further in Chapter 4: Priority Issues, under “Impacts of Human Activity and Growth.”

The multiple jurisdictions, complex issues, and need for coordinated management in the study area are also recognized as a priority issue in the Estuary Program. This issue is discussed further in Chapter 4 under “Institutional Constraints.”

The following overview of the nine counties within the Estuary Program study area illustrates the variety of land uses, from highly urbanized population centers to National Wildlife Refuges.

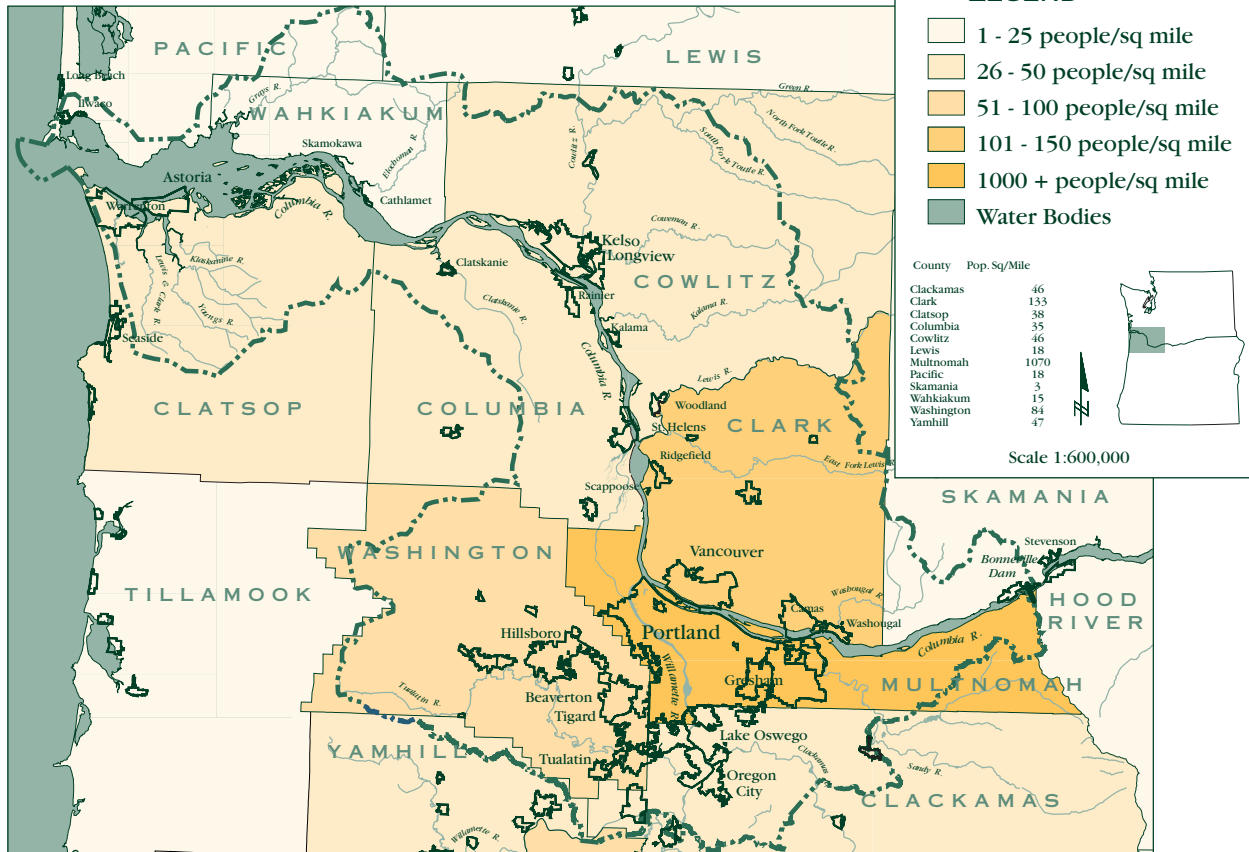
Washington

Communities along the Columbia River in **Pacific County** include the fishing port of Ilwaco and the rural communities of Chinook and Megler. Fishing, timber, agriculture, tourism, and home-based industries provide the economic base for Pacific County. Key features of the Pacific shoreline are Cape Disappointment, Baker Bay, Fort Canby, Fort Columbia State Park, and the Lewis and Clark Campground.

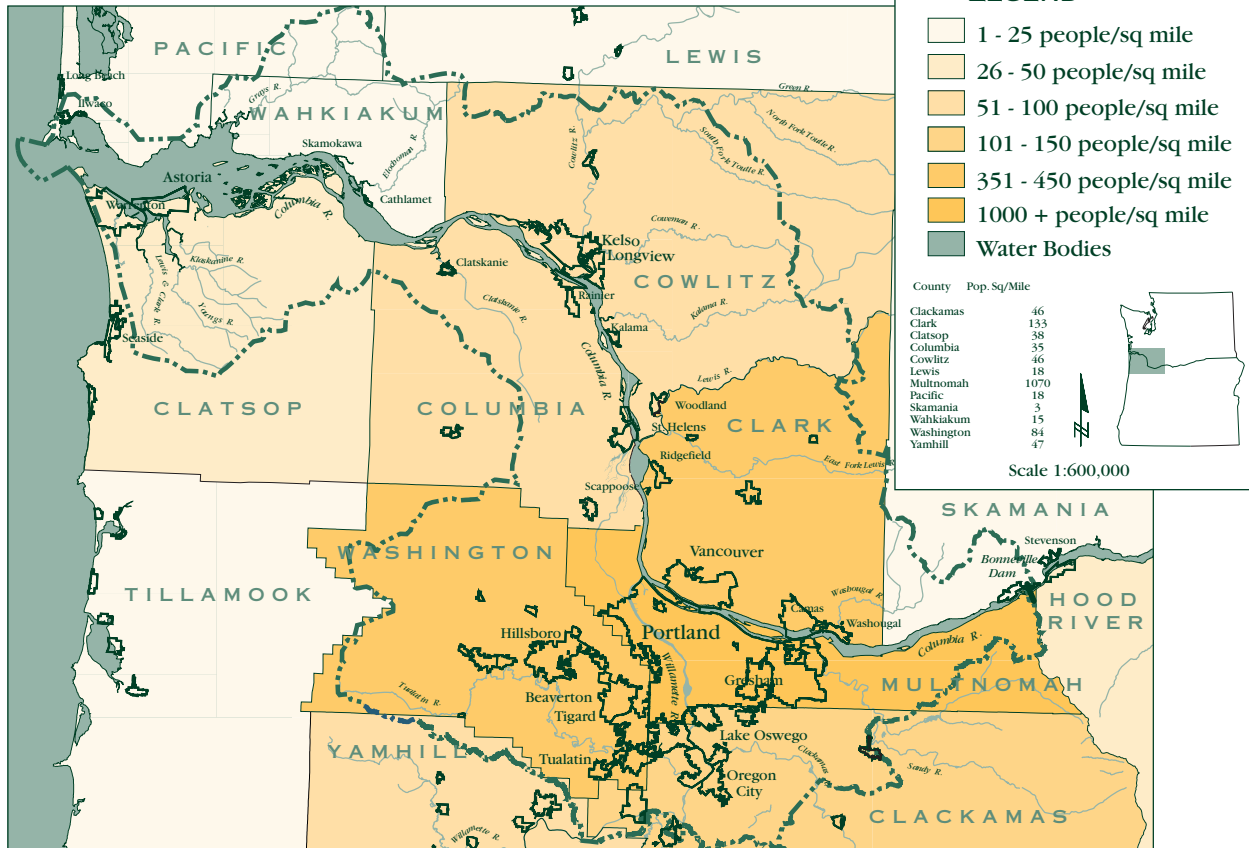


² Unless otherwise specified, population statistics in this chapter and throughout the *Management Plan* are from two sources: the Washington State Office of Financial Management (for Washington statistics) and the Portland State University Center for Population Research and Census (for Oregon statistics).

1950 POPULATION DENSITY BY COUNTY



1990 POPULATION DENSITY BY COUNTY



**CITIES ALONG THE LOWER COLUMBIA RIVER
ESTUARY STUDY AREA**

Population in 1998

OREGON		WASHINGTON	
Astoria	10,090	Camas	10,300
Clatskanie	1,870	Cathlamet	545
Columbia City	1,635	Ilwaco	876
Fairview	5,910	Kalama	1,555
Gladstone	11,745	Kelso	12,100
Gresham	83,595	Longview	34,060
Lake Oswego	34,280	North Bonneville	532
Milwaukie	20,220	Ridgefield	1,795
Oregon City	22,560	Stevenson	1,212
Portland	509,610	Vancouver	132,000
Rainier	1,800	Washougal	7,685
Scappoose	4,855	Woodland	3,570
St. Helens	9,060		
Troutdale	14,040		
Warrenton	4,175		
West Linn	21,405		

**COUNTIES ALONG THE LOWER COLUMBIA RIVER
ESTUARY STUDY AREA**

Total County Population in 1998

OREGON		WASHINGTON	
Clackamas	323,600	Clark	328,800
Clatsop	34,700	Cowlitz	93,100
Columbia	42,300	Pacific	21,500
Multnomah	641,900	Skamania	9,900
		Wahkiakum	3,900



Aerial photo 1966—Columbia River at future site of I-205 Bridge



Aerial photo 1995—Columbia River at I-205 Bridge

In **Wahkiakum County**, Cathlamet is the largest community along the Columbia River and is also the county seat. Other smaller communities include Rosburg, Grays River, Puget Island, and Skamokawa. The county's economy is based on natural resources such as timber, fish, and agriculture. In recent years, new development activities have been devoted to tourism and retirement needs. The river shoreline is dominated by Grays Bay, Puget Island, and the Julia Butler Hansen National Wildlife Refuge. Areas of interest include County Line and Skamokawa Vista Parks. In addition, the entire Skamokawa area is listed on the Washington and National Registers of Historic Places.

The Longview-Kelso urban area occupies the central shoreline of **Cowlitz County**, with a combined population of over 46,000. The characteristic uses of this area are urban, industrial, and commercial shipping. Evidence of the 1980 eruption of Mount St. Helens to the north is found along the banks of the Cowlitz River in the form of large deposits of volcanic residues dredged from the river.

The river's shoreline in **Clark County** is dominated by the Vancouver urban area, with a population of about 132,000. This area, as well as the communities of Camas and Washougal to the east, are sites of major industrial and commercial shipping activities. The Ridgefield National Wildlife Refuge is located north of Vancouver.

The Estuary Program study area includes approximately the western third of **Skamania County**, including the rural communities of Skamania and North Bonneville. The river's shoreline is predominantly a forested rural area. Key features include Bonneville Dam and Beacon Rock State Park. The federally designated Columbia River Gorge National Scenic Area covers portions of Skamania and Clark Counties in Washington and Multnomah County in Oregon.

Oregon

The shoreline land use in **Clatsop County** is predominantly rural agricultural, designated primarily as conservation and natural shorelands. The area near Astoria is urban residential and water-dependent industrial. Principal industries in this county include fishing, timber, agriculture, and recreation. Areas of special interest are Fort Stevens State Park, Lewis and Clark National Wildlife Refuge, and the Fort Clatsop/Lewis and Clark Expedition Memorial.

Columbia County includes the towns of Clatskanie, Rainier, Columbia City, Scappoose, and St. Helens, with forested areas between. The principal industries in this county are agriculture, timber, and fishing. Although industrial development has expanded, dairies and horticulture remain important. A particularly unique and rich fish and wildlife area is located on lower Sauvie Island, where thousands of migrating waterfowl and several endangered species use the island and Sturgeon Lake for feeding and wintering habitat.

Multnomah County includes the cities of Portland, Troutdale, Gresham, and Fairview, as well as part of Sauvie Island. Although the county is the smallest in area in Oregon, it is the largest in population, with 642,000 people. Residential, recreational, and industrial uses are widespread in the county, along with farming on Sauvie Island. The principal industries include manufacturing, transportation, wholesale and retail trade, and tourism. The Port of Portland, the largest port in the Estuary Program Study area, is of particular economic importance. Areas of special scenic and recreational quality include the Columbia River Gorge National Scenic Area, Multnomah Falls, and Rooster Rock State Park.

A very small portion of **Clackamas County** is included in the study area. It includes Oregon City and West Linn, two cities located at the head of tide (the upper reach of the tidally influenced water) on the Willamette River. The northern portion of the county is heavily populated; the southern portion, and the largest land area, is heavily forested and farmed.

ENVIRONMENT

Habitat

Numerous areas of “special biological significance” (see page 21) are located within the Estuary Program study area, providing critical natural habitats and playing key roles in maintaining the delicate balance of the ecosystem. These special resources have declined over time. Since 1870, more than half of the tidal swamp and marsh areas in the lower river have been lost as a result of diking, draining, filling, dredging, and flow regulation. Since 1948, tidal wetland habitats in the lower 46 miles of the river have decreased by as much as 70 percent.³ Much of the remaining wetlands are protected by inclusion in the Lewis and Clark and the Julia Butler Hansen National Wildlife Refuges. In addition to the feeding, spawning, nursery, and migratory habitat they provide, these wetlands are critical to flood control and water quality.



Living Resources

The lower Columbia River and estuary historically supported diverse wildlife populations. The moderate climate, food resources, ample water, and diverse array of habitats still make it attractive to many species. Extensive urbanization and development in substantial portions of the study area have, however, had significant effects on wildlife populations.

³ Wetland acreage numbers are from the following three sources: *The Health of the River 1990-1996 Integrated Technical Report* (Lower Columbia River Bi-State Program, 1996); *Overview and Synthesis of Fish and Wildlife Studies in the Lower Columbia River* (Lower Columbia River Bi-State Program, 1996); and *Oregon Wetlands Plan* (Oregon Wetlands Joint Venture, 1994).

Areas of Special Biological Significance in the Lower Columbia River Estuary Study Area

- *Pierce Island Natural Area Preserve and a high-quality black cottonwood-Oregon ash community, both in Skamania County*
- *Puget Island Natural Area Preserve*
- *White Island Natural Area Preserve, black cottonwood-willow community, and high-quality surge-plain wetlands in Wabkiakum County*
- *High-quality wetlands in Pacific County*
- *Ridgefield National Wildlife Refuge*
- *Vancouver Lake Lowlands, including Shillapoo Wildlife Recreation Area*
- *Julia Butler Hansen National Wildlife Refuge, which includes Tenasillabee Island in Oregon and the lower Elochoman River area in Washington*
- *Tenasillabee Island Research Natural Area; the upstream tip of the island consists of a spruce swamp that is a remnant of a once widespread habitat type in the program study area*
- *Lewis and Clark National Wildlife Refuge, which includes most of the islands and the open water between river mile 18 and 25; managed primarily for waterfowl*
- *Bald eagle nesting sites in the lower estuary*
- *Baker Bay, Youngs Bay, Trestle Bay, Grays Bay, and Cathlamet Bay—especially productive areas for benthic organisms, anadromous fish, and waterfowl*
- *Clatsop Spit in Fort Stevens State Park—a significant migratory shorebird feeding and nesting area for sanderlings*
- *Sauvie Island Wildlife Management Area*
- *Steigerwald Lake Wildlife Refuge*
- *Franz Lake Wildlife Refuge*
- *Pierce Ranch Wildlife Refuge*

Other areas of special biological significance include: Bradwood Cliffs; Kerry Island; Big and Little Creek Estuary; Tansy Point; Tongue Point; Cooperage Slough; Russian Point Marsh; East Sand Island; Gnat Creek Marsh; Blind Slough Spruce Swamp; Burnside Marsh; Deer Island; Wallace Island; Prescott and Carr Slough; Wapato Bay; Scappoose Flats; Sandy Island; Burlington Bottom; Smith and Bybee Lakes; Virginia Lakes; McGuire Island; Sandy River Delta; Gary, Flat, and Chatham Islands; Horsetail Creek Wetlands; and Rooster Rock State Park Wetlands.

Fish and Other Aquatic Species

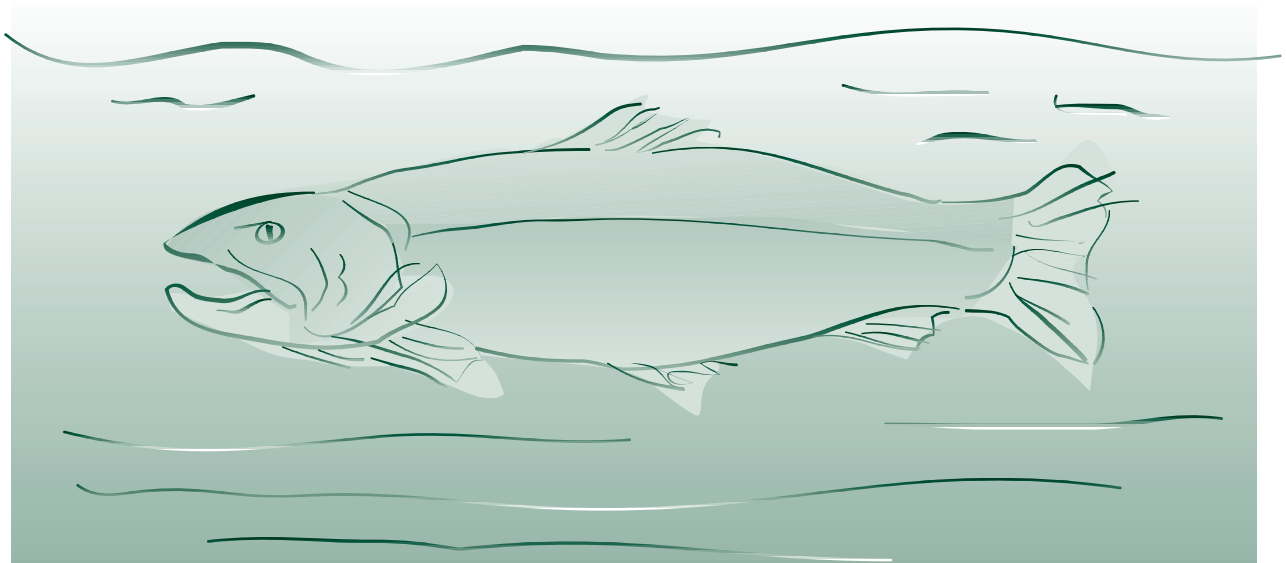
The lower Columbia River and estuary provides essential habitat for a great number of freshwater and marine fish species. The estuary is an important feeding and breeding area for numerous shellfish, including oysters, clams, mussels, and the commercially valuable Dungeness crab. Sturgeon is an important commercial and recreational fish, and populations are stable throughout the lower river.

The Columbia River Basin has historically produced some of the world's largest runs of chinook salmon and steelhead. Estuarine habitats provide important nursery and rearing areas for young salmon and steelhead, and adults use them as temporary holding areas during their return migration from the ocean to upstream spawning areas. Changes in the environment and the loss or degradation of habitat have contributed to decreased runs of native fish.

Overall populations of the basin's anadromous fish stocks are estimated at less than 10 percent of their historic size, despite major hatchery programs. Wild stocks of salmon, steelhead, and sea-run cutthroat trout are virtually gone in some areas. The Columbia Basin's historically large chum salmon stocks have declined to less than 1 percent of their original level. Habitat for sockeye salmon has declined to less than 4 percent of its historic level. Most wild chinook stocks are very weak, and natural spawning of native fall chinook stocks is believed to be low or nonexistent in many tributaries.

Several Columbia River salmon species are listed as threatened or endangered. In 1998, the listing of the Lower Columbia River steelhead made the Portland-Vancouver metropolitan area the first urban area in the United States with an Endangered Species Act listing for an anadromous fish. In March 1999, five more species of salmon and steelhead were listed. Three transit the lower river and two—the Lower Columbia River chinook salmon and the Lower Columbia River chum salmon—are specific to the study area. Currently, 12 species of salmon and steelhead associated with the Columbia River are listed as threatened or endangered (see page 23).

Despite these declines, Columbia River fish runs are still very important and continue to support fisheries in Oregon, Washington, California, and Alaska. Over 50 hatcheries are in operation, and artificial production now accounts for about 75 percent of all fish returning to the Columbia River system.



THREATENED AND ENDANGERED SPECIES OF THE LOWER COLUMBIA RIVER

FISH

Lower Columbia River Chum Salmon
Lower Columbia River Chinook Salmon
Lower Columbia River Steelhead
Middle Columbia River Steelhead
Upper Columbia River Steelhead
Upper Columbia River Spring
Chinook Salmon
Oregon Chub
Snake River Fall Chinook Salmon
Snake River Sockeye Salmon
Snake River Spring/Summer Chinook
Salmon
Snake River Steelhead
Upper Willamette River Chinook Salmon
Upper Willamette River Steelhead

OTHER ANIMALS

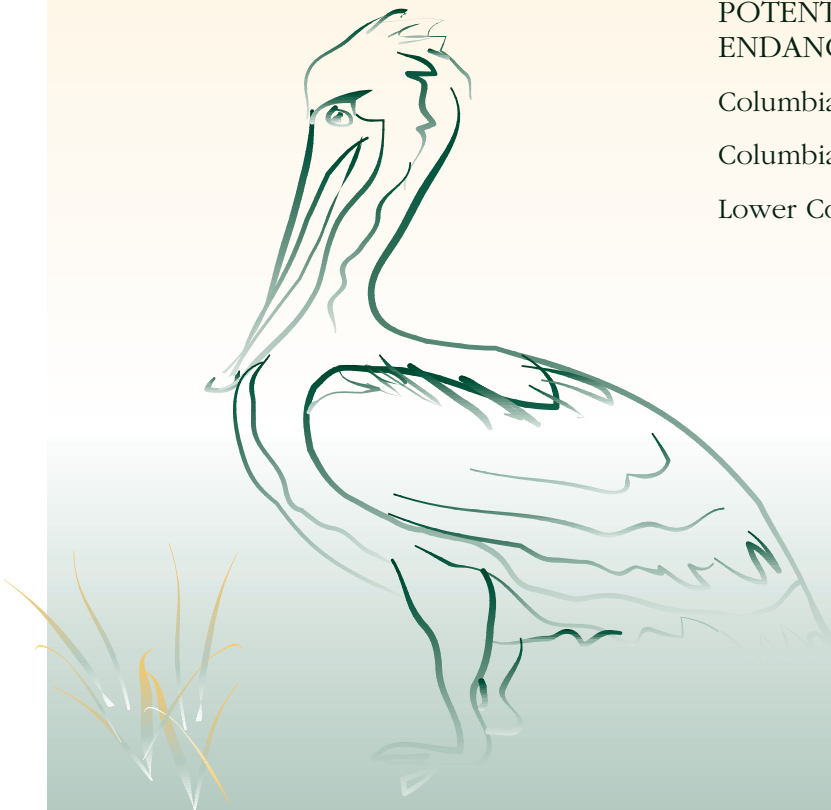
Aleutian Canada Goose
American Peregrine Falcon
Bald Eagle
Brown Pelican
Columbia White-tailed Deer
Marbled Murrelet
Nelson's Checker-mallow
Northern Spotted Owl
Oregon Silverspot Butterfly
Western Snowy Plover

PLANTS

Bradshaw's Lomatium
Water Howellia

POTENTIAL THREATENED AND ENDANGERED FISH SPECIES

Columbia River Bull Trout
Columbia River Coastal Cutthroat Trout
Lower Columbia River Coho Salmon



Birds

Over 175 species of birds use the food and habitat of the lower Columbia River and estuary. Some of the islands in the lower river support large gull and tern nesting colonies, and large great blue heron colonies are found throughout the Estuary Program study area. Bald eagle nesting sites are found along the length of the lower river. Peregrine falcons, hawks, eagles, ospreys and owls find abundant prey in the area's diverse habitats.

The lower Columbia River is one of the most important areas in the Pacific Flyway for migrating shorebirds, with peak counts in the estuary of almost 150,000 birds. Substantial numbers use other areas along the river, up to Sauvie Island and into the Willamette Valley. Wintering waterfowl populations in the lower Columbia area reach peaks of more than 200,000 birds. Several wildlife refuges, including Ridgefield National Wildlife Refuge and the State of Oregon's Sauvie Island Wildlife Area, contain agricultural lands that are intensively managed to provide feed and resting areas for wintering waterfowl.

The lower Columbia River also provides important migratory and breeding habitat for a variety of other neo-tropical migrant bird species. One survey of a bottomland forest during peak migration recorded some of the highest concentrations of neo-tropical migrants ever reported.

Several species of birds that depend on the area for habitat are listed as threatened or endangered, including the bald eagle, northern spotted owl, marbled murrelet, brown pelican, and American peregrine falcon (see page 23).



Mammals

Many mammal species depend on the waters, tidal marshes, and wetlands of the lower Columbia River and estuary for food and habitat. The tip of the south jetty at the river's mouth is a haul-out site for California and Stellar's sea lions, which feed on a variety of fish in the estuary. Harbor seals use sandbars and mudflats as haul-out sites at low tides. Elk, bear, black-tailed deer, and a variety of smaller mammals, including beaver, river otter, raccoon, and coyote, are found throughout the study area.



Habitat loss and modification have had significant effects on mammal populations. Many native species are thought to be much less numerous in the lower river and estuary today than they were 100 years ago. Columbia white-tailed deer are listed as endangered. Even as the area's abundant living resources are a source of wonder, the decline in their numbers and health is of great concern.

The threats to biological integrity and the extent of habitat loss and modification are recognized as priority issues in the Lower Columbia River Estuary Program. These issues are discussed further in Chapter 4: Priority Issues.

ECONOMY

The Columbia River is a vital economic asset to the Pacific Northwest and the nation. Major economic activities that depend on the river include commercial fishing, ports and transportation, pulp and paper, and energy. Economic and environmental health are closely intertwined, particularly since many economic uses depend on good water quality and other natural resources.

Commercial Fishing

From its earliest history, the Columbia River has been highly valued for its fishery. Salmon and other fish have been part of Native American economies for centuries. As early as 1828, various European and Spanish trading companies were purchasing and exporting salmon from the river. The first regulations directed at controlling the commercial salmon fishery were enacted by the State of Oregon and the Washington Territory in the 1870s. By 1883, there were 40 canneries on the Columbia. That year they packed 634,300 cases, or approximately 35 million pounds, of canned chinook salmon.

Once the largest in the world, the Columbia River’s salmon runs are now decimated, and commercial landings of salmon and steelhead have dramatically decreased. Stock declines have reduced the number of fishing days allowed per year from over 270 before 1943 to an average of 39 since 1980. Only 33 commercial salmon fishing days were allowed in the Columbia River mainstem below Bonneville Dam in 1998, resulting in a catch of 145,698 pounds (9,521 fish), one of the lowest catches on record. Commercial fishing, however, still plays a significant role in the regional economy.

Today, salmon restoration is an important industry. Over 2,000 people are directly working on projects aimed at restoring the salmon runs, with an annual investment exceeding \$400 million. Funds are being used to protect and restore habitat; assess specific causes for decline; and test various options for restoring fish numbers, including barging, hatchery alterations, and spill and flow control.

Ports And Transportation

Maintenance and management of the Columbia River channel have enabled deep-water ports to be located as far as 110 river miles inland. The Columbia and Snake River system is navigable from the Pacific Ocean to Lewiston, Idaho, and is an important gateway for national and international trade. Five major deep-water ports are located in the lower Columbia: at Portland, Vancouver, Kalama, Astoria, and Longview. Nine smaller ports also serve the lower Columbia River.

In 1997, 30 million metric tons of waterborne cargo worth \$13 billion were imported and exported via lower Columbia River ports. A total of 1,970 cargo-carrying vessels representing 49 countries entered the river that year.⁴ Such maritime activity generates significant economic impact each time cargo is handled, stored, or moved. The livelihood of an estimated 2.6 million people in Oregon, Washington, and Idaho is at least partly dependent on the trade opportunities provided by the Columbia River.

PORT DISTRICTS ALONG THE LOWER COLUMBIA RIVER ESTUARY

OREGON	WASHINGTON
Portland, Astoria, St. Helens <i>(Deep-water ports engaged in international trade are in bold type)</i>	Vancouver, Kalama, Longview, Ilwaco, Chinook, Wahkiakum County (1 & 2), Woodland, Ridgefield, Camas/Washougal, Skamania County

⁴ Port of Portland, 1999

Some notable statistics demonstrate the magnitude of this maritime trade.⁵

- In terms of overall tonnage, Columbia River ports constitute the second-largest port area on the West Coast, behind only southern California.
- In 1997, 43 percent of the wheat that America exported went through Columbia River ports.
- The Port of Portland is the largest port in the country for export of wheat and soda ash. It is the second largest port on the West Coast for import and export of automobiles.
- The Columbia River is the second-largest grain-exporting port area in the world. Only the Mississippi is larger. The Port of Kalama is the fourth-largest grain exporter in the United States, shipping grains from the entire Northwest and Midwest.
- Over \$75 million in processed potatoes from Idaho, Oregon, and Washington are exported annually via the Columbia River system.

MAJOR EXPORTS AND IMPORTS FROM LOWER COLUMBIA RIVER PORTS

Exports	Wheat, corn, logs, paper, wood chips and other forest products, barley, copper, sorghum, coke, metal ores, automobiles
Imports	Automobiles, limestone, salt, iron and steel products, alumina, gasoline, ores, plywood, veneer and other building materials, oil and petroleum products, fertilizer

Ship repair is also an important contributor to the Northwest economy. In 1996, activities at the Portland shipyard generated 2,066 full-time equivalent jobs and \$251 million for the Portland metropolitan area.⁶



⁵ U.S. Department of Commerce, 1998; *World Grain*, Nov-Dec 1996; Port of Portland, 1999

⁶ *The Local and Regional Economic Impacts of the Cascade General Portland Shipyard* (prepared by Martin and Associates, Lancaster, PA, for Cascade General Portland Shipyard and the Port of Portland, July 1997).

Energy

The Columbia River Basin, with 27 mainstem Columbia River dams and more than 60 smaller hydropower projects, constitutes the world's largest hydroelectric power system. The system supplies low-priced hydroelectric power to most of the Pacific Northwest and areas beyond, and provides flood control, irrigation, and river transportation.

One major federal hydroelectric project—Bonneville Dam—bounds the Estuary Program study area at river mile 146. The Bonneville Dam Project has two powerhouses, one on the Oregon side of the river that was completed in 1938, and one on the Washington side that came on-line in 1981. They have a combined generating capacity of more than 1 million kilowatts. In 1993, the original 1938 lock was closed to river traffic and replaced by a new \$341-million lock. The Bonneville Dam Project also includes recreations areas, a fish hatchery, fish bypass facilities, and a visitors' center. The majority of the project was placed on the National Register of Historic Places as a historic district in 1986.

Many industries have been drawn to the Pacific Northwest for its low-priced electricity. As one example, the ready supply of power and military needs brought the aluminum industry to the lower Columbia during World War II. Today, plants along the river produce 43 percent of the nation's aluminum.



Forestry

Forest resources near the Columbia River continue to play a large role in the regional economy. Most of the area's forests are privately owned, either by a handful of corporations or thousands of small woodlot owners, and are actively managed. Yields remain high, with some lands on their third rotation. In some areas, forest acreage has increased over the years. Unproductive dairy land has been converted to forest land to take advantage of excellent growing conditions. Close to the river, hybrid poplars are replacing agricultural land in some places. Columbia County alone has over 9,000 acres planted with these specialized trees, which are used for woodchip and paper making.

Forest resources in the area historically supported and continue to support numerous pulp and paper mills, as well as other mills that supply lumber, plywood and woodchip. The first pulp mill was established in 1884 in Camas, Washington. This was followed by others in Vancouver, (1923), St. Helens, (1926 and 1930), and Longview, (1927 and 1931). Today, six major pulp and paper mills line the lower Columbia River. Washington has one each at Camas and Vancouver and two in Longview, while Oregon has major mills in St. Helens and Wauna. These mills contribute significant dollars and jobs to the regional economy.

AESTHETIC AND RECREATIONAL RESOURCES

The lower Columbia River and estuary is one of the most scenic areas in the nation. It encompasses forested mountains, verdant valleys, rolling green hillsides, and miles of tidelands rich with wildlife. Recognizing the unparalleled beauty and resources of the river's gorge, Congress created the 285,000-acre Columbia River Gorge National Scenic Area in 1986. Almost one-third of the Scenic Area lies within the Estuary Program study area. The waterfall-draped walls of this natural wonder rise 3,000 feet above the river, providing spectacular views for miles around.

Recreational opportunities abound. Fishing, crabbing, hunting, windsurfing, boating, paddling, swimming, hiking, and sightseeing attract millions of residents and visitors each year. Multnomah Falls is the number-one natural tourist attraction in the State of Oregon. Sauvie Island, which includes an Oregon State Fish and Wildlife Management Area and a 3,000-acre lake, averages 695,000 recreational user-days per year. In addition to providing pleasure and renewal, recreation and tourism are important economic resources for the area.

FUTURE PROFILE

The lower Columbia River and estuary is clearly an area of diverse opportunities. It offers an array of resources and uses that support numerous living communities—from the plant and animal life of the river to the surrounding human populations. But many of these uses also place great demands on the river. Significant problems exist. The future well-being of the lower river and estuary depends on addressing these problems, envisioning a healthy future, and working to achieve it.



On the river yesterday's fact slides past.

Kim Stafford

GLOSSARY

Algal growths: Growths of microscopic aquatic plants.

Alluvial: Relating to clay, silt, sand, gravel, or similar material deposited by running water.

Ambient: Refers to overall conditions surrounding a place or thing. For example, ambient monitoring refers to routine water quality monitoring.

Anadromous: Describes fish that are born in fresh water, migrate to the sea, and return to fresh water to spawn (reproduce). Examples include salmon, sturgeon, shad, smelt, and steelhead.

Aquatic: Living in or around water.

Arsenic: A naturally occurring chemical element, currently used primarily in the production of pesticides and wood preservatives. In some areas, levels of arsenic are increasing in groundwater because of seepage from hazardous waste sites. In sufficient quantities, arsenic is highly toxic to fish, wildlife, and humans.

Basin: An area of land drained by a river and its tributaries.

Bathymetry: The measurement of water depths in water bodies.

Beneficial uses: The specific uses of a river by people and wildlife, defined by state laws and regulations, and protected by state agencies. Oregon and Washington's defined beneficial uses for the lower Columbia River are: public and private drinking water supply, irrigation, stock watering, fish migration and spawning, other fish wildlife and aquatic plant uses, wildlife usage, preservation of significant and unique habitats, water contact sports, fishing and hunting, aesthetic quality, hydroelectric power, navigation and transportation, marinas and related commercial activity, and commercial fishing.

Benthic: Bottom-dwelling or substrate-oriented; at or in the bottom of a body of water.

Best Management Practice (BMP): A practice or combination of practices that are determined to be the most effective and practical means of controlling point and non-point source pollutants at levels compatible with environmental quality goals.

Bioaccumulative: Contaminants that accumulate in the tissues of individual organisms.

Bioassay: A laboratory test using live organisms to measure biological effects of a substance, factor, or condition.

Biodiversity: The number and abundance of species found within a common environment. This includes the variety of genus, species, ecosystems, and the ecological processes that connect everything in a common environment.

Biological integrity: The capacity of the river system to support and maintain an integrated, adaptive community of plant and animal life.

Biota: All living organisms that exist in a region.

Bis (2-ethyl hexyl) phthalate: A common plasticizer used in a wide variety of industrial processes.

Carcinogenic: Capable of causing or inciting cancer.

Chronic toxicity: Measured as the concentrations of toxics that cause long-term sublethal effects such as impaired growth or reproduction.

Clean Water Act: The 1973 Federal Water Pollution Control Act and Amendments are concerned with the pollution of surface water and groundwater and basically call for fishable and swimmable water everywhere. Permits are required for discharges into waters. The law provides for pretreatment standards, plans involving non-point source pollution, and effluent limitations to effectuate the statutory purpose.

Environmental Protection Agency Cluster Rule: An integrated, multi-media regulation to control the release of pollutants to air and water from the pulp and paper industry. The Cluster Rule sets new baseline limits for releases of toxics and non-conventional pollutants.

Columbia River Basin: All tributaries and their watersheds that drain into the Columbia River along its entire 1,200-mile length. The Columbia River Basin drains approximately 259,000 square miles.

Combined Sewer Overflow (CSO): Untreated overflow from commingled sanitary and storm sewers.

Confluence: The place where two or more streams or rivers meet.

Conventional Pollutants: Constituents or characteristics of the water that occur naturally but become problematic to aquatic organisms and humans due to human activity or, in some cases, natural events. Examples include high water temperatures and high levels of total dissolved gas.

Crustaceans: Invertebrates (animals without backbones) of the phylum Arthropoda, including amphipods, shrimps, crabs, barnacles, and other animals that have segmented bodies, jointed legs, and hard external shells.

Cumulative impacts: The combined environmental impacts that accrue over time and space from a series of similar or related individual actions, contaminants, or projects. Although each action may seem to have a negligible impact, the combined effect can be severe.

DDD: See DDT.

DDE: See DDT.

DDT (Dichloro-diphenyl-trichloroethane): The first chlorinated hydrocarbon insecticide (pesticide). DDT collects in the fatty tissue of some animals and was responsible for eggshell thinning and reproductive failure in eagles. The U.S Environmental Protection Agency banned registration and interstate sale of DDT in 1972 because of its persistence in the environment and accumulation in the food chain. In the environment, DDT breaks down to form DDD and DDE, which are also toxic.

Diking: A method of artificially changing the direction of a course of water or confining water.

Dioxin: A chlorinated organic compound that is widespread and persistent in the environment, some forms of which are highly toxic to fish, wildlife, and humans.

Dissolved oxygen (DO): Oxygen dissolved in water; necessary for the life of fish and most other aquatic organisms. The measurement of dissolved oxygen can be an important indicator of the condition of a water body.

Dredging: The removal of sediments from a river, estuary, or ocean, usually for navigation or docking purposes.

Ecology: The interrelationships of living things to one another and to their environment, or the study of these interrelationships.

Evolutionary Significant Unit (ESU): A population or group of populations that is considered distinct (and hence a “species”) for purposes of conservation under the Endangered Species Act. To qualify as an ESU, a population must: 1) be reproductively isolated from other conspecific (of the same species) populations, and 2) represent an important component in the evolutionary legacy of the biological species.

Ecosystem: A community of organisms in a given area together with their physical environment and its characteristic climate.

Effluent: Wastewater discharged into a body of water from point sources.

Endangered Species: A plant or animal that is in danger of extinction throughout all or a significant portion of its range, as identified in accordance with the Endangered Species Act of 1973.

Endangered Species Act: A federal act to protect plant and animal species whose continued existence is in jeopardy. When species are listed under the Act as threatened or endangered, certain actions must be taken for their conservation.

Enhancement: Making changes or improvements to habitat to replace functions or values lost or damaged.

Environmental Indicators: Conditions or occurrences that indicate the health or degradation of the environment.

Erosion: Wearing away of rock or soil by the gradual detachment of soil or rock fragments by water, wind, ice, and other mechanical and chemical forces. Human activities can greatly speed this detachment.

Estuary: The area where the fresh water of a river meets the salt water of an ocean. In the National Estuary Program, this definition is extended to include the tidally influenced waters of the river.

Fecal Coliform: Bacteria associated with the feces of warm-blooded animals, including livestock and humans.

Fertilizers: Material added to the soil to supply chemical elements needed for plant nutrition.

Fill: Soil, sand, and debris deposited in aquatic areas, such as wetlands, to create dry land, usually for agricultural or commercial development purposes.

Flip lips: A structure added to the sloping surface of a spillway to change the downward direction of flow and “flip” it outward. This minimizes deep plunging of water, thereby reducing gas supersaturation and minimizing gas bubble disease in both juvenile and adult migrating fish. Also called spill flow detectors.

Floodplain: The area along a stream or river that is subject to flooding.

Food chain: An arrangement of the organisms of an ecological community according to the order of predation in which each uses the next (usually lower) member as a food source.

Furan: A chlorinated organic compound closely related to dioxin.

Gas bubble disease: A potentially fatal disease affecting fish, triggered by exposure to elevated levels of dissolved gas when water is spilled over dams.

Groundwater recharge: Replenishment of water that circulates in underground aquifers.

Habitat: Places where plants and animals live, feed, find shelter, and reproduce.

Infiltration: The downward movement of water from the atmosphere into soil or porous rock.

Instream water rights: Rights that establish flow levels to stay in a stream on a month-by-month basis, and are usually set for a certain stream reach and measurement at a specific point on the stream. Instream water rights have a priority date and are regulated in the same way as other water rights.

Lower Columbia River Basin: All tributaries and their watersheds that drain into the Columbia River from its mouth to river mile 146. It is larger than the Lower Columbia River Estuary Program study area because it includes the entire watersheds of the tributaries, beyond the waters that are tidally influenced. The Lower Columbia River Basin drains approximately 18,000 square miles, about 7 percent of the entire Columbia River Basin.

Lower Columbia River Estuary Program Study Area: Those portions of the Columbia River and its tributaries that are tidally influenced. The study area extends from the Pacific Ocean to Bonneville Dam at river mile 146. It also includes near-coastal waters from the mouth of the Columbia to the 3-mile limit, to the extent that those waters are influenced by the plume of fresh water flowing out of the Columbia River to the sea. The study area covers approximately 4,300 square miles. It is also referred to as the lower Columbia River and estuary.

Macro-invertebrates: Invertebrates large enough to be seen with the naked eye (i.e., most aquatic insects, snails, and amphipods).

Mainstem: The main course of a stream or river.

Marsh: A wetland where the dominant vegetation is non-woody plants such as grasses and sedges, as opposed to a swamp, where the dominant vegetation is woody plants and trees.

Metabolite: The product of the physical and chemical processes by which foodstuffs are synthesized into complex elements, complex substances are transformed into simple ones, and energy is made available for use by an organism.

Metadata: Information about data, such as their source, sampling protocol, and standards.

Metals: A group of elements found in rocks and minerals that are naturally released to the environment by erosion, as well as generated by human activities. Certain metals, such as mercury, lead, zinc, and cadmium, are of environmental concern because they are released into the environment in excessive amounts by human activity and can produce toxic effects.

Mitigation: Measures taken to reduce the severity of impacts resulting from an action or practice.

Morphology: The form and structure of a stream or river.

Mouth: The place where a stream or river enters a larger body of water (e.g., the ocean).

Native species: Species that are indigenous to the local region and have evolved to thrive in local conditions.

Natural flood storage capacity: The natural capacity of lands surrounding a river to absorb floodwaters and excess runoff.

National Estuary Program (NEP): A federal program established in 1987 by amendments to the Clean Water Act and administered by the U.S. Environmental Protection Agency. The NEP's primary goal is "to protect estuaries of national significance that are threatened by degradation caused by human activity." The NEP employs community-based environmental planning, designating primary responsibility for program development and implementation to the local community.

Non-indigenous species: Species not naturally growing or living in a particular area. Their introduction and expansion can destroy or deplete habitat and food needed by native populations. Also referred to as exotic or non-native species.

Non-point source pollution: Pollution entering waterways from broad land areas as a result of the way the land is used—for example, runoff from agricultural practices, construction and road-building, logging, and urban development.

National Pollutant Discharge Elimination System (NPDES) permit program: A provision of the Clean Water Act that prohibits discharge of pollutants into waters of the United States unless a special permit is issued by U.S. EPA, a state, or another delegated agency.

Nutrients: Essential chemicals needed by plants and animals for growth. Enriched nutrient loads from sewage, land runoff, and atmospheric deposition can result in excessive growth of algae and lead to degradation of water quality.

PAHs (Polycyclic or polynuclear aromatic hydrocarbons): A class of complex organic compounds, some of which are persistent and cause cancer. These compounds are formed from the combustion of organic material and are ubiquitous in the environment. PAHs are commonly formed by forest fires and by the combustion of gasoline and other petroleum products. They often reach the environment through atmospheric fallout and highway runoff.

Particulate matter: Material composed of minute separate particles.

PCBs (polychlorinated biphenyls): A group of manufactured colorless and odorless chemicals made up of carbon, hydrogen, and chlorine. Because of their insulating and nonflammable properties, PCBs were widely used as coolants and lubricants in transformers, capacitors, and other electrical equipment. Banned from production in the United States in 1976, PCBs found today are from historical use or spills. PCBs are suspected of causing cancer in humans and other animals.

Performance standards: Standards based on meeting certain desirable outcomes through flexible methods.

PBTs (persistent bioaccumulative chemicals): Toxic and long-lasting substances that can build up in the food chain to levels that can be harmful to human and ecological health. Many of these substances are man-made and have been in existence for a relatively short period. A few, such as mercury and cadmium, are naturally occurring.

Pesticides: Pesticides include herbicides, insecticides, fungicides, and rodenticides that are used to control unwanted plants, insects, fungi, or rodents, respectively. Most of these chemicals are manufactured and are not found naturally in the environment.

pH: Measure of the negative logarithm of the hydrogen ion concentration to determine the acidity or alkalinity of water. Water of pH 7 is neutral; lesser values are acidic; higher values (pH 14 maximum) are alkaline.

Plankton: Microscopic plants and animals that drift with currents.

Plume: An elongated column or cloud of water or suspended sediment.

Point source pollution: A source of pollutants from a single point of conveyance, such as a pipe. For example, the discharge from a sewage treatment plant or a factory is a point source.

Radionuclides: Decayed products of radioactive materials.

Redds: Nests made in gravel (particularly by salmonids), consisting of a depression that is

created and then covered.

Restoration: Returning a damaged habitat, as nearly as possible, to its condition prior to being damaged.

Riparian zone: The land bordering a stream or river, and the vegetation typical of those borders.

Riprap: Large rocks, broken concrete, or other structure used to stabilize streambanks and other slopes.

Riverine: On or near the banks of a river.

River mile: The mile marking a particular point along or in a river, measured from the mouth of a river to its source.

Rock barbs: Rock structures placed in a stream that alter flow to protect streambanks and create new aquatic and riparian habitats.

Runoff: Water from precipitation, snowmelt, and agricultural or landscape irrigation that runs off the land into water bodies.

Salmonid: Fish of the family Salmonidae, including salmon, trout, chars, whitefish, ciscoes, and grayling.

Sanitary Sewer Overflow (SSO): Overflow resulting from a municipal sanitary sewer system exceeding its capacity, due to unintended inflow and infiltration of storm water.

Sediment: Mud, sand, silt, clay and other particles that settle on the bottoms of waterways.

Self-sustaining: Species able to reproduce and rear successfully in their natural habitats and survive the remainder of their life stages.

Sensitive species: Those species that 1) have appeared in the Federal Register as proposed for classification and are under consideration for official listing as endangered or threatened species, or 2) are on an official state list, or 3) are recognized as needing special management to prevent their being placed on a federal or state list.

Slough: A channel through a marsh or mudflat.

Spawn: The act of reproduction of fish, which includes egg laying and fertilization, and sometimes nest building (e.g., salmon).

Stewardship: Taking care of the earth for ourselves and others; sharing knowledge and enthusiasm about that care with others.

Stormwater: Surface water resulting from all natural forms of precipitation.

Substrate: Material that forms a stream or lake bed (silt, sand, gravel, cobble, etc.).

Supersaturation: Water is supersaturated when concentrations of dissolved gas exceed 100 percent. This can occur when gas is forced into the water under pressure, such as when water spills over dams and forces gas into the water.

Suspended solids: Solid inorganic and organic materials that remain suspended in the water column.

Synergistically toxic: Chemicals that become toxic as they mix with other chemicals.

303(d) lists: State-compiled lists of stream segments that do not meet water quality standards.

They are called 303(d) lists after the section of the Clean Water Act that makes the requirement.

Tidal wetlands: Wetlands that have a direct connection to or are influenced by the ocean's tides. For the purposes of the *Management Plan*, tidal wetlands are defined as wetlands below river mile 46.

Tide flats: Flat areas of land exposed during low tides.

Tide gate: A structure designed to allow drainage of diked areas while preventing their inundation by the ocean's tides.

Threatened species: A plant or animal species likely to become endangered throughout all or a specific portion of its range within the foreseeable future, as identified in accordance with the Endangered Species Act of 1973.

Total dissolved gas: A measurement of the amount of nitrogen and oxygen gas dissolved in water. Water is saturated when it can hold no more dissolved gas under normal atmospheric conditions.

Total Maximum Daily Loads (TMDLs): Allocated measures that ensure compliance with water quality standards for 303(d)-listed water bodies.

Toxic chlorinated hydrocarbons: Toxic compounds resulting from the mixing of chlorine, carbon, and water.

Toxic: Poisonous, carcinogenic, or otherwise directly harmful to life.

Tributary: A stream or river feeding a larger body of water.

Tributyltin: An organic compound used as an additive in many marine anti-foulant plants to prevent algal and barnacle growth. Tributyltin is highly toxic to many marine organisms.

Turbidity: A measure of the amount of suspended material in the water, based on the material's refractory characteristics.

Urban growth boundaries: Generally state-wide, land use planning programs that mark the separation between rural and urban land. They are intended to encompass an adequate supply of buildable land that can be efficiently provided with urban services (such as roads, sewers, water lines, and street lights) to accommodate the expected growth during a specific time period.

Waste load allocations: The portion of a receiving water's loading capacity that is allocated to existing or future point source discharges.

Water column: The layer of water between surface and bottom sediments; the moving mass of water contained by a stream or river bed. The water column contains dissolved and particulate matter and provides habitat for plankton, fish, and marine mammals.

Watershed: A geographic area within which all surface water drains to a particular body of water.

Wetland: An area that is saturated by a surface of groundwater and subsequently is characterized by a prevalence of vegetation that is adapted for life in saturated soil conditions.

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HISTORICAL PHOTOGRAPHS

Page 12 - Fish net seining. Earl Moore photo, Oregon Historical Society, #OrHi GI 7185 #390-D

Page 143 - The Rapids, Upper Cascades. Charles E. Watkins photo, Oregon Historical Society, #OrHi 21089 #1100B

In memory of Terry Husseman

whose vision and commitment inspires us still.

*Terry served as Deputy Director of the Washington Department of Ecology
and was a founding member of the Estuary Program Policy Committee.*

*In large part, it was Terry's vision and guidance for a two-state comprehensive
environmental program that shaped the Estuary Program.*

He is missed.