US Army Corps
of Engineers ®
Portland District

Water Resources Development in Oregon 2000

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This publication is authorized by
the Secretary of the Army
as required by PL 99-662

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Water Resources Development by the U.S. Army Corps of Engineers in Oregon

Foreword

The Portland, Walla Walla, San Francisco, and Sacramento districts administer the water resource activities assigned to the U.S. Army Corps of Engineers for the state of Oregon.

Portland and Walla Walla districts are in the Northwestern Division. San Francisco and Sacramento are in the South Pacific Division. The division offices report to the Office of the Chief of Engineers in Washington, D.C. Projects and activities in Oregon are defined by river basins rather than by political boundaries. Thus, work throughout the state is under the jurisdiction of the Corps district assigned to each specific area, as indicated on the state map on page 20. The following chapters contain short descriptions of civil works projects assigned to the districts for Oregon. For more complete information regarding any project, inquiries should be directed to the division or district engineer of the appropriate office.

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Civil Works Overview

Introduction

From 1775 to the present, the U.S. Army Corps of Engineers has served the nation in peace and war. The Corps traces its history to June 1775, when the Continental Congress appointed Colonel Richard Gridley as Chief of Engineers of the Continental Army, under General George Washington. The original Corps was the Army's engineering and construction arm until it mustered out of service at the close of the Revolutionary War in 1783.

In 1802, Congress re-established a separate Corps of Engineers within the Army. At the same time, it established the U.S. Military Academy at West Point, the country's first— and for 20 years its only— engineering school. With the Army having the nation's most readily available engineering talent, successive Congresses and administrations established a role for the Corps as an organization to carry out both military construction and works "of a civil nature."

Throughout the 19th century, the Corps supervised the construction of coastal fortifications, lighthouses, several early railroads, and many of the public buildings in Washington, D.C. and elsewhere. Meanwhile, the Corps of Topographical Engineers, which enjoyed a separate existence for 25 years (1838— 1863), mapped much of the American West. Army Engineers served with distinction in war, with many engineer officers rising to prominence during the Civil War.

In its civil role, the Corps of Engineers became increasingly involved with river and harbor improvements, carrying out its first harbor and jetty work in the first quarter of the 19th century. The Corps' ongoing responsibility for federal river and harbor improvements dates from 1824, when Congress passed two acts authorizing the Corps to survey roads and canals and to remove obstacles on the Ohio and Mississippi rivers. Over the years since then, the expertise gained by the Corps in navigation projects has led succeeding administrations and Congresses to assign new water-related missions to the Corps in such areas as flood control, shore and hurricane protection, hydropower, recreation, water supply and quality, wetland protection, and ecosystem restoration.

Today's Corps of Engineers carries out missions in three broad areas: military construction and engineering support to military installations; reimbursable support to other federal agencies (such as the Environmental Protection Agency's "Superfund" program to clean up hazardous and toxic waste sites); and the Civil Works mission, centered around navigation, flood damage reduction and— under the Water Resources Development Acts of 1986, 1988, 1990, 1992, 1996 and 1999— a growing role in environmental restoration.

Authorization and Planning of Water Resources Projects

Corps of Engineers water resources activities are normally initiated by non-federal interests, authorized by Congress, funded by a combination of federal and non-federal sources, constructed by the Corps under the Civil Works Program, and operated and maintained either by the Corps or by a non-federal sponsoring agency.

The Water Resources Development Act of 1986 (PL 99-662) made numerous changes in the way potential new water resources projects are studied, evaluated, and funded. The major change is that the law now specifies greater non-federal cost sharing for most Corps water resources projects. The Water Resources Development Act of 1996 increased non-federal sharing costs again to

35 percent of costs for most water resources projects.

When local interests feel that a need exists for improved navigation, flood protection, ecosystem restoration, or other water resources development, they may petition their representatives in Congress. A Congressional committee resolution or an act of Congress may then authorize the Corps of Engineers to investigate the problems and submit a report. Water resources studies, except studies of the inland waterway navigation system, are conducted in partnership with a non-federal sponsor, with the Corps and the sponsor jointly funding and managing the study.

For inland navigation and waterway projects, which are by their nature not "local," Congress, in the Water Resources Development Act of 1986, established an Inland Waterway Users Board, comprised of waterway transportation companies and shippers of major commodities. This board advises the Secretary of the Army and makes recommendations on priorities for new navigation projects such as locks and dams. Such projects are funded in part from the Inland Waterway Trust Fund, which in turn is funded by waterway fuel taxes.

Normally, the planning process for a water resource problem starts with a brief reconnaissance study to determine whether a project falls within the Corps' statutory authority and meets national priorities. Should that be the case, the Corps district where the project is located will carry out a full feasibility study to develop alternatives and select the best possible solution. This process normally includes public meetings to determine the views of local interests on the extent and type of improvements desired. The federal, state, and other agencies with interests in a project are partners in the planning process.

Before making recommendations to Congress for project authorization, the Corps ensures that the proposed project's benefits will exceed costs, its engineering design is sound, the project best serves the needs of the people concerned, it makes the wisest possible use of the natural resources involved, and it adequately protects the environment. Once the Corps of Engineers district completes its feasibility study, it submits a report, along with a final environmental impact statement, to higher authority for review and recommendations. After review and coordination with all interested federal agencies and the governors of affected states, the Chief of Engineers forwards the report and environmental statement to the Secretary of the Army, who obtains the views of the Office of Management and Budget before transmitting these documents to Congress.

If Congress includes the project in an authorization bill, enactment of the bill constitutes authorization of the project. Before construction can get underway, however, both the federal government and the project sponsor must provide funds. A federal budget recommendation for a project is based on evidence of support by the state and the ability and willingness of a non-federal sponsor to provide its share of the project cost.

Appropriation of money to build a particular project is usually included in the annual Energy and Water Development Appropriations Act, which must be passed by both Houses of the Congress and signed by the President.

Navigation

Corps of Engineers involvement in navigation projects dates to the early days of the United States, when rivers and coastal harbors were the primary paths of commerce in the new country. Without its great rivers, the vast, thickly forested region west of the Appalachians would have remained impenetrable to all but the most resourceful early pioneers. Consequently, western politicians such as Henry Clay agitated for federal assistance to improve rivers. At the same time, the War of 1812 showed the importance of a reliable inland navigation system to national defense.

There was, however, a question as to whether transportation was, under the Constitution, a legitimate federal activity. This question was resolved when the Supreme Court ruled that the Commerce Clause of the Constitution granted the federal government the authority, not only to regulate navigation and commerce, but also to make necessary navigation improvements.

The system of harbors and waterways maintained by the Corps of Engineers remains one of the most important parts of the nation's transportation system. The Corps maintains the nation's waterways as a safe, reliable, and economically efficient navigation system. The 12,000 miles of inland waterways maintained by the Corps carry one-sixth of the nation's inter-city cargo. The importance of the Corps mission in maintaining depths at more than 500 harbors, meanwhile, is underscored by an estimated one job in five in the United States being dependent, to some extent, on the commerce handled by these ports.

Flood Damage Reduction and Flood Plain Management

Federal interest in flood control began in the alluvial valley of the Mississippi River in the mid-19th century. As the relationship between flood control and navigation became apparent, Congress called on the Corps of Engineers to use its navigational expertise to devise solutions to flooding problems along the river.

After a series of disastrous floods affecting wide areas in the 1920s and 30s, Congress determined, in the Flood Control Act of 1936, that the federal government would participate in the solution of flooding problems affecting the public interest that were too large or complex to be handled by states or localities. Corps authority for flood control work was thus extended to embrace the entire country. The Corps turns most of the flood control projects it builds over to non-federal authorities for operation and maintenance once construction is completed.

The purpose of flood damage reduction work is to prevent damage through regulation of the flow of water and other means. Prevention of flood-related damages can be accomplished with structural measures, such as reservoirs, levees, channels, and floodwalls that modify the characteristics of floods; or non-structural measures, such as flood plain evacuation, floodproofing, and floodway

acquisition, that alter the way people use these areas and reduce the susceptibility of human activities to flood risk.

Corps flood damage reduction reservoirs are often designed and built for multiple-purpose uses, such as municipal and industrial water supply, navigation, irrigation, hydroelectric power, conservation of fish and wildlife, and recreation.

The Corps fights the nation's flood problems not only by constructing and maintaining structures, but also by providing detailed technical information on flood hazards. Under the Flood Plain Management Services Program, the Corps provides, on request, flood hazard information, technical assistance, and planning guidance to other federal agencies, states, local governments, and private citizens. Once community officials know the flood-prone areas in their communities and how often floods are likely to occur, they can take necessary action to prevent or minimize damages to existing and new buildings and facilities, such as adopting and enforcing zoning ordinances, building codes, and subdivision regulations. The Flood Plain Management Services Program provides assistance to other federal and state agencies in the same manner.

Shore and Hurricane Protection

Corps work in shore protection began in 1930, when Congress directed the Corps to study ways to reduce erosion along U.S. seacoasts and the Great Lakes. Hurricane protection work was added to the erosion control mission in 1955, when Congress directed the Corps to conduct investigations along the Atlantic and Gulf Coasts to identify problem areas and determine the feasibility of protection.

While each situation the Corps studies involves different considerations, Corps engineers always consider engineering feasibility and economic efficiency along with environmental and social impacts. Federal participation in a shore protection project varies, depending on shore ownership, use, and type and frequency of benefits. (If there is no public use or benefit, the Corps will not recommend federal participation.) Once the project is complete, non-federal interests assume responsibility for its operation and maintenance.

There are 82 federal shore protection projects along the coasts of the Atlantic, Pacific, Gulf of Mexico, and the Great Lakes. Total investment in these projects since 1950 has been $674 million, of which $405 million was provided by the federal government, the rest by non-federal sponsors.

One shore protection method popular in seaside communities is beach nourishment— the periodic replenishment of sand along the shoreline to replace that lost to storms and erosion. Authorized nourishment projects usually have a nourishment period of 50 years. In addition, Section 145 of the Water Resources Development Act of 1976 authorizes placement of beach-quality sand from Corps dredging projects on nearby beaches. Under Section 933 of the Water Resources Development Act of 1986, local sponsors pay the federal government 50 percent of the additional costs of this placement of sand.

Hydropower

The Corps has played a significant role in meeting the nation's electric power generation needs by building and operating hydropower plants in connection with its large multiple-purpose dams. The Corps' involvement in hydropower generation began with the Rivers

and Harbors Acts of 1890 and 1899, which required the Secretary of War and the Corps of Engineers to approve the sites and plans for all dams and to issue permits for their construction. The Rivers and Harbors Act of 1909 directed the Corps to consider various water uses, including water power, when submitting preliminary reports on potential projects.

The Corps continues to consider the potential for hydroelectric power development during the planning process for all water resources projects involving dams and reservoirs. In most instances today, it is non-federal interests that develop hydropower facilities at Corps projects without federal assistance. The Corps, however, can plan, build, and operate hydropower projects when it is impractical for non-federal interests to do so. Today, the more than 20,000 megawatts of capacity at Corps-operated power plants provide approximately 24 percent of the nation's hydroelectric power, or 3 percent of its total electric energy supply.

Water Supply

Corps involvement in water supply dates back to 1853, when it began building the Washington Aqueduct, which provides water to the nation's capital city and some of its suburbs to this day.

Elsewhere in the nation, the Water Supply Act of 1958 authorized the Corps to provide additional storage in its reservoirs for municipal and industrial water supply at the request of local interests, who must agree to pay the cost. The Corps also supplies water for irrigation, under terms of the Flood Control Act of 1944. This act provided that the Secretary of War, upon the recommendation of the Secretary of the Interior, could allow use of Corps reservoirs for irrigation, provided that users agree to repay the government for the water.

Recreation

The Flood Control Act of 1944, the Federal Water Project Recreation Act of 1965, and language in specific project authorization acts authorize the Corps to construct, maintain, and operate public park and recreational facilities at its projects, and to permit others to build, maintain, and operate such facilities. The water areas of Corps projects are open to public use for boating, fishing, and other recreational purposes.

The Corps of Engineers today is one of the federal government's largest providers of outdoor recreational opportunities, operating more than 4,300 sites at its lakes and other water resource projects. More than 370 million visits per year are recorded at these sites. State and local park authorities and private interests operate nearly 2,000 other areas at Corps projects.

Environmental Quality

The Corps carries out the Civil Works Programs in consistency with environmental laws, executive orders, and regulations. Perhaps primary among these is the National Environmental Policy Act (NEPA) of 1969. This law requires federal agencies to study and consider the environmental impacts of their proposed actions. Consideration of the environmental impact of a Corps project begins in the early stages, and continues through design, construction, and operation of the project. The Corps must also comply with these environmental laws and regulations in conducting its regulatory programs.

NEPA procedures ensure that public officials and private citizens may obtain and provide environmental information before federal agencies make decisions concerning the environment. In selecting alternative project designs, the Corps strives to choose options with minimal environmental impact.

The Water Resources Development Act of 1986 authorizes the Corps to propose modifications of its existing projects— many of them built before current environmental requirements were in effect— for environmental improvement. In recent years, the Corps of Engineers has planned and recommended environmental restoration actions at federal projects to restore environmental conditions. Under the Corps' specifically authorized General Investigations program, ecosystem restoration can be pursued either as a single purpose, or

in conjunction with navigation or flood control investigations. Corps activities are directed at engineering solutions to water and related land resource problems. The Corps' focus is on those ecological resources and processes that are directly associated with or directly dependent upon the hydrologic regime of the ecosystem and watershed. Proposals the Corps has made under this authority range from use of dredged material to create nesting sites for waterfowl to modification of water control structures to improve downstream water quality for fish.

Regulatory Programs

The Corps of Engineers regulates construction and other work in navigable waterways under Section 10 of the Rivers and Harbors Act of 1899, and has authority over the discharge of dredged or fill material into the "waters of the United States"— a term which includes wetlands and all other aquatic areas— under Section 404 of the Federal Water Pollution Control Act Amendments of 1972 (PL 92-500, the "Clean Water Act"). Under these laws, those who seek to carry out such work must first receive a permit from the Corps.

The "Section 404" program is the principal way by which the federal government protects wetlands and other aquatic environments. The program's goal is to ensure protection of the aquatic environment while allowing for necessary economic development.

The permit evaluation process includes a public notice and a public comment period. Applications for complex projects may also require a public hearing before the Corps makes a permit decision. In its evaluation of applications, the Corps is required by law to consider all factors involving the public interest. These may include economics, environmental concerns, historical values, fish and wildlife, aesthetics, flood damage prevention, land use classifications, navigation, recreation, water supply, water quality, energy needs, food production, and the general welfare of the public.

The Corps of Engineers has issued a number of nationwide general permits, mostly for minor activities which have little or no environmental impact. Individual Corps districts have also issued regional permits for certain types of minor work in specific areas. Individuals who propose work that falls under one of these general or regional permits need not go through the full standard individual permit process. However, many general permit authorizations do involve substantial effort by the Corps, and often require project-specific mitigation for the activities authorized by the permit. Corps districts have also issued State Program General Permits for work in states that have comprehensive wetland protection programs. These permits allow applicants to do work for which they have received a permit under the state program. These general permits reduce delays and paperwork for applicants and allow the Corps to devote most of its resources to the most significant cases while maintaining the environmental safeguards of the Clean Water Act.

Emergency Response and Recovery

The Corps provides emergency response to natural disasters under Public Law 84-99, which covers flood control and coastal emergencies. It also provides emergency support to other agencies, particularly the Federal Emergency Management Agency (FEMA), under Public Law 93-288 (the Stafford Act), as amended.

Under PL 84-99, the Chief of Engineers, acting for the Secretary of the Army, is authorized to carry out disaster preparedness work; advance measures; emergency operations such as flood fighting, rescue, and emergency relief activities; rehabilitation of flood control works threatened or destroyed by flood; and protection or repair of federally authorized shore protection works threatened or damaged by coastal storms. This act also authorizes the Corps to provide emergency supplies of clean water in cases of drought or contaminated water supply. After the immediate flooding has passed, the Corps provides temporary construction and repairs to essential public utilities and facilities and emergency access for a 10-day period, at the request of the governor and prior to a Presidential Disaster Declaration

Under the Stafford Act and the Federal Disaster Response Plan, the Corps of Engineers, as designated by the Department of Defense, is responsible for providing public works and engineering support in response to a major disaster or catastrophic earthquake. Under this plan, the Corps, in coordination with FEMA, will work directly with state authorities in providing temporary

repair and construction of roads, bridges, and utilities; temporary shelter; debris removal and demolition; water supply; etc. The Corps is the lead federal agency tasked by FEMA to provide engineering, design, construction, and contract management in support of recovery operations.

The Army and Water Resource Development

A logical question often asked the Corps of Engineers is "Why is the Army involved in building harbors, waterways, dams, and flood control projects?" The answer begins with the founding of our country. The U.S. Army Corps of Engineers was established June 16, 1775, a year before the War of Independence. After distinguished performance in the Revolution, engineers were asked to continue serving the country to design and construct roads, canals, harbors, and other civil works. In 1802, the U.S. Military Academy was established at West Point, N.Y., as the nation's first engineering school.

In 1803, the Louisiana Purchase doubled the territorial holdings of the United States. President Jefferson dispatched Capt. Meriwether Lewis and Lt. William Clark on their famous expedition to the Pacific Northwest. This was the first Army involvement in the region.

In the early 1800s, many immigrants and pioneers moved westward and trade flourished. In 1824, Congress passed a series of laws, one of which was the General Survey Act, that marked the beginning of the Corps civil works program. Explorations and surveys were completed by the Topographical Engineers, the predecessor organization of the present Corps of Engineers. They laid out early stagecoach routes, Pony Express routes, railroads, and military roads.

John C. Fremont, George B. McClellan, and Isaac Ingalls Stevens, the first governor of the Washington Territory, were Army Engineers. The Army placed much importance on the Pacific Northwest as some of the nation's finest officers were assigned to the region, including Ulysses S. Grant and Philip Sheridan.

During the Civil War, Army Engineers continued their work in the Northwest. One of their efforts was removing navigation hazards such as rocks, stumps, and sandbars from the Snake River between what is now Pasco, Washington, and Lewiston, Idaho, so sternwheelers could navigate the river, carrying gold from Idaho mines to federal coffers to finance the war.

One hundred years ago, the work of Army Engineers consisted of efforts to improve navigation. Pulling snags from river waterways, cutting a bar to 17 feet with a primitive bucket dredge borrowed from the city of Portland, or dynamiting rocks out of the Columbia or Snake rivers was typical of the work done at that time. Since then, Congress, acting through the will of the people, has directed the Corps of Engineers to design, construct, and operate huge multipurpose water resource development projects.

In a newer age in which conservation, preservation, and restoration mean as much as development, the Corps of Engineers carries on its complex duties under the U.S. Army Corps of Engineers traditional motto— "Essayons— Let us Try."

How Projects Are Initiated

The Corps of Engineers functions as an engineering consultant to Congress. Most major Corps water resource projects are developed under specific congressional authorization. When local interests believe a need exists for construction or improvement of a water resource project, they petition their representative in Congress. The senator or representative then requests the appropriate congressional committee to direct the Corps of Engineers to make a survey and furnish a recommendation. Authority for a study is either by Senate or House committee resolution or by congressional act and is usually conducted under the General Investigations Program..

Economic and engineering solutions to the problem and possible impact on the environment are studied. In making the study, public meetings are held to determine the wishes of local interests, to assure that the concerns and needs of the local people are considered and that requirements are understood when local interests must provide real estate or financial participation in the project. Other federal and non-federal agencies concerned with any phase of resource planning or development are consulted. When all the data are analyzed and a determination of the fullest possible use of the resource is made, the study, with its recommendations, is submitted to Congress which may then authorize a project. If authorized, the project requires congressional funding before construction can begin.

Some studies may be confined to a small area with a comparatively simple solution. For these types

of problems, the Corps has other authorities within the Continuing Authorities program that can be used to better meet local needs. Other studies may involve an urban area or cover an entire river basin or watershed and require detailed analyses of navigation, flood control, erosion control, hurricane and flood protection, municipal and industrial water supply, water quality control, fish and wildlife, hydroelectric power, major drainage, irrigation, recreation, or other purposes that may be deemed necessary to promote the national welfare.

When Congress provides funds for construction, the Corps of Engineers prepares plans and specifications, awards contracts, and supervises construction. Completed projects may be operated and maintained by the Corps or they may be transferred to another agency or the non-federal sponsor to operate and maintain.

A procedure to deauthorize projects was established by Section 12 of PL 93-251, Water Resources Development Act of 1974, as amended. Every two years, the Secretary of the Army, acting through the Chief of Engineers, is required to provide Congress with a list of projects that have been authorized for at least five years and meet the criteria for deauthorization. Before the list is submitted to Congress, the Chief of Engineers obtains views of interested federal departments, agencies and instrumentalities, the governors of affected states, and concerned members of Congress.

Continuing Authorities Program

Congress has established continuing authorities, which give the Corps of Engineers discretion to plan, design, and construct certain flood control, navigation, and water resource improvements without specific Congressional authorization for project activities of limited scope and extent. The basic objective of the Continuing Authorities program is to allow the Corps of Engineers to respond more quickly to problems or needs where the apparent project scope and costs are limited, and which do not merit a large feasibility investigation. The Chief of Engineers, under direction of the Secretary of the Army, may authorize and construct those small projects that are complete in themselves and do not commit the United States to any additional improvement to ensure successful operation.

Small Flood Damage Reduction Projects

Section 205 of the Flood Control Act of 1948, as amended, provides for construction of small flood control projects not specifically authorized by Congress, when such work is determined to be advisable by the Chief of Engineers. Levees, floodwalls, channel improvements, and small dams are the most common structural projects constructed under Section 205 authority. Non-structural flood plain management alternatives such as flood-proofing, flood plain evacuation, and floodplain warning also are considered under this authority. Bank protection against erosion without flooding on adjacent lands is excluded from this authority, unless specifically required to protect other project features. The maximum federal cost of a Section 205 project is $7 million, including all planning, engineering, design, and construction costs. Larger project costs are possible if the project sponsor agrees to bear costs in excess of that amount. Local sponsors must agree to operate and maintain the project after completion, and are required to pay a share of planning and construction costs.

Small Navigation Projects

Section 107 of the Rivers and Harbors Act of 1960, as amended, authorizes the Corps of Engineers to plan and construct small navigation projects not specifically authorized by Congress. Federal assistance is limited to general navigation facilities, which may include a safe entrance channel protected by breakwaters or jetties if needed, anchorage basins, turning basins, and major access channels leading to the anchorage basin or locally provided berthing area. Docks, landings, piers, berthing areas, boat stalls, slips, mooring facilities, launching ramps, access roads, parking areas, and interior access channels needed for maneuvering into berths are entirely a local responsibility and are constructed and maintained at non-federal expense. A Section 107 navigation project is adopted for construction after a detailed investigation clearly shows the engineering feasibility and economic justification of the improvement. Local sponsors are required to pay a share of the costs. Each project is limited to a federal cost of $4 million, which includes all project-related costs for feasibility studies and investigations, engineering, preparation of plans and specifications, construction, supervision, and administration.

Small Beach Erosion Control Projects

Section 103 of the Rivers and Harbors Act of 1962, as amended, authorizes construction of small beach restoration and protection projects, not specifically authorized by Congress, for protecting coastal shores from erosion caused by natural wave and current action. Federal funds cannot be used to protect privately owned shores. However, if there is significant benefit arising from public use or from protection of nearby public facilities, privately owned shores may be eligible for protection with up to 50 percent federal cost-sharing. The federal participation is adjusted in accordance with the degree of such benefits. Publicly owned shores or nearby public facilities, public parks, and conservation areas may qualify for up to 65 percent federal participation. A Section 103 project can be constructed only after detailed investigation clearly shows that it is engineeringly feasible economically justified and environmentally sound. Federal participation is limited to a maximum of $3 million for any one project. The local sponsoring agency must pay a share of planning and construction costs and agree to operate and maintain the project.

Snagging and Clearing Projects

There are two separate authorities that allow the Corps to clear snags and other debris from waterways. Section 2 of the Flood Control Act of 1937, as amended by Section 208 of the Flood Control Act of 1954, provides authority for the Corps of Engineers to remove accumulated snags and other debris, and to clear and straighten stream channels in the interest of flood control. The maximum allowable cost for work under this authority is $500,000 on any given tributary during one fiscal year.

Section 3 of the Rivers and Harbors Act of 1954 allows the Corps of Engineers to undertake emergency snagging or clearing work to clear or remove unreasonable obstructions from rivers, harbors, and other waterways in the interest of maintaining navigation. General widening or deepening of waterways, or the removal of materials due to a normal shoaling process rather than a sudden occurrence, is not eligible. Conditions in the waterway can be restored only to those that existed prior to the sudden occurrence, and the project sponsor is required to maintain the channel after it has been restored. There is no federal cost limitation for any project under this authority. However, this authority has been used almost exclusively for emergency navigation improvements. No more than $1 million can be spent nationwide on this program in any one fiscal year.

Emergency Streambank and Shoreline Protection

Section 14 of the Flood Control Act of 1946, as amended, authorizes up to $1 million of federal funds per year at a single location to construct, repair, restore, or modify emergency streambank and shoreline protection works to prevent damage to highways, bridge approaches, municipal water systems, sewage treatment plants, and other essential public works endangered by floods due to bank erosion. Churches, hospitals, schools, and other nonprofit public services also can be protected under Section 14 authority. For any Section 14 project, the local sponsor must pay a share of the project costs. The local sponsor must also operate, maintain, and repair the project as required to serve the intended purposes.

Prevention and Mitigation of Shore Damage

Section 111 of the Rivers and Harbors Act of 1968, as amended, provides authority for the Corps of Engineers to develop and construct projects that prevent and mitigate damages to both public and privately owned shores caused by federal navigation work located along the coastal and Great Lakes shorelines of the United States. Each project is limited to a cost of $2 million. After a reconnaissance of the problem, the Corps may recommend construction of a project to prevent or mitigate shore damage attributable to a federal navigation project only when the navigation project has been determined to be the cause of the damage and its abandonment is not the most viable solution. Section 111 authority may not be used for preventing or mitigating shore damages caused by non-federal navigation projects.

Project Modifications for Environmental Improvement

Section 1135 of the Water Resources Development Act of 1986 (PL 99-662), as amended, provides the authority to modify existing Corps projects to restore the environment and construct new projects to restore areas degraded by Corps projects. A project is accepted for construction after a detailed investigation shows it is technically feasible, environmentally acceptable, and provides cost-effective environmental benefits. Projects generally accomplish restoration by modifying a Corps project or operation of a Corps project, or are located on Corps land. The total federal project costs, including planning and design costs, cannot exceed $5 million. Local sponsors must pay a share of the project costs. The non-federal sponsor generally must assume responsibility for future operation and maintenance of the project.

Environmental Restoration Projects in Connection with Dredging

Section 204 of the Water Resources Development Act of 1992 (PL 102-580) applies beneficial uses of material dredged in conjunction with federal navigation projects. Section 204 authorizes projects for the protection, restoration, and creation of aquatic and ecologically related habitats, including wetlands, in connection with dredging for construction, operation, or maintenance of

an authorized federal navigation project. These authorities do not encompass emergency actions undertaken by the Corps. The project costs are costs above the cost of the least costly plan (that accomplishes the disposal of dredged material from a navigation project consistent with sound engineering practices and environmental standards). There is no per project limit on federal expenditures, however, there is an annual appropriation limit of $15 million nationwide.

Aquatic Ecosystem Restoration

Section 206 of the Water Resources Development Act of 1996 provides the authority for the Corps to restore aquatic ecosystems. Such projects will usually include manipulation of the hydrology in and along bodies of water including wetlands and riparian areas. A project is adopted for construction only after a detailed investigation determines that the project will improve the quality of the environment and is in the best interest of the public, and clearly shows the engineering feasibility and economic justification of the improvement. Each project is limited to a federal cost share of not more than $5 million. The federal limitation includes all project-related costs for feasibility studies, planning, engineering, construction, supervision, and administration.

Special Programs

Planning Assistance to States and Tribes

Section 22 of the Water Resources Development Act of 1974 , as amended, authorizes the Corps to use its technical expertise to assist states and tribes in preparing comprehensive plans for the development, use, and conservation of water and related land resources. The non-federal sponsor is required to pay 50 percent of the costs. The federal share in such plans is limited to $500,000 annually in any one state or for any one tribe. Typical activities under this program include studies for flood damage reduction; water conservation; water quality; wetland evaluations; port and harbor development; coastal zone management; environmental planning; economic, social, and cultural issues; and hydrology, hydraulics, and engineering.

Shoreline Erosion Control

Section 54 of the Water Resources Development Act of 1974 establishes a national shoreline erosion control development and demonstration program.

Fish and Wildlife

Fish and wildlife conservation is closely tied to the Corps' environmental and recreation responsibilities. The Fish and Wildlife Coordination Act of 1958 provides for conservation and development of wildlife in association with water resources projects. The Corps of Engineers consults with federal and state wildlife resource agencies on conservation and enhancement measures.

Irrigation

Storage of water for irrigation on agricultural land is used to meet or supplement natural supplies. Section 8 of the Flood Control Act of 1944 provides that such storage may be included in a Corps reservoir upon recommendation of the Secretary of Interior, conforming with Reclamation Law. Section 8 applies only in the 17 western states to which the Reclamation Law applies.

Aquatic Plant Control

A program for control and progressive eradication of certain nuisance aquatic plant growths is authorized by Section 302 of the Rivers and Harbors Act of 1965. The program is administered by the Corps in cooperation with other federal and state agencies. Local governments pay 50 percent of the costs in any projects developed as a result of the studies.

Flood Insurance Studies

The Corps of Engineers carries out flood insurance studies to map eligible communities by risk zones for insurance purpose. Those studies are accomplished on a reimbursable basis for the Federal Emergency Management Agency (FEMA), which administers the National Flood Insurance Program. The studies are made under the provisions of PL 90-448, Title XIII, the National Flood Insurance Act of 1968, as amended by PL 93-234, and the Flood Disaster Protection Act of 1973. The statutes call for private insurance industry services and provide for federal subsidization of flood insurance. The insurance covers damage caused by overflow of either inland or tidal waters on flood-prone land. To obtain flood insurance coverage, a community must

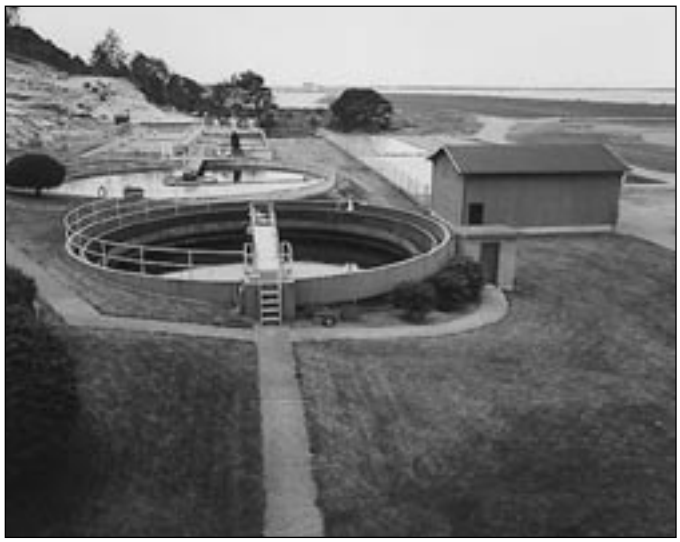
take action through its legislative body. It must enact zoning which requires construction of the first livable floor of a structure to be above the level of the 100-year flood (a flood magnitude with a 1 percent chance of occurring each year). Studies to determine the extent to which flood protection measures affect such rates are conducted by several agencies of the federal government, including the Corps of Engineers.

Water Quality and Pollution Control

Water quality and pollution control are given full consideration in the planning and construction of federal water resources development projects under the 1948 Water Pollution Control Act as amended; other related legislation; and certain Executive Orders. In water storage projects, adequate capacity may be included for streamflow regulation to maintain high quality; however, this is not a substitute for treatment or other methods of controlling waste at the source.

Support of EPA Construction Grants Program

In 1978, the Corps of Engineers North Pacific Division and Environmental Protection Agency, Region X, entered into an agreement under which the Corps assists EPA in administering the Construction Grants Program in Oregon, Washington, Idaho, and Alaska. The program is mandated by Congress through the Clean Water Act. The EPA program for Oregon calls for a yearly allocation of about $30 million. The Corps assists by reviewing plans and specifications, inspecting construction of wastewater treatment facilities, and monitoring management of construction grants.



The Pacific Northwest Region

The Pacific Northwest is described in Indian legends; reports from Russian, Spanish, and English explorers; descriptions from Lewis and Clark; and by more recent visitors as bountiful, beautiful, and varied. All paint glowing word pictures of mountains, sea, forests, rivers, canyons, glaciers, harbors, and deserts.

The Rocky Mountain, Cascade, and Coast ranges connect valleys and plains fed by rivers providing the water that is a major resource of the Pacific Northwest.

The Columbia River and coastal streams supply power, transportation, and water supplies for communities, commerce and industry, irrigation, recreation, fish, and wildlife.

The climate of the Pacific Northwest is as varied as its topography. Predominant weather systems in the northern reaches of the Pacific Ocean and storms are borne inland by prevailing westerly winds. Good supplies of rain and snow fall in the western part of the region. Storm clouds are usually depleted when they reach the high, dry, interior reaches. On the eastern slopes of the mountains, the weather changes and dry winds draw moisture from semi-arid lands on the high plateaus and deserts.

This varied climate has created a broad mix of vegetation ranging from rain forests, vast timbered tracts, and verdant valleys to dusty, dry sagebrush and juniper-covered plateaus and plains.

Water has always been important in development of the Pacific Northwest and is one of the keys to the region's future. The Columbia River system is the Northwest's river highway. Its flows stem from highlands in Canada to Washington, Oregon, Idaho, Montana, Wyoming, and Nevada. Surface water totals 200 million acre-feet annually. Canada provides 54 million acre-feet from streams flowing south into the Columbia. More than 600 miles of shoreline, including estuaries, beaches, tidelands, and rockbound shores, run along the Washington and Oregon coasts.

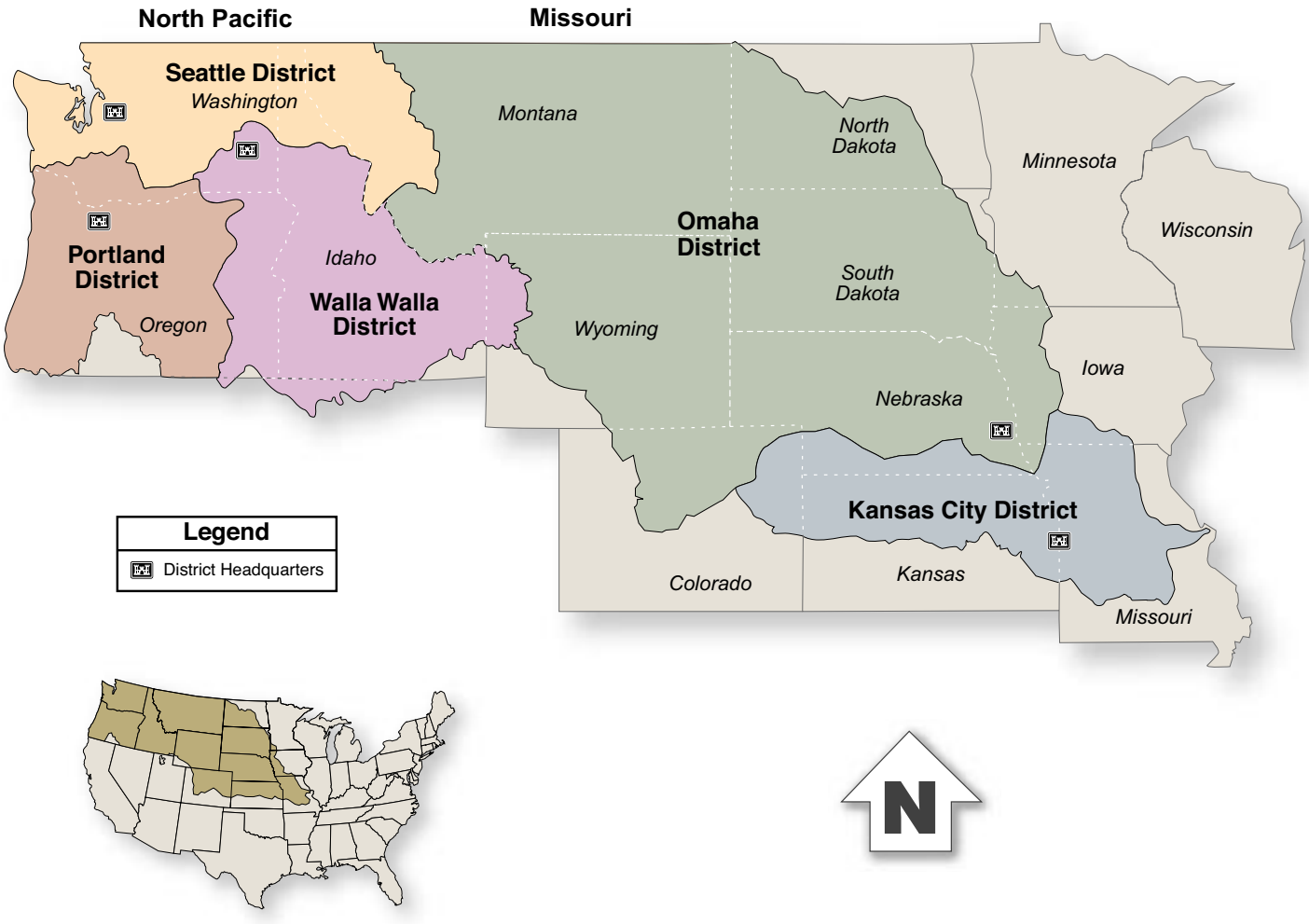
A land-locked closed basin lies completely in Oregon, enclosed in the southern part of the high central Oregon plateau.

More than 170 million acres of land are classified into use types. Cropland totals 20 million acres. There are 85 million acres of forest land and 58 million acres of rangeland. The last category, about eight million acres, includes five million acres of barren land and mountain rock outcroppings and three million acres of concentrated population.

Communities are situated in low-lying good soil areas adjacent to streams. Some of the region's most fertile soil has been developed for residential or industrial settlement. Major population centers are Seattle-Tacoma, Portland-Vancouver, Spokane, Eugene, Salem, and Boise. The 1990 census counted more than 10.4 million people in the Pacific Northwest. National projections estimate the population will reach 16 million by 2030, with heaviest concentrations of people in the two largest metro areas, a megalopolis stretching from Everett, Washington, to Eugene, Oregon.

Economic leaders in the region are agriculture, timber, and tourism. Largest employers are service industries, manufacturing, and retailing. Employment is predicted to increase from 5.7 million employed in 1990 to 6.9 million in the year 2000, an increase of 20.7 percent. Nationwide employment during the same period is expected to increase by about 13.4 percent.

Predicted growth in all segments of Northwest society is expected to bring heavy demands for municipal and industrial water supplies, electric energy, irrigation flows, recreation, and other essential uses. Demands will add to pressure and stress on all natural resources in the Pacific Northwest.


North Pacific
Missouri
Seattle District
Washington
Montana
North Dakota
Minnesota
Wisconsin
Omaha District
Portland District
Idaho
Walla Walla District
Oregon
Wyoming
South Dakota
Iowa
Nebraska
Kansas City District
Colorado
Kansas
Missouri
Legend
District Headquarters
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Northwestern Division

The U.S. Army Corps of Engineers has eight division offices throughout the United States. These divisions manage Corps civil works activities accomplished by districts whose boundaries are based on river basins rather than state lines.

On April 1, 1997, the North Pacific Division and the Missouri River Division were realigned and combined to form the Northwestern Division with corporate headquarters in Portland, Oregon, and an additional office located in Omaha, Nebraska. The Northwestern Division Engineer directs all Corps of Engineers water resource activities in a 14-state area that contains about 25 percent of the nation's continental land mass.

The Northwestern Division Engineer and senior staff provide direction and guidance for five subordinate district offices located in Kansas City, Missouri; Omaha, Nebraska; Portland, Oregon; Seattle, Washington; and Walla Walla, Washington. They coordinate technical policy and budgetary issues that cross district boundaries and interact with other Federal and state agencies, congressional leaders, interest groups, and international commissions. The division office oversees management, coordination, and analysis of various division-wide programs, ensuring that processes, procedures, and activities performed by the districts result in top-quality products and services to Corps customers.

Technical Support Services

Water Management Division—Columbia Basin

The Water Management Division is responsible for managing the system of Corps-managed reservoirs in the greater Columbia River Basin and the coastal streams in Oregon and Washington. This is accomplished through developing, coordinating, and implementing reservoir operation plans to balance the competing demands for water. Because of the interconnection with many non-Corps projects, this effort also encompasses both federal

and non-federal reservoirs in the basin owned and operated by different interests. Altogether, some 75 projects are involved. During flood control operations, the Corps is empowered, through various Congressional authorities, to operate non-Corps reservoirs in a cooperative effort with other private and public agencies.

The Columbia Basin Reservoir Control Center (RCC) in the Water Management Division in Portland, Oregon, manages the day-to-day regulation of the projects for flood control, navigation, power generation, recreation, fish and wildlife, and other purposes. Utilizing weather, streamflow, and project data, along with forecasts of future streamflow and present system requirements, RCC develops regulation strategies for the system and issues operating instructions to the dams. Close coordination with agencies and individuals affected by any operation is important to ensure the best interests of the public are being served. RCC also coordinates with Bonneville Power Administration to request releases from the Canadian reservoirs under the terms of the Columbia River Treaty, discussed later in this section.

The RCC is one of three main branches within the Water Management Division. The other two branches (the Hydrologic Engineering Branch (HEB) and the Power Branch (PWR) (specialize in hydropower planning, hydropower economics, flood control, water quality, and river forecasting. They prepare studies that establish reservoir operating plans and criteria for hydropower and flood control, and make analyses to address hydropower impacts of operational scenarios developed to increase fishery survival. As with the day-to-day operations, extensive coordination is also required for long-term hydropower planning. This coordination affects the northwest electrical utility industry, environmental agencies, and other water resource agencies, often through established regional coordinating entities such as the Northwest Power Pool, the Pacific Northwest Coordination Agreement, the Columbia River Treaty, and the Columbia River Water Management Group.

Another important Water Management Division function performed by the RCC is chairing the Technical Management Team (TMT), an adaptive management inter-agency group charged with implementing Federal Columbia River Power System operations to assist salmon migration. The TMT is composed of federal fish managers from the National Marine Fisheries Service, U.S. Fish and Wildlife Service, and the states of Oregon, Washington, Idaho, Alaska, and Montana; and representatives of the Bureau of Reclamation, Bonneville Power Administration, the Corps, and the 13 sovereign Indian tribes. It meets at least weekly during the migration season and provides a forum for the federal action agencies to receive and discuss recommendations from federal, state, and tribal fishery interests.

Still another critical mission occurs during periods of high runoff, when the Water Management Division, working cooperatively with other federal, private, and Canadian agencies, ensures that flood control criteria are met. The Corps also works with Bonneville Power Administration to manage the system to optimize production of hydroelectric power for the region and, when possible, for export to other regions. During low runoff, Water Management Division's work is no less critical, since a careful balancing of all water uses is needed to minimize adverse impacts associated with drought conditions.

Regional Issues

Columbia River Treaty with Canada

The Columbia River Basin spans the boundary between the United States and Canada. To address jurisdictional and operating problems and promote regional growth, the United States and Canada signed the Columbia River Treaty in 1961, which was ratified three years later. The Treaty provided for the construction of three dams in Canada -Mica, Hugh Keenleyside, and Duncan— and one in the United States— Libby Dam on the Kootenai River in Montana. The treaty provides that 15.5 million acre-feet of storage space be made available for power production. Of that, 8.45 million acre-feet is reserved for flood control storage in Canadian reservoirs.

The Treaty ensures Canada will operate storage features to provide downstream flood control and optimum power generation in the Basin. Libby's reservoir, Lake Koocanusa, extends 42 miles into British Columbia. Canada assumed all costs of construction and operation of that part of the reservoir in Canada. All four of the projects under the Treaty are constructed and have been in operation since 1972.

In return for constructing and operating the three Canadian projects, Canada was paid a one-time lump sum payment of $64.4 million for 50 percent of the flood damages prevented in the United States during the 60-year life of the treaty. Canada also receives half of the additional power produced downstream as a result of the added Canadian storage. The United States does

not receive any payments for downstream benefits that Canada receives from the operation of Libby Dam in Montana. The Treaty Flood Control Operating Plan document can be found at www.nwd-wc.usace.army.mil/report/colriverflood.htm.

Canada sold its share of this additional power to the United States for $254 million for a 30-year period. The Columbia Storage Power Exchange (CSPE), a non-profit U.S. corporation, was established for the purchase. Power is divided among 41 public and private utilities. Participants' shares range from 0.5 to 17.5 percent.

These power allocation agreements phase out in stages from 1998 through 2003. After 2003, the United States is obligated to deliver half of the additional power attributed to Canadian storage operations back to Canada.

The Columbia River Treaty signed with Canada addresses Canadian operational needs for flood control and power. In 1995, a dispute occurred when Libby Dam was first operated for listed species. The U.S. and Canadian entities disagreed on how to determine downstream power benefits for the years after August 2000.

The Bonneville Power Administrator and the Northwestern Division Engineer are designated by Presidential Executive Order as the U.S. Entity. The British Columbia Hydro and Power Authority acts as the Canadian Entity. Both have established operating and hydro-meteorological committees to develop and implement operating plans for Canadian storage and to collect real-time hydromet data needed to operate the system.

Northwest Power Planning Council

In December 1980, Congress passed the Pacific Northwest Electric Power Planning and Conservation Act that established the Northwest Power Planning Council. The Council is composed of two members each from Idaho, Montana, Oregon, and Washington appointed by their respective governors. The Council is charged with preparing and adopting a regional conservation and electric power plan and a fish and wildlife plan which puts fish and wildlife considerations on an equitable basis with power planning and other purposes for which hydroelectric facilities were developed.

In December 1994, the Council passed amendments to its Fish and Wildlife Plan which called upon the region to implement certain actions for Columbia and Snake River salmon. The amendments, called the Strategy for Salmon, laid out a number of actions for the Corps, including operational changes to the hydro system and physical changes to the dams. Many of these actions also appeared in a Biological Opinion issued in March 1995 by the National Marine Fisheries Service under the Endangered Species Act concerning listed Snake River salmon species.

The Corps, while considering Council plans to the greatest extent possible, has a legal mandate to fulfill Endangered Species Act requirements, with a high priority on implementing measures contained in the Biological Opinion. The Council is currently in the midst of a public process to amend its Fish and Wildlife Plan.

Fish Mitigation Program, Oregon and Washington

The Columbia, Oregon Coast, Snake, Willamette, and Rogue river basins provide habitat for anadromous salmon and steelhead. Anadromous fish hatch in freshwater rivers and tributaries, migrate to and mature in the ocean, and return to their place of origin as adults to spawn. Salmon generally spend two to five years in the ocean before returning to spawning areas.

From estimated highs in the early 1800s of eight to 16 million fish returning annually, populations of West Coast salmon and steelhead have declined sharply in the past 120 years. Chum salmon populations in the

Columbia Basin have declined to less than 1 percent of their former levels. Only about 8,000 to 12,000 wild salmon return annually to the entire Willamette Basin. Recent returns of spring-run chinook salmon to the Upper Columbia River have averaged only 5,000 naturally produced fish. Willamette River steelhead returns during 1995 were the lowest in 30 years of record keeping.

Most salmon and steelhead in the region are affected to some extent by the hydropower system. Fish destined for the Upper Snake River must pass eight hydroelectric dams operated by the Corps on the Columbia and Snake rivers. Besides interfering with fish migration, the dams create reservoirs that alter water velocities and temperature regimes, which improve conditions for predators. Major dams upriver from Corps dams on the Columbia-Snake system do not include fish passage facilities for either juvenile or adult fish.

To help adult fish returning from the ocean swim upstream to their spawning beds, fish ladders were built into each of the eight lower Snake and Columbia river dams. The ladders provide adult fish a series of graduated steps and pools, allowing the fish to scale the rise in elevation from the tailrace to the forebay of the dams. The ladders have proven effective.

Juvenile fish must pass the dams on their way downstream to the ocean. There are a number of ways for juvenile fish to pass the dams: through the spillways, through the juvenile bypass systems, in specially

designed barges, and through the turbines. The need for some way to help juvenile fish past the dams was recognized by the 1950s. Juvenile passage via screened bypass systems and fish transport programs has evolved since that time, with improvements consistently implemented as more is learned about juvenile fish behavior and requirements, and their response to various ways of passing the dams. To help the Corps continue that development, Congress, through the Energy and Water Development Appropriations Act of 1989 (PL 100-371), authorized the design, testing, and construction of new or improved juvenile fish bypass facilities for the Columbia River projects.

Despite these efforts, fish populations continued to decline in the 1980s. In response to growing concerns, the National Marine Fisheries Service (NMFS) conducted a scientific review of Pacific salmon in 1991 and concluded that the low numbers cannot be explained by ocean cycles or other natural events and that these species are at risk of extinction primarily due to human activities such as over-fishing, habitat destruction, hydropower development, hatchery practices, degraded water quality, and other causes.

Fifteen unique populations of salmon, steelhead, and sturgeon have been listed as threatened or endangered under the Endangered Species Act (ESA). An endangered species is "in danger of extinction throughout all or a significant portion of its range." A threatened species is "likely to become endangered within the foreseeable future throughout all or a significant portion of its range." In December 1991, the NMFS listed Snake River sockeye salmon as endangered; in May 1992, it listed Snake River spring/summer chinook and fall chinook salmon listed as threatened. In August 1997, NMFS listed the Upper Columbia steelhead as endangered and Snake River steelhead as threatened under ESA. Less than a year later, in March 1998, Lower Columbia steelhead were listed as threatened, and in

August 1998 Oregon Coast coho salmon were listed as threatened. In March 1999, six species were given threatened status: Lower Columbia chinook, Upper Willamette River chinook, Upper Columbia chinook, Columbia River chum, Upper Willamette steelhead, and Middle Columbia steelhead. Also in March 1999, the NMFS listed the Upper Columbia River spring-run chinook salmon as endangered. The U.S. Fish and Wildlife Service (FWS) listed the Kootenai River white sturgeon as endangered in October 1994.

Activities Resulting from the Biological Opinions

Under the ESA, no federal agency may fund, permit or carry out any activity that will jeopardize the listed species' continued existence. Where activities of state and local governments and private citizens harm listed species, the ESA requires harm to be controlled so it does not lead to extinction. The rule applies to ocean and inland areas and to any authority, agency, or private individual subject to U.S. jurisdiction. To determine whether actions will jeopardize the species, the listing agency consults with agencies whose actions could affect the listed species. These agencies present a biological assessment for managing their actions to the listing agency. If after reviewing the plan, the listing agency determines that proposed actions would jeopardize the continued existence of the listed species, the listing agency issues a biological opinion with recommended measures to avoid jeopardy for the species.

On March 2, 1995, the NMFS issued a biological opinion for operation of the federal dams on the Columbia and Snake rivers for 1995 and future years. A supplemental 1998 biological opinion by NMFS addressed newly-added steelhead listings. The biological opinions called for a variety of actions and studies for improving conditions for salmon migration throughout the Columbia and Snake River system. The Corps has since operated the system in accordance with the NMFS biological opinion.

The Corps' Columbia River Fish Mitigation Project has served to implement many of the terms of the Biological Opinion. Oversight of the salmon recovery efforts is performed by the Pacific Salmon Coordination Office of the Corps' Northwestern Division in Portland, Ore., and the fish recovery measures are carried out by the Corps' Portland and Walla Walla districts. Seattle District projects also are used for flow augmentation. The Corps, in cooperation with the Bonneville Power Administration, Bureau of Reclamation, and NMFS, plus state agencies, tribes, and public interest groups, initiated and continues to take the following actions to improve fish passage through hydroelectric projects:

1) flow augmentation (release of water from storage or headwater reservoirs to meet flow targets in the lower river for salmon and steelhead);

2) reservoir operations of headwater projects to provide for spawning, minimize rapid fluctuation in both reservoirs and unimpounded river reaches, and temperature control;

3) spill measures to send juvenile fish through the spillway rather than through the turbines;

4) transportation of juvenile salmon and steelhead from the Snake River and McNary Dam on the Columbia River for release below Bonneville Dam;

5) evaluation of modifications to existing facilities, such as fish guidance structures and turbines, to improve juvenile passage survival;

6) development of surface bypass technology, and additional fish transport and monitoring facilities;

7) studies to evaluate gas and temperature conditions in the system for potential improvements;

8) a comprehensive Lower Snake River Juvenile Salmon Migration Feasibility Study to examine alternatives for long-term configuration and operation of the lower Snake River dams (Walla Walla District), including breach (dam removal) options;

9) a Phase I study of natural river and spillway crest drawdown options for John Day Dam on the Columbia River (Portland District);

10) additional research efforts on evaluation of in-river migration versus transport of juvenile fish, study of juvenile fish survival and travel time through the reservoirs, and various aspects of fish behavior; and

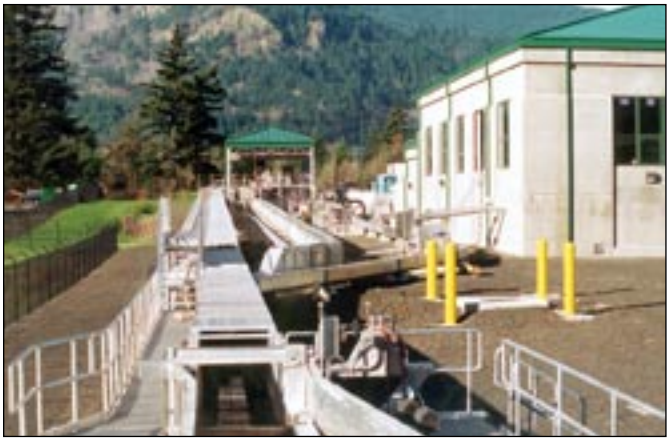
11) adult salmonid studies to evaluate potential losses through the system and methodologies to improve survival.

Recent Activities

Extended (40-foot-long) screens have been installed in the existing juvenile bypass systems at Lower Granite and Little Goose dams on the lower Snake River and at McNary Dam on the Lower Columbia. These screens to increase the percentage of juvenile fish guided away from the turbine intakes and into the bypass channels. Testing of extended screens continued at the John Day Dam. Extended screens may replace existing 20-foot screens in the existing juvenile bypass system there. Passive integrated transponder (PIT) tag monitor-

ing facilities were completed at John Day Dam. At Bonneville Dam's second powerhouse, the existing juvenile bypass system was improved, a smolt monitoring and evaluation facility constructed, and a juvenile outfall two miles downriver from the powerhouse completed.

Drawdown of the John Day pool to minimum operating level (minimum operating pool [MOP) during the juvenile fish migration season was studied in the early 1990s. The Corps' conclusion was that drawdown to MOP would not be an effective way to increase juvenile fish survival. Study of a spillway crest level drawdown



at John Day was requested in the 1995 biological opinion. In 1998, Congress directed the Corps to conduct a Phase I study of two drawdown levels: spillway crest and natural river. The John Day Drawdown Phase I Study was initiated in 1999, with its goal a recommendation to Congress to either do further study (Phase II), or to take further study of John Day drawdown off the regional agenda. The final phase I report is expected to go to Congress in late 2000.

The Walla Walla District's multi-year Lower Snake Study examined the biological, social, economic, and engineering impacts of the various options proposed for breaching or changing operations of the dams. The study will identify a preferred alternative for moving juvenile fish past the four Lower Snake dams in a final environmental impact statement expected in 2001.

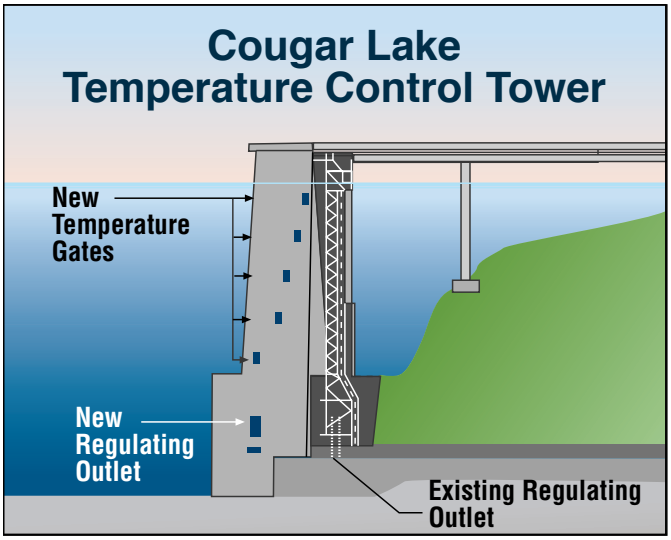
Since 1995, surface bypass prototype systems, which intercept juvenile fish within the upper portion of the water column where they typically migrate, were installed and tested at Ice Harbor, Lower Granite, Bonneville, and The Dalles dams. In 1999, The Dalles Dam sluiceway and spillway juvenile fish survival studies continued in conjunction with the development of future bypass system alternatives. Design work for relocating the sluiceway outfalls and for providing emergency auxiliary water for adult fishways continues.

Beginning in the mid 1990s, federal funding for fish mitigation projects increased. For example, the 1999 fiscal year budget included about $80 million to fund the Columbia River Fish Mitigation Project.

The Corps also is working to improve fish runs in the middle fork of the Willamette River and will design water temperature control structures to modify the McKenzie River water temperatures to benefit migratory and resident fish. In 2000, the Corps plans to begin construction to add temperature control at Cougar Dam.

That work will take about four years. When it is completed, similar work will be done at Blue River Dam.

To assist in river flow monitoring, the Corps formed a Technical Management Team, with representatives from the U.S. Fish and Wildlife Service (FWS), NMFS, Bureau of Reclamation, Bonneville Power Administration, the Corps, the Northwest Power Planning Council, and the states of Oregon, Washington, and Idaho. The team closely monitors river levels and fish migration times and recommends adjustments to operations to improve instream flow conditions when necessary.



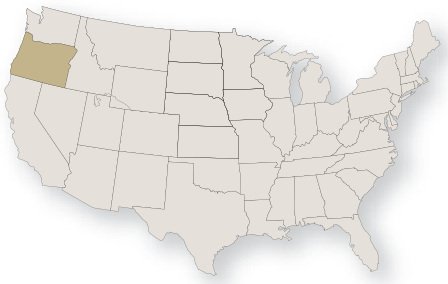
The 1998 addendum biological opinion noted that Caspian terns nesting on Rice Island at the mouth of the Columbia River were jeopardizing salmon by eating up to 10 percent of the juveniles as they passed the area. Rice Island is an artificial land mass made up of material dredged from the Columbia River federal navigation

channel by the Corps. To address the situation, the Corps worked with a multi-agency team including NMFS and the FWS to devise ways to encourage the birds to move to East Sand Island, one of their old nesting sites. About 1,400 pairs of Caspian terns were successfully relocated during the first year's effort. Researchers estimate the terns consumed about 11.7 million salmon and steelhead during 1999. This number, while still large, was significantly down from an estimated high of more than 20 million. The long-term aim is to relocate the entire colony of 20,000 birds.

Publications Available

More information on fish recovery measures is available at the Corps' website: www.nwd.usace.army.mil/ps. Because of regional interest in actions to aid the migration of salmon and steelhead past the dams operated by the Corps, archived issues of Salmon Passage Notes, a Corps' publication, are available on the Corps' website. Other excellent sources of information can be found at www.nwp.usace.army.mil/PM/E/ and links, and at the interagency website: www.bpa.gov/federalcaucus.


LOWER COLUMBIA RIVER BASIN
WASHINGTON
Columbia R.
Columbia R.
Pendleton
26
Portland
The Dalles
John Day R.
La Grande
5
26
97
Deschutes R.
Willamette R.
Salem
WILLAMETTE BASIN
Portland District
MIDDLE COLUMBIA RIVER BASIN
Portland District
Snake R.
COAST BASIN
Eugene
Bend
SNAKE RIVER BASIN
Walla Walla District
Burns
IDAHO
5
97
OREGON INTERIOR BASIN
Portland District
KLAMATH RIVER BASIN
Rogue R.
Grants Pass
Medford
Applegate R.
Klamath Falls
OREGON
CALIFORNIA
GOOSE LAKE BASIN
Sacramento District
NEVADA

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Water Resources in the State of Oregon

Oregon has seven major river basins— Willamette, Lower Columbia, Middle Columbia, Snake, Oregon Interior, Klamath, and Oregon Coast. The Lower Columbia, Willamette, and Coast basins are in the rainy, heavily forested area west of the Cascade Mountains; the others are in much drier eastern Oregon.

The Cascade Range, generally about 5,000 feet high, is the climatic barrier between western and eastern Oregon.

The Columbia River, flowing for 300 miles along Oregon's northern boundary, drains most of the Pacific Northwest including four of Oregon's major river basins: the Lower Columbia, Middle Columbia, Willamette, and Snake. The Willamette River enters the Columbia about 100 miles upstream from the ocean.

The boundary between the Lower and Middle Columbia River basins is at Bonneville Dam on the Columbia, about 145 miles from the ocean. The mouth of the Snake River, in Washington, marks the boundary between the Middle and Upper Columbia River basins, the latter being entirely in Washington, Idaho, Montana, and Canada. The Snake River drains the easternmost one-fifth of Oregon; most of Idaho; and smaller parts of Nevada, Utah, and Wyoming. The Snake and Willamette rivers are the Columbia River's two largest tributaries.

More than two-thirds of Oregon's population is concentrated in the Willamette and Lower Columbia basins. Portland, Oregon's largest city, is at the confluence of the Willamette and Columbia rivers. Much of the work accomplished by the Army Corps of Engineers in Oregon has directly furthered the economic development of the region.

The Klamath Basin includes the part of Oregon drained by the Klamath River. The Klamath drains to the Pacific Ocean in Northern California. The Klamath and the Columbia are the only two rivers that breach the Cascade Range in their courses to the sea.

The Oregon Coast Basin includes those rivers entirely in Oregon which drain directly to the Pacific Ocean. The Oregon Interior Basin includes those areas in southeastern Oregon which have no drainage outlet to the sea.

Corps activities in the various river basins are discussed in the following chapters. In each chapter, a general map of the basin is included, together with a small location map showing that basin's position in Oregon. No projects have been constructed by the Corps in the Klamath Basin, which is within the boundaries of the San Francisco District, or in Goose Lake Basin, an interior basin within the Sacramento District area.

Willamette River Basin

Willamette River Basin

The Willamette Basin lies between the Cascade and Coast mountain ranges in the northwestern part of Oregon. It is drained by the Willamette and Sandy rivers, which enter the lower Columbia River from the south. The basin is home to about two-thirds of Oregon's people, and includes the state's three largest cities—Portland, Eugene, and Salem. The basin lies entirely in the Corps' Portland District.

The Willamette Basin, an area of 11,200 square miles, is bounded on the east by the Cascade Range, on the south by the Calapooya Mountains, and on the west by the Coast Range. The Columbia River, from Bonneville Dam to St. Helens, forms its northern boundary. The basin is like a huge amphitheater, with the open end fronting on the Columbia. The Willamette Valley is an elongated lowland extending north to south, between the Cascade and Coast ranges. The Cascade Range has five peaks over 10,000 feet in elevation, and the Coast Range reaches to 4,000 feet. The general heights of these ranges, however, are about 5,000 and 2,000 feet. The Calapooya Mountains form a cross-range that connects the two principal ranges. Elevations in the main valleys range from sea level along the Columbia to 450 feet in Eugene, near the head of the Willamette Valley, 120 miles to the south. The valley floor, as much as 30 miles wide and covering 3,500 square miles, is nearly level in many places, gently rolling in others, and broken by several groups of hills and scattered buttes.

The Willamette River forms at the confluence of its Coast and Middle forks, near Eugene. Its largest tributaries rise in the Cascade Range and enter from the east. Numerous smaller tributaries rise in the Coast Range and enter from the west. The Willamette River drains about 10,400 square miles, or about 93 percent of the basin. The Sandy River does not drain into the Willamette, but is culturally a part of the basin because it is close to Portland and important to the metropolitan area, especially for water supply and recreation. Annual runoff from the Willamette Basin averages about 26 million acre-feet, about 24 million carried by the Willamette River.

As the most populated area in Oregon, the Willamette Basin is highly developed. Water supplies have been developed for municipal, industrial, domestic, and agricultural use. The Willamette River is navigable for more than 100 miles upstream from its mouth. Numerous multipurpose dams have been constructed to control floods, generate power, and provide water for

navigation and irrigation. Resource problems of particular concern at present include flood damage, fish and wildlife conservation, floodplain restoration, water quality, municipal and industrial water supply, and recreational opportunities.

Corps of Engineers development programs in the Willamette Basin have been underway since the 1870s. Water resource development projects completed include 13 dams and many miles of levees and channels for flood protection. Flood plain information reports have been compiled for many areas in the basin.

Other multipurpose dam projects and flood control works have been authorized. Work on these projects is in various stages; some have not been started because funds have not been appropriated or other requirements have not been met.

Navigation work in the basin includes construction and maintenance of several waterways. The Willamette Falls Locks, originally built by private interests, were acquired by the U.S. Government in 1915 and have since been operated by the Corps. These navigation projects provide for both ocean-going and inland traffic. The lower Willamette River (Portland Harbor) provides adequate depths to serve ocean-going vessels. Further upstream, the Willamette carries shallow-draft river traffic. Multnomah Channel, near the mouth of the Willamette, also serves shallow-draft traffic.

Multipurpose Development

In 1938, the original congressional authorization for the basin's multipurpose projects provided for flood control, navigation, irrigation, and power generation at projects where it could be economically installed. Navigation is improved by releasing water to increase depths in the navigable part of the Willamette River during late-summer low-flow periods. The dams are located far upstream from the navigable reach of the Willamette, and do not have navigation locks. Since 1950, additional projects have been authorized. It was recommended in the Willamette Basin Comprehensive Study, completed in 1971, that additional water resource needs— recreation, fish and wildlife enhancement, water quality control, and municipal and industrial water supply— be served in addition to those purposes provided for in the original authorization.

Existing Projects

The Army Corps of Engineers has constructed 13 of the 17 construction projects originally authorized by Congress for the Willamette Basin: 10 multipurpose dam projects and three reregulating dams which smooth out discharges of water from hydroelectric power plants. Fern Ridge Dam and Lake, completed in 1941, was the first storage project, followed by Cottage Grove, Dorena, Detroit, Lookout Point, Hills Creek, Cougar, Green Peter, Fall Creek, and Blue River. The three reregulating dams are Big Cliff, Foster, and Dexter.

Four of the 17 authorized projects were never constructed. Cascadia, Gate Creek, and Holley Lakes were deauthorized by the Water Resources Development Act of 1986 (PL 99-662). The reregulating project for Strube Lake, located on the South Fork McKenzie River below Cougar Dam, included plans for construction of a dam, spillway, and power plant. The Strube Lake project will soon be eligible for deauthorization.

An example of the Corps' role in environmental protection and improvement in Oregon is the part that Willamette Basin multipurpose storage reservoirs have played in the cleanup of the river. Badly polluted a number of years ago, the Willamette River's water quality has been greatly improved over the last 25 years. Water stored in Corps reservoirs in the Willamette Basin has played an important role in this improvement. Stored water released from reservoirs boosts streamflows far above natural levels during late summer months, when sluggish flows formerly contributed to high pollution levels near populated areas and to low oxygen levels in the lower reaches of the river, especially in Portland Harbor. This streamflow augmentation often raises flows to more than twice what they would be under normal conditions. Improving water quality in the Willamette Basin has improved fish habitat during the summer and fall season. Improvements to water quality have restored some fisheries and created new fisheries in the basin. However, the projects have caused some negative impacts, primarily related to loss of fisheries habitat above the projects.

Improved fish passage facilities, higher late-summer streamflows, and improved water quality have made it possible to establish a fall chinook run in the Willamette River. However, in March 1999, the NMFS added Upper Willamette River Chinook and Winter Steelhead as threatened species under the Endangered Species Act (ESA). In response, the Corps began preparation of a Biological Assessment (BA) of the operation of the Willamette projects under Section 7 of the ESA to determine the impact of the agency's activities on listed species in the Willamette Basin. The BA focuses principally on the operation of the 13 existing Corps dam and reservoir projects in the basin, including their impacts to fish via modifications in flows, water temperatures and juvenile and adult fish passage. The BA will also address other Corps activities in the Basin, including bank protection projects constructed under the Willamette River Basin Bank Protection program and other authorities. In addition to salmon and steelhead, the BA will also address other previously listed species, including bull trout.

The BA, scheduled for completion in October 1999, is expected to determine that Corps activities do have a significant impact on threatened and endangered species in the Willamette. On the basis of that finding, the Corps will request formal Section 7 consultation with NMFS

and USFWS. Those agencies will have 180 days (March 2000 under the current schedule) from the completion of the BA to prepare a Biological Opinion (BO). The BO will address incidental take of the listed species occurring as a result of the Corps' ongoing Willamette activities and will identify and recommend reasonable and prudent activities that the Corps should undertake to assist in the recovery of those species.

Fern Ridge Lake

The Fern Ridge project, at River Mile 23.6 of the Long Tom River, is about 12 miles west of Eugene. The dam and reservoir have been in continuous operation since 1941. To provide for additional flood storage capacity, it was raised from 47 to 49 feet in 1965. The reservoir provides 110,000 acre-feet of usable flood control storage and controls runoff from a 275 square-mile drainage area, including the Amazon Creek Basin.

The main dam consists of an earthfill embankment dam, a concrete gravity spillway near the left abutment, a non-overflow structure 46 feet long containing outlet works, and an overflow structure 248 feet long controlled by six automatic gates. Two auxiliary dikes close off low areas along the northeast shore of the lake. The project also includes channel improvement on the Long Tom River downstream from the dam to the Willamette River. The authorized primary project purposes are flood control, navigation, and irrigation.

Since the project began operating in 1941, it has prevented an estimated $401 million (unadjusted) in flood damages. Repair of the embankment was completed in 1998, and repairs to the regulating outlet discharge and stilling basin began. Through September 1999, the total federal cost of the project was $32,167,400, which includes $8,685,600 for construction and $23,481,800 for operation and maintenance. The non-federal cost was $52,700.

At full pool, Fern Ridge Lake has 9,340 acres of water surface. It has become extremely popular with swimmers, boaters, and other users, even though recreation was not originally an authorized primary project purpose. The multi-agency Willamette Basin Comprehensive Study, completed in 1971, included recommendations for modification of the project to permit fuller use of recreational potential without hindering irrigation and flood control uses. Fern Ridge is used heavily for picnicking, swimming, sailing, water skiing, and fishing. The Corps operates Perkins Peninsula and Kirk parks. Richardson, Orchard Point, and Zumwalt parks are managed by the Lane County Parks Department under lease agreements. In 1997, a study began of possible exchange of management responsibilities between Lane County Parks, Oregon State Parks and Recreation Department, and the Corps. The rearrangement of responsibilities would streamline and clarify management among the agencies, which have overlapping jurisdictional boundaries and management authorities. The study was completed and the management of several parks throughout the basin has changed hands. Fern Ridge Shores is a private park which provides day-use and camping facilities and boat moorage. In 1999, about 925,400 recreation visits were made to Fern Ridge. In 1999, plans were approved to restore the natural channel of Richardson Creek and instream and adjacent riparian habitat that was filled during construction of Richardson Park. About 18,600 cubic yards of material is to be excavated to create 1,125 linear feet of stream channel with the goal of improving potential fish passage.

The Oregon Department of Fish and Wildlife manages 5,000 acres of land and water for migratory waterfowl under a lease agreement. A special continuing authority contained in Section 1135 of the Water Resources Development Act of 1986, as amended, allows modifications to structures and operations of constructed Corps projects to improve the quality of the environment. Fern Ridge, Long Tom River, and Fisher Butte waterfowl impoundments were initiated in July 1993. The three impoundments restored 115 acres of project lands on the east shore of Fern Ridge Lake to a more natural condition for waterfowl management. Construction included levees, ditches, and overflow spillways, as well as installation of an irrigation water supply pump, a water supply pipeline, and drainage culverts with positive closure gates. The modification project was constructed under a cooperative agreement with the Bureau of Land Management and was completed on May 6, 1994. The non-federal sponsor is the Oregon Department of Fish and Wildlife. Total modification cost, including all planning, design, and construction, was $210,700, of which $158,000 is federal and $52,700 is non-federal.

The Fern Ridge Marsh Restoration Project entails marsh restoration and management actions on 347 acres in the western portion of the Fisher Butte Management

Unit (West Fisher Butte sub-unit) at Fern Ridge Lake Project. The general intent of the proposed action is the restoration of a more diverse and productive marsh plant and wildlife community in areas currently dominated by reed canarygrass, a non-native plant. Construction was initiated in August 1999, but halted prior to completion due to adverse weather conditions. The project is scheduled to be resumed in 2000. Total project cost, including lands, is estimated at $540,000.

Cottage Grove Lake

The Cottage Grove project, completed in 1942, is about six miles south of the city of Cottage Grove at River Mile 29 of the Coast Fork Willamette River. It controls runoff from a 104-square-mile area drained by the Coast Fork Willamette River. The earthfill and concrete dam, 95 feet high, impounds 33,000 acre-feet of water at full pool. The authorized primary project purpose is flood control, but other uses include irrigation, recreation, and improved navigation downstream.

Through September 1996, the total cost of the project was $21,071,000— $4,013,100 for construction and $17,057,900 for operation and maintenance. Since the project began operating in 1942, it has prevented an estimated $1 million (unadjusted) in flood damages.

The Cottage Grove Lake surface is 1,115 acres at full pool. The lake and its shoreline are used for boating, swimming, picnicking, camping, fishing, and hunting. Visitors may camp at Pine Meadows Campground, a 92-unit campground on the west side of the lake, or at the Primitive Campground which has 18 campsites. Three day-use parks, Wilson Creek, Lakeside, and Shortridge, provide for activities such as swimming, picnicking, fishing, and water skiing. In 1999, almost 401,600 recreation visits were made to the Cottage Grove project.

Dorena Lake

Dorena Dam, at River Mile 6.5 of the Row River, is about six miles east of Cottage Grove. The project, completed in 1949, provides 77,600 acre-feet of storage at full pool level and controls runoff from 265 square miles of drainage area. The lake surface is 1,885 acres at full pool.

Dorena Dam controls the Row River and reduces flood stages downstream on the Willamette. Dorena Dam is a 145-foot-high earthfill and concrete structure with spillway and outlet works near the right abutment. Authorized primary project purposes are flood control, navigation improvement, and irrigation. Repairs to 560 linear feet of the Jenkins Location revetment, part of the Dorena Dam project, were undertaken in 1998 to repair damages caused by flooding in 1996.

Through September 1999, the total cost of the project was $26,016,000— $14,568,300 for construction and $11,447,700 for operation and maintenance. Since the project began operating in 1949, it has prevented over $3 billion (unadjusted) in flood damages.

Recreation areas have been developed by the Corps

and Lane County at Dorena Lake. Water skiing, boating, and swimming are popular activities. Harms and Baker Bay parks, operated by Lane County, have facilities for picnicking and boat launching, and Baker Bay has a camping area. Schwarz Park, operated by the Corps just downstream from the dam, is a minimally-developed campground with river access. Bake-Stewart and Vaughn day-use areas are operated by Lane County. In 1997 and 1998, the Corps cooperated with the Bureau of Land Management to establish a "rails to trails" route along the north shore of the lake. In 1999, about 351,600 recreation visits were made to the Dorena project.

Lookout Point and Dexter Lakes

The Lookout Point-Dexter project, completed in 1955, is on the Middle Fork Willamette River about 22 miles southeast of Eugene. Both dams are embankments, with concrete spillways and powerhouses near the right abutments. The two-dam project controls runoff from about 1,000 square miles. Authorized primary project purposes are flood control, navigation improvement, irrigation, and power generation.

Lookout Point Dam, at River Mile 21.3, is one of the key projects in the Willamette Basin multipurpose-storage program because of its strategic location at the upper end of the Willamette Valley. In conjunction with

Fall Creek and Hills Creek dams, it controls runoff of the Middle Fork Willamette River and contributes to flood-stage reduction downstream on the Willamette River. Lookout Point Dam is 258 feet high and impounds 456,000 acre-feet of water at full pool level. Just downstream of Lookout Point is Dexter Dam. Dexter Dam, at River Mile 18, is 107 feet high and impounds a small reservoir, 27,500 acre-feet of water at full pool. It is used as a reregulating dam to smooth out water releases made from power generation at Lookout Point.

The Corps cut back water releases from Dexter in late 1995, when an eroding dike three miles downstream from the dam threatened a local community. Working with Lane County and National Guard workers, Corps contract crews completed emergency repairs in just a few days, allowing reservoir regulators to increase releases to

maintain adequate flood control space in the reservoir.

The Lookout Point powerhouse has three generators with a total installed capacity of 120,000 kilowatts. The Dexter powerhouse has a capacity of 15,000 kilowatts. In 1999, 436,262,000 kilowatt-hours of electrical power energy were generated at the project, of which 433,670,000 were delivered to the Bonneville Power Administration. Through September 1999, power generation totaled 17.9 billion kilowatt-hours. Of the gross income from sale of this power by Bonneville Power Administration, $ 90.5 million was reimbursed to the U.S. Treasury to recover Corps of Engineers project investment and operating costs. New generator windings were completed in 1999 and installation of new exciters began. Through September 1999, the total cost of the project was $175,484,600- $88,238,400 for construction and $87,246,200 for operation and maintenance. Since the project began operating in 1954, it has prevented more than $4.8 billion (unadjusted) in flood damages.

As mitigation for project-caused loss of salmon spawning and rearing areas, the Corps of Engineers built Oakridge Hatchery and Dexter holding ponds. They are operated by the Oregon Department of Fish and Wildlife. Operating funds are provided by the federal government and the state of Oregon.

Most project recreation activity is at Dexter Lake, which is more accessible than Lookout Point Lake. At full pool, Dexter has 1,030 acres of water and Lookout Point has 4,250 acres. Water skiing and picnicking are especially popular at the project, with opportunities for swimming, boating, fishing, and camping also available. Four recreation areas— Dexter Park and Lowell Park on Dexter Lake, and Landax Park and Ivan Oakes Park on Lookout Point Lake— are administered by Lane County. Near the Lookout Point Dam, the Corps operates the North Shore boat ramp. Hampton and Black Canyon campgrounds, at the upper end of Lookout Point Lake, are managed by the U.S. Forest Service. In 1999, about 567,400 recreation visits were made to Lookout Point-Dexter project areas.

Hills Creek Lake

Hills Creek Dam, completed in 1961, is at River Mile 47.8 of the Middle Fork Willamette River about 45

miles southeast of Eugene. It is operated as a unit with Lookout Point Dam downstream, for the authorized primary purposes of flood control, power generation, irrigation, and navigation improvement. The embankment dam is 338 feet high with a chute spillway in the right abutment. The regulating outlet and powerhouse penstock are connected to an intake tower near the dam. The reservoir controls runoff of a 390-square-mile drainage area. At full pool level, Hills Creek Lake has a surface of 2,850 acres, impounding 356,000 acre-feet.

The powerhouse has two 15,000 kilowatt generators. In 1999, power generated at the project was 184,226,000 kilowatt-hours; 183,584,000 kilowatt-hours were delivered to the Bonneville Power Administration.

Through September 1999, the total cost of the project was $61,442,800— $45,700,600 for construction and $15,742,200 for operation and maintenance. Since the project began operating in 1961, it has prevented more than $3 billion (unadjusted) in flood damages. Through September 1999, power generation totaled 5.9 billion kilowatt-hours. Of the gross income from sale of this power by Bonneville Power Administration, $24.8 million was reimbursed to the U.S. Treasury to recover Corps of Engineers project investment and operation costs.

The Hills Creek Lake project lies within the Willamette National Forest. Recreation facilities at Hills Creek Lake are managed by the U.S. Forest Service. Visitors can enjoy picnicking and other recreational activities at Cline-Clark picnic ground, C.T. Beach picnic ground, Bingham boat ramp, Sand Prairie Campground, and Packard Creek Campground. Sand Prairie and Packard Creek have RV camps without utilities, in addition to their regular campsites. The Packard Creek campsite hosts a swimming beach. In 1999, about 15,000 recreation visits were made to Hills Creek project areas operated by the Corps near the dam's abutments and downstream of the dam.

Fall Creek Lake

Fall Creek Dam is at River Mile 7.2 of Fall Creek, about 20 miles southeast of Eugene. Fall Creek is a tributary of the Middle Fork Willamette River and enters that stream several miles below Dexter Dam. Fall Creek Dam is operated in conjunction with Lookout Point and Hills Creek dams to control the Middle Fork Willamette River. Construction of the project was completed in 1966.

Fall Creek Lake provides 115,100 acre-feet of storage and controls runoff from 184 square miles of drainage area. The lake's surface area is 1,760 acres at full pool.

The dam is a 193-foot-high embankment, with the spillway in the left abutment and outlet works near the right abutment. Fish collection facilities are provided. Chinook salmon collected at Fall Creek are transported to state hatcheries. Steelhead migrating upstream are collected and transported past the dam in tank trucks. Fall Creek Lake is used as a rearing pool for chinook salmon. Fingerlings migrate downstream through a collection system and bypass conduit at the dam. Authorized primary project purposes for Fall Creek are flood control, navigation improvement, and irrigation.

An interim feasibility study for adding power generation to Fall Creek was approved by the Board of Engineers for Rivers and Harbors and forwarded to the Office, Chief of Engineers in July 1984. The recommended plan is for construction of two turbine/generating units, with installed capacity of 9.8 megawatts. The hydropower plan is awaiting a non-federal sponsor. Existing operations of Fall Creek would not change.

Through September 1999, the total cost of the project was $33,078,400- $22,118,300 for construction and $10,960,100 for operation and maintenance. Since operations began in 1965, an estimated $2.3 billion (unadjusted) in flood damages have been prevented.

Day-use recreation facilities for boating, water skiing, fishing, swimming, and picnicking are provided at two sites managed by the Lane County Parks Department—Winberry Creek Park and North Shore Park. Swimming, boating, and camping are available at Cascara Campground and Fisherman's Point Campground, operated by the Corps. SKY Camp, an outdoor youth

education and recreation facility dedicated in 1978, was developed in cooperation with the Bethel School District and the Springfield Kiwanis Club. About 217,000 recreation visits were made to Fall Creek project areas in 1996.

Cougar Lake

Cougar Dam, at River Mile 4.4 of the South Fork McKenzie River about 42 miles east of Eugene, began providing flood control in 1963, and downstream navigation improvement and power generation in 1964. Primary project purposes are flood control, navigation, irrigation, and power generation. Below Cougar Lake, construction is authorized for a reregulating dam, Strube Lake, which would permit Cougar to operate as a peaking powerplant.

Cougar Lake has a storage capacity of 219,000 acre-feet and controls runoff from an area of 208 square miles. The lake's surface area is 1,235 acres at full pool. The dam rises 445 feet above the streambed.

The Cougar powerplant has a 25,000 kilowatt generating capacity. In 1999, 178,052,000 kilowatt-hours of power were generated. Through September 1999, total cost of the project was $82,378,700— $58,636,400 for construction and $23,742,300 for operation and maintenance. Since beginning operation in 1963, the project has prevented an estimated $400 million (unadjusted) in flood damages. Through September 1999, power generation totaled 4.8 billion kilowatt-hours. Of the gross income from sale of this power by Bonneville Power Administration, $26.8 million was reimbursed to the U.S. Treasury to recover Corps of Engineers project investment and operating costs.

McKenzie Hatchery was built near Leaburg on the McKenzie River as mitigation for loss of salmon and steelhead spawning grounds caused by construction of Cougar and Blue River dams. In a joint effort, the Corps of Engineers is financing the cost of restoring the fish runs to their former size and the Oregon Department of Fish and Wildlife pays for facilities to boost runs above natural numbers.

An Environmental Impact Statement (EIS) for the addition of water temperature control to the project's intake tower was completed in 1995. In 1998, the design for construction was modified to include a larger residual pool, an unscreened opening for the diversion tunnel, and placement of two cofferdams to manage water flows during construction. These changes require further review of the environmental impacts. The additional review began in 1999. Water temperature control will enhance fish passage and incubation in the McKenzie River.

The project's recreation facilities, all within the Willamette National Forest, are managed by the U.S. Forest Service. Cougar Crossing, Slide Creek, and Sunnyside campgrounds offer picnicking, boat launching, and camping. Echo Park has picnic and boat launch facilities. Delta Campground, two miles downstream of the dam, and French Pete Campground, two miles above the upper end of Cougar Lake, are other nearby Forest Service campgrounds. Record water levels in 1995-1996 left considerable debris in the lake, making boating and water skiing potentially dangerous. Much of the mess was removed by the spring of 1996.

About 76,000 recreation visits were made in 1999 to Corps-operated Cougar project areas downstream of the dam and on both abutments.

Blue River Lake

Blue River Dam is at River Mile 1.8 of the Blue River, a tributary of the McKenzie River, about 40 miles east of Eugene. Construction was completed in 1969. Flood control operation started during the winter of 1968-69. The dam is a 320-foot-high embankment with spillway and outlets in the left abutment. A 70-foot embankment dam (Saddle Dam) about four miles from the main dam closes off a low saddle between the Blue River and McKenzie River watersheds. Authorized primary project purposes are flood control, irrigation, and downstream navigation improvements. The reservoir provides 85,000 acre-feet of storage and controls runoff from an 88-square-mile drainage area. At full pool, the lake's surface area is 940 acres.

A final feasibility report for adding power to Blue River Dam was approved by the Board of Engineers for Rivers and Harbors in 1982 and forwarded to the Secretary of the Army in August 1983 by the Chief of Engineers. The recommended plan, which was authorized by PL 99-662, is for construction of two turbine/generator units with installed capacity of 29 megawatts. Eugene Water and Electric Board (EWEB) was granted a FERC license in November 1989 to install two small hydropower units at Blue River Lake project. EWEB has delayed its plans for hydropower units pending completion of the Corps' addition of water temperature control to the regulating outlet tower. EWEB's

FERC license has been extended until 2005 when it is anticipated the agency would install hydropower facilities. Through September 1999, the total cost of the project was $36706100— $32,038,200 for construction and $4,667,900 for operation and maintenance. Since the project began operation in 1968, it has prevented over $313 million (unadjusted) in flood damages.

Blue River Lake is operated in conjunction with Cougar Lake to control the McKenzie River and the Willamette River downstream.

Blue River Lake is in the Willamette National Forest and recreation areas at the lake are managed by the U.S. Forest Service. Overnight camping is available at Mona Campground and boat launching facilities are provided at Lookout Creek ramp. Fishing, swimming, and water skiing also are available at the two recreation areas, both near the upper end of the lake. Record water levels in 1995-1996 left considerable debris in the lake, making boating and water skiing potentially dangerous. Much of the mess was removed by the spring of 1996.

In 1999, about 57,000 recreation visits were made to Blue River project areas operated by the Corps.

Detroit and Big Cliff Lakes

The project, about three miles downstream from Detroit, consists of Detroit Dam, the principal facility, at River Mile 49 on the North Santiam River, and Big Cliff Dam, a smaller reregulating dam at River Mile 46. These reservoirs store waters of the North Santiam River, controlling runoff from about 438 square miles of drainage area. The project is located about 45 miles southeast of Salem. The authorized primary project purposes are flood control, irrigation, downstream navigation improvement, and power generation. Detroit Lake provides 455,000 acre-feet of storage capacity.
Big Cliff, a reregulating dam and small reservoir, is used to smooth out the power generation water releases at Detroit. The reregulating operation controls downstream river level fluctuations.

The North Santiam canyon is rocky, narrow, and steep at the dam sites. For that reason, Detroit and Big Cliff are concrete dams, rather than earth and rockfill embankments like most Corps dams in the Willamette Basin. Detroit Dam rises 454 feet above streambed and has a 100,000-kilowatt powerhouse. Big Cliff is 191 feet high and has an 18,000-kilowatt powerhouse.

The two generators at Detroit were put in service in 1953, the Big Cliff unit the following year. During 1999, power generated at the two dams was 609,498,000 kilowatt-hours.

To mitigate for loss of salmon-spawning areas upstream from the project, the Marion Forks Hatchery and Minto Holding Pond were built by the Corps in 1950. Both facilities are operated by the Oregon Department of Fish and Wildlife.

Through September 1999, total cost of the project was $111,397,100— $62,729,700 for construction, $48,304,300 for operation and maintenance, and $363,100 for rehabilitation. Since the project began operating in 1953, it has prevented an estimated $585 million (unadjusted) in flood damages. Through September 1999, power generation totaled 22.6 billion kilowatt-hours. Of the gross income from sale of this power by Bonneville Power Administration, $80.8 million was reimbursed to the U.S. Treasury to recover Corps of Engineers project investment and operating costs.

Detroit Lake is a popular recreation area. At full pool, 3,600 acres of reservoir are available for water skiing, swimming, and fishing. The Oregon State Parks Department operates two parks which include picnicking, swimming, and boat launching facilities. Mongold is a day-use area, whereas the Detroit Lake State Park has campsites and RV camps. The U.S. Forest Service runs three campgrounds: Piety Boat Camp, Hoover Campground, and South Shore Campground. Private moorage facilities are available in the town of Detroit. In 1999, about 27,000 people visited the Detroit powerhouse and other Corps-operated projects.

Green Peter and Foster Lakes

This project consists of Green Peter and Foster dams. Green Peter Dam, a concrete structure, is at River Mile 5.5 of the Middle Santiam River. Foster Dam, an embankment, is at River Mile 38.5 of the South Santiam River, the confluence of the South Santiam and Middle Santiam rivers. Authorized primary project purposes are flood control, downstream navigation improvement, irrigation, and power generation.

Green Peter Dam is 385 feet high and provides 428,100 acre-feet of usable storage. The project controls runoff from 227 square miles of drainage area. Foster Dam is 146 feet high and provides 61,000 acre-feet of storage. In addition, it reregulates water releases made from Green Peter for power generation.

The power generators at the two dams are operated differently. At Green Peter, the 80,000-kilowatt plant is run during periods of peak power demand. With that operation, large water-level fluctuations occur in a short stretch of the Middle Santiam River. Foster Lake absorbs those fluctuations, then the water is released evenly through the Foster power plant. The 20,000-kilowatt power plant at Foster is run about 80 percent of the time, thereby adding to the base (continuous) power supply.

Green Peter power plant operates about 40 percent of the time, providing valuable peaking capacity. During 1999, 278,547,000 kilowatt-hours of power were generated and 276,224,000 delivered to the Bonneville Power Administration. .

Provisions for fisheries at the two projects include facilities to pass migrating salmon and steelhead upstream and downstream, and stocking lakes with resident fish. When the project was completed in 1968, the Oregon Department of Fish and Wildlife's South Santiam Hatchery was relocated and expanded to provide mitigation for loss of spawning grounds. Capacity of the Leaburg Hatchery was increased to provide additional resident fish required for stocking.

Rewind of Green Peter Unit 1 began in 1998 and continued in 1999. Rewind of Green Peter Unit 2 began in 1999. Through September 1999, the total cost of the two-dam project was $133,719,900— $84,005,800 for

construction and $49,714,100 for operation and maintenance. Since the project began operating in 1966, it has prevented an estimated $1 billion (unadjusted) in flood damages. Through September 1999, power generation totaled 11 billion kilowatt-hours. Of the gross income from sale of this power by Bonneville Power Administration, $68.1 million was reimbursed to the U.S. Treasury to recover Corps of Engineers project investment and operating costs.

Recreation areas at Green Peter Lake include Whitcomb Creek Park and Thistle Creek boat ramp, administered by Linn County Parks and Recreation Commission. Public recreation areas at Foster Lake include Sunnyside Park, Lewis Creek Park, and Gedney Creek Boat Ramp, administered by the county parks commission; and Andrew S. Wiley Park and Shea Point, operated by the Corps. Facilities for camping, picnicking, and boating have been built at both lakes. During record water levels in 1995-1996, log jams that were 20 to 30 years old broke loose, dotting Green Peter and Foster lakes with logs and woody debris. Much of the mess was removed the following spring.

The two lakes provide more than 4,800 acres of water surface, three-quarters of it at Green Peter. Opportunities for fishing, boating, water skiing, camping, and picnicking are available. The old Quartzville mining district above

Green Peter Lake is a nearby attraction. In 1999, about 899,100 recreation visits were made to the Green Peter-Foster project areas.

Authorized Projects

Of the 14 projects presently authorized by Congress in the Willamette Basin, one has not been constructed. This project is Strube Lake, located on the South Fork McKenzie River below Cougar Dam.

Strube Lake

Strube Dam remains authorized for construction on the South Fork McKenzie River, about two miles downstream from Cougar Dam. The dam would be an 80-foot-high embankment with a gate-controlled, concrete-chute spillway and a 4,600-kilowatt power plant. Strube Lake would smooth out water discharged from the Cougar powerhouse. This would permit Cougar to be operated as a peaking plant with 35,000 kilowatts of new capacity in addition to its present 25,000 kilowatts. Estimated cost of the Strube project is $114 million (1996). Benefits of this new development would be from additional electricity produced. Preconstruction engineering and design have been completed; but no funds have been expended on this project for many years and there are no plans to do so. The project will soon be eligible for deauthorization.

Current and Recent Studies

Willamette River Basin Review

A reconnaissance report completed in June 1991 investigated a number of water resources problems and opportunities for the Willamette Basin. Water uses, needs, and public expectations have changed since the reservoir system was originally authorized more than 40 years ago. Because the Willamette Valley is heavily populated and one of the fastest-growing regions in the state, the demands placed on Corps reservoirs for municipal and industrial water supply, irrigation, and recreation will increase in the future. State and public concerns and management objectives for the projects are diverse and sometimes conflicting. A major finding of the reconnaissance report was that modifications to the operation and storage allocation of the existing Corps reservoirs to reflect changed conditions in the basin could result in a net economic benefit to the nation.

In May 1995, the Oregon Water Resources Department agreed to act as local sponsor for a feasibility study. Municipal and industrial interests in the Willamette Basin have agreed to provide some of the needed local funding. The four-year study, which began in June 1996, is investigating future water demand in the Willamette Basin, especially as it relates to operation of the Corps' 13 Willamette Basin reservoirs during the summer months.

In October 1999, the Water Resources Department and the Corps agreed to extend the completion of the study by 12 months pending completion of the ESA Section 7 consultation. The extension will allow information developed for the Biological Opinion on reservoir operations to be used in crafting the alternatives for the Basin Review Study. Criteria developed by fisheries agencies to protect declining runs are likely to play a major role in shaping future project operations. Following the release of the opinion, the Corps expects to resume an active schedule for completing the study. One of the first activities at that time will be to determine what changes in the study plan will be needed to respond to NMFS recommendations and other changing conditions in the basin.

Willamette River Temperature Control

For many years, state and federal resource agencies including the Northwest Power Planning Council have been seeking modification of water temperatures downstream from two reservoirs, Blue River and Cougar lakes. Replicating preproject temperatures could improve conditions for anadromous fish. A final Feasibility Report and final Environmental Impact Statement were completed in April 1995. Plans call for modifying both the Cougar and Blue River projects by adding adjustable weir gates to intake structures to improve water temperatures in the South Fork and Blue Rivers. Water will be withdrawn from specific reservoir elevations and blended to achieve desired river temperatures downstream. The fully funded cost is estimated at $75.2 million. Preconstruction engineering and design is expected to be completed by March 2000.

South Santiam Fishery Restoration

A reconnaissance study to determine if there is federal interest in reestablishing anadromous fish runs on the South Santiam River above the Corps' Foster and Green Peter projects was completed in July 1995. The study evaluated alternatives for both adult and juvenile winter steelhead and Willamette spring chinook salmon passage. Reestablishing wild runs of these species is a high priority of the state of Oregon. These species were historically present in the South Santiam River before federal projects were constructed in the late 1960s. The reconnaissance report concluded fish passage facilities at Green Peter do not function as they were designed and winter steelhead and spring chinook can no longer utilize prime spawning and rearing habitat in the upper reaches of the sub-basin. The report recommends winter steelhead and Willamette spring chinook runs be reestablished above Green Peter. A Major Rehabilitation Evaluation report to address fish passage measures will be initiated as Operation and Maintenance funding becomes available.

Middle Fork Willamette Fishery Restoration

A reconnaissance study was initiated in August 1995 to investigate whether it is in the federal interest to modify existing structures and/or operations on the Middle Fork of the Willamette River to restore anadro-

mous fish runs. Hills Creek, Lookout Point/Dexter, and Fall Creek projects were initially considered for evaluation. Since Fall Creek already provides for anadromous fish passage, it was eliminated from further analysis. The reconnaissance report was completed in February 1997. However, the Oregon Department of Fish and Wildlife, the study sponsor, indicated that it could not meet the non-federal cost sharing requirement for the feasibility phase and requested the study be placed in a deferred status.

Willamette River Floodplain Restoration Study

Through this General Investigations study, the Corps will evaluate opportunities to modify existing floodplain features that may further reduce flood damages while restoring natural wetlands and promoting ecosystem restoration. Corps' reservoirs in the Basin control only 27 percent of the drainage. A restored floodplain would help absorb excess flood waters, slow the velocity of the water, and create habitat for a variety of plants and animals, including fish species. The Corps completed a reconnaissance phase evaluation of floodplain restoration in June 1999. The report is being used as the basis for development of a detailed Project Study Plan and Feasibility Cost-Sharing Agreement for the Feasibility Phase Study, scheduled to be initiated in 2000. The State of Oregon, through Governor Kitzhaber, has agreed to act as the local sponsor for the feasibility phase. One or more state agencies will take the lead role in acting as local sponsor of the study, which will also be conducted in close coordination with the Willamette Basin Initiative.

Environmental Dredging— Lower Willamette River

Environmental dredging, as authorized by Section 312 of the Water Resources Development Act of 1990 (as amended), allows the Corps to remove or remediate contaminated sediments from waterways for the purposes of environmental enhancement. Late in 1999, the Corps received funding to initiate the reconnaissance phase of this study. The study would encompass the lower 25 miles (below the Clackamas River) of the Willamette River. The Corps hopes to study the feasibility of remediating contaminated sediment in parallel with state efforts to remediate the Portland Harbor. The Corps may augment or supplement state remedial efforts by assisting in establishing sediment quality criteria, documenting harbor wide contamination, remediating orphaned contamination, and siting disposal facilities for contaminated sediments.

Flood Damage Reduction Projects

Four single-purpose flood damage reduction projects have been authorized for construction by the Corps of Engineers in the Willamette Basin. Work has been done on three projects. The fourth, Johnson Creek, is in inactive status pending local cooperation and will automatically be deauthorized in the year 2000.

Existing Projects

Willamette River Basin Bank Protection

The Willamette River Basin Bank Protection program protects agricultural lands as well as urban and suburban areas from erosion damage. Bank erosion results in the loss of farmland and threatens roads, bridges, utility lines, and other improvements. Erosion also opens overflow channels. These new channels threaten property and isolate developed areas from their normal access routes, requiring construction of new roads and bridges. Authorized by the Flood Control Acts of 1936, 1938, and 1950, the Willamette River Basin Bank Protection program assists with erosion problems in the region. It covers bank protection and channel clearing works along the Willamette River from New Era upstream to the dams and along major tributaries which include the Clackamas River, Tualatin River, Mollala River, Santiam River, Marys River, Muddy Creek, and the McKenzie River in Oregon.

Investigations are initiated at the request of a non-federal sponsor who is willing and able to cost-share 25 percent of the project implementation costs. Total federal cost of the project is estimated to be $30,700,000 (1999). As of September 1999, the project was 96 percent complete with 489,795 linear feet of protection in place at 230 locations. The project includes riverbank revetments, pile and timber bulkheads, drift barriers, minor channel

improvements, and maintenance of existing works for control of floods and prevention of riverbank erosion at various locations. Costs through September 1999 were $24,971,300 for construction and $5,695,400 for maintenance. An additional $93,733 has been expended for new

construction by local governments. Through September 1999, bank protection works had prevented almost $74.7 million (unadjusted) in flood damages.

Willamette Basin Channel Improvements

Channel improvements for flood control and major drainage improvements on 16 tributaries of the Willamette River were authorized by the Flood Control Act of 1950. In several areas, local interests have accomplished improvements essentially in accordance with the preliminary plans made by the Corps. That work was done with assistance of the Production and Marketing Administration (now the Commodity Stabilization Service), U.S. Department of Agriculture. Those improvements have stimulated installation of tile drainage.

One project has been classified inactive at Beaver Creek. Five others— Turner Prairie, Bear Creek, Calapooia River, Shelton Ditch, and Ferguson Creek— have been deauthorized.

Amazon Creek Channel Improvements

This project provides about 5.4 miles of channel improvements through the city of Eugene including a 1.1-mile concrete-lined channel, a 2.5-mile improved channel from Eugene to a diversion structure, and a 3.8-mile canal from the diversion structure to Fern Ridge Lake. The project reduces flood damages in and near Eugene.

The project was authorized by the Flood Control Act of 1946 and modified by the acts of 1950 and 1954. Construction began in 1951 and was completed in 1959. Total federal cost of the project was $1,214,300. The city of Eugene contributed $89,000. In addition, the city of Eugene paid $66,000 for construction work outside the scope of the authorized project, including extension of the concrete channel about 700 feet upstream from

the end of the federal project. The total project cost was $1,369,300, not including the cost of rights-of-way and utility relocations. Since completion of the project in 1959, it has prevented an estimated $9.4 million (unadjusted) in flood damages.

A feasibility study for project modification for improvement of the environment, conducted under Section 1135 of the Water Resources Development Act of 1986, was completed in 1996. The project recommended modification of the existing project to restore about 400 acres of wetlands that were significantly altered by flood damage reduction projects along Amazon Creek. The Water Resources Development Act of 1996 authorized the Corps to include channels constructed by the Natural Resources Conservation Service. Total project cost, including lands, is estimated at $4.2 million (1999).

Phase I was completed in November 1999. Phase I involved removing existing levees along Amazon Creek and associated drainages and restoring the more natural meandering stream configurations of the various channels. New levees were set back around the margin of the wetland restoration area to maintain the flood control function of the project. Interior wetland areas will be subject to the high frequency flooding that occurred prior to the flood control projects. The new levees were seeded with a combination of native upland grass species. A slotted weir was constructed to maintain the complex flow relationship between the connected channels. Culverts, some gated, were also installed to maintain drainage and to allow manipulation of surface hydrology for wetland management purposes. Disturbed areas along the stream channels and the old levee footprints were seeded and planted with native wet prairie, emergent marsh, and vernal pool species. Total cost of Phase I was approximately $1.7 million. Construction will continue with Phase II, which will involve removal of non-native plant materials throughout the entire project area and replacement with native wet prairie plants. A major portion of this effort will be propagation of native plants and seeds. Phase II will also include modification of surface hydrology.

Authorized Project

Johnson Creek in and near Portland

Flooding during heavy rains is a frequent problem along Johnson Creek. Flood control improvements in Gresham, southeast Portland, Milwaukie, and other parts of Multnomah County were authorized by the Flood Control Act of 1950. The authorization provides for channel improvements and bank protection at various locations between the creek's mouth in Milwaukie and the vicinity of Southeast Park Drive in Gresham.

Advanced engineering and design for the reach from the mouth to 158th Avenue was completed in 1958, but construction was not started due to lack of local sponsorship. The project was reclassified as inactive in 1966. In 1971, the Metropolitan Service District (MSD) agreed to sponsor the project and furnish preliminary assurances of local cooperation.

Since completion of the 1958 design memorandum,

significant changes had occurred in the Johnson Creek Basin. A restudy was undertaken. Results of the restudy showed channel improvements from the mouth of Johnson Creek to 158th Avenue were economically justified, but no project could be justified in the Gresham area.

In November 1979, MSD initiated the formation of a Local Improvement District (LID) to provide funds for non-federal costs of the Johnson Creek project. Advanced engineering and design studies began in 1980. In July 1980, MSD postponed action on the assessment ordinance for the project pending resolution of problems associated with LID boundaries. Economic and hydrology studies are complete.

MSD was unable to develop a cooperation agreement with the municipalities involved in the 1980 Johnson Creek studies, and consequently the project was never completed.

In 1988, the city of Portland became the sponsor of the project and a study was initiated to determine the feasibility of solving the flooding problems on Johnson Creek. The sponsor withdrew support and the study was terminated. This project will be deauthorized in 2000.

Continuing Authorities for Flood Control

Work has been accomplished at many locations in the Willamette Basin under various special authorities for projects of limited scope. The special authorities are described in detail in the introductory chapter.

Sandy River at Troutdale

The continuing authority contained in Section 14 of the 1946 Flood Control Act, as amended, allows construction of emergency bank protection to prevent flood damage to public works. The authorized project is located within the Troutdale city limits on the left bank of the Sandy River between the Interstate Highway 84 bridge and the Union Pacific Railroad bridge, about 11 miles east of Portland. The project consists of construction of 600 feet of embankment fill and revetment stone to stabilize the bank to protect both the Interstate Highway 84 bridge abutment and the City of Troutdale sewage treatment ponds.

Construction was completed in October 1993. Total project cost was $431,230, of which $323,422 is federal and $107,808 is non-federal. The non-federal sponsor, the City of Troutdale, participated financially in accordance with the cost-sharing requirements of the Water Resources Development Act of 1986, Public Law 99-662, through a cash contribution of $98,313 and by providing lands, easements and rights of way, relocations, and disposal areas valued at $9,495.

Calapooia Riverbank Protection Plan

This Section 14 project is located on the bank of the Calapooia River at river mile 5.4 on the southwestern outskirts of the City of Albany. It provides 550 feet of bank protection consisting of class III riprap over gravel bedding, to prevent encroachment of the Calapooia River into an old landfill site that contains toxic and hazardous industrial wastes. These wastes would seriously

degrade water quality if released into the Calapooia and Willamette rivers. The project was completed in 1996 at a cost of $274,476 of which $205,857 was federal and $68,619 was non-federal money.

Navigation Development

Navigation developments authorized or constructed within the Willamette Basin include Willamette Falls Locks, the Willamette River channel upstream from Portland, the deep-draft channel in Portland Harbor, and Multnomah Channel. The last two projects are discussed in the Lower Columbia Basin chapter due to their close relationship to navigation works in that basin.

Existing Projects

Willamette River above Portland and Yamhill River

The project, authorized in 1896 and later modified, provides for navigation in the Willamette River from Portland (river mile 14) to Eugene (river mile 185), and in the Yamhill River. At present, dredging of the channel in the Willamette River is only required in the vicinity of the mouth of the Clackamas River below Oregon City. Authorized snagging and clearing in the Willamette River between Harrisburg and Eugene were determined to be not economically justified and no work has been done. On the Yamhill River, a dam and lock at Lafayette, built in 1898-1900, provided the 18-mile channel to McMinnville. Operation of the lock was discontinued in 1954 because commercial traffic was lacking. The lock and adjacent property were turned over to Yamhill County in 1959 for a park. At West Linn (river mile 27), the Willamette Falls Locks provide passage around the falls.

Local interests constructed a channel 20 feet deep and 200 feet wide to Lake Oswego (river mile 21) in 1962. A channel with a depth of eight feet and width of 200 feet is maintained from Lake Oswego to Cedar Island (river mile 23), and a 150-foot width from there to Oregon City. Commercial gravel operations have provided most of the channel maintenance from Portland to Oregon City. From Oregon City to Corvallis, the project provides for a channel to be maintained at 2.5 to 3.5 feet deep and 100 or more feet wide. Additional depth is provided by streamflow augmentation. Due to minimal commercial navigation, regular dredging activities were terminated in the reach above Newberg (river mile 50) in 1973. Only periodic removal of snags has been accomplished since then.

Total cost of the project through September 1999 was $18,763,200 (excluding $485,000 from flood control funds for bank protection). Of that, $862,900 was for construction and $17,900,300 for operation and maintenance. Waterborne traffic in 1999 was 748,000 tons. The average annual traffic for the five-year period 1995-1999 was 1,200,000 tons.

Willamette River at Willamette Falls

The locks and dam at Willamette Falls, a rocky reef in the Willamette River at Oregon City, were completed in 1873 by private interests. The locks were purchased by the U.S. government in 1915 for $375,000. The dam along the crest of the falls remains the property of private interests. The locks completed 125 years of successful operation in 1998. Their historical value has been recognized by the National Park Service, which placed them in its Register of Historic Places in 1974. The project was established as an Oregon Civil Engineering Landmark in 1991.

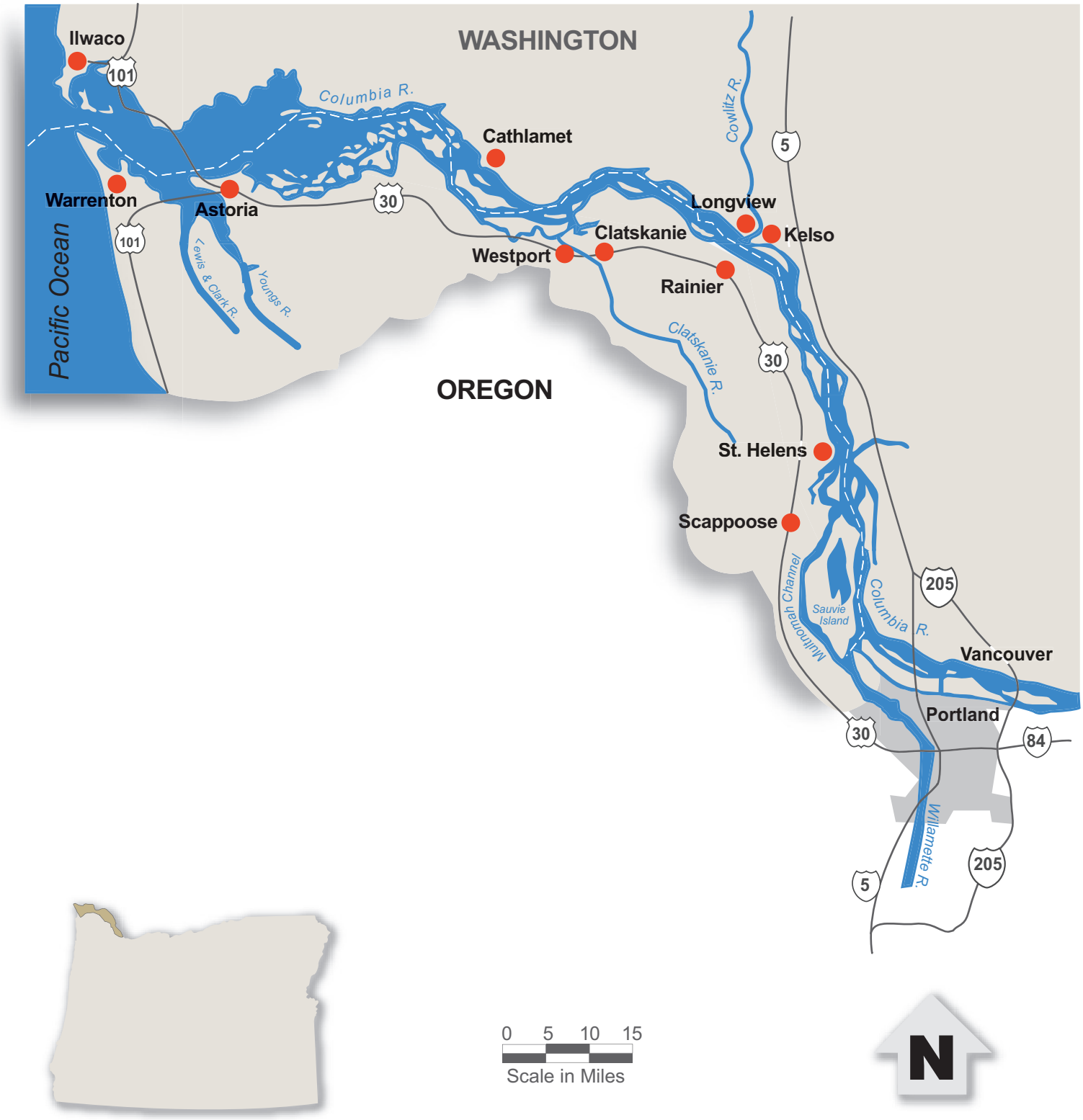
The project includes four locks, a canal basin, and an extra guard lock used to prevent flooding when river levels are high. The system acts as a fluid staircase between the upper and lower reaches of the Willamette River. Each of the four locks is 175 feet long and 37 feet wide. Total lift is 50 feet. The total length of the canal and locks is 3,500 feet. Controlling depth over the sills is six feet.

Until the 1940s, the gates were opened manually. Now, the gates are operated by hydraulic pumps controlled by switches in two control stations with the aid of closed-circuit television and radio communication. All the gates have been replaced under minor rehabilitation funds. Existing locks and grounds are in good condition and in continuous operation. A new communications and control system was installed in 1995 to improve operation of the locks. Floods in 1996 caused damage to electrical systems, deposited a large amount of silt in the lock chambers and damaged the docks on the upriver and downriver sides of the locks. The locks remained closed for four months for repairs, which cost about $280,000. Through September 1999, the total federal costs were $25,094,800 ($520,000 for construction, $234,800 for rehabilitation, and $24,340,000 for operation and maintenance. In addition, $300,000 was contributed by non-federal interests.

In the past, there were more 9,000 lockages in an

average year. Major volume cargoes were sand and gravel, used as construction materials; and pulp and paper materials. The 1996 closure of the paper mill adjacent to the locks reduced commercial traffic through the locks by 85 percent, however. Operating hours were cut back, but are re-evaluated periodically as user needs change.

Lower Columbia River Basin



Lower Columbia River Basin

The Lower Columbia River Basin comprises the western most portion of the Columbia-Snake Inland Waterway. Discovered by Capt. Robert Gray in 1792, the Columbia River has been a commercial waterway since the early 19th century. Fur traders of the Northwest Company, Astoria Pacific Fur Company, and the Hudson's Bay Company frequently used it. Oceangoing vessels sailed upriver to Vancouver, Washington, and to Portland and Oregon City, Oregon, via a tributary, the Willamette River. By mid-century, river steamers were plying sections of the Columbia upstream from Vancouver, but rapids blocked commerce into the interior.

Wagon portages were used at first, then railways, until Cascades Canal was constructed in 1896 by the U.S. Army Corps of Engineers. The old canal is now covered by waters of the lake backed up by Bonneville Dam. The Dalles-Celilo Canal was completed in 1915. It also is under water, flooded when The Dalles Dam was completed. When gold was discovered in Idaho in 1862, steamers began traveling from The Dalles, Oregon, to Lewiston, Idaho. They occasionally made trips beyond Lewiston on the Clearwater River to the Orofino mines. Before construction of Grand Coulee Dam, the upper Columbia was navigated in some seasons to Kettle Falls, Washington, 700 miles above the mouth. The Columbia-Snake Inland Waterway now extends from the Pacific Ocean to Lewiston, Idaho, a distance of 465 miles.

The lower Columbia River extends from Bonneville Dam downstream 145 miles to its mouth. The entire reach is subject to tidal influence. The Lower Columbia River Basin includes all the lower Columbia River plus its tributaries downstream from the mouth of the Willamette River. The Willamette and Sandy rivers, which also enter the lower Columbia River, are discussed in the Willamette Basin chapter. The Cowlitz River, another major tributary, is discussed in the corresponding book for Washington.

The Lower Columbia River Basin includes part of the Portland metropolitan area and numerous small communities downstream. The remaining basin area is taken up by farms, forests, undeveloped rural areas, industrial developments, and ports along the river.

Many levees and revetments have been constructed by the Corps of Engineers to provide flood and erosion protection. Storage dams far upstream in both the Columbia and Willamette River basins substantially reduce flood flows along the lower Columbia. Historically, the largest floods have come during the spring, after the snowmelt in the Rocky Mountains. Floods almost as large have occurred in the winter, after heavy rainfall and rapid snowmelt in the Cascade Range and in certain tributary drainages of the Snake River.

During the December 1964 flood, about $25 million in damages along the lower Columbia River in Oregon were prevented by dams upstream in the Willamette and Columbia River basins. Levees and revetments along the river prevented an additional $23 million in damages. Damages prevented along the Washington side of the Columbia are not included in these totals.

Severe flooding occurred again during the winter of 1995-96, one of the wettest on record in the Pacific Northwest. Heavy rains in November and December brought flooding in Clackamas and Tillamook counties and several parts of Washington. Working with local, county, state, and federal agencies, the Corps provided technical advice and assistance. Heavy rains continued in January and February. As reservoirs reached capacity, Corps engineers began increasing releases at several projects, including Detroit, Applegate, Lost Creek, Willow Creek, Fern Ridge, and Lookout Point. Subtropical rains began in February and snowpacks that were 200 to 300 percent greater than normal began melting. The combination brought severe flooding to many parts of northern Oregon. River levels were comparable to those of the hundred-year flood of 1964, the largest flood event in Oregon since flood control reservoirs were built. Corps staff worked continuously to coordinate the operations of 60 dams throughout the Columbia River Basin and reduced releases to minimums on the 11 storage dams in the Willamette Basin. These actions helped keep the Willamette River below the top of the seawall in downtown Portland and prevented flooding. Severe flooding occurred in Lake Oswego, Oregon City, Tillamook, and Clatskanie in Oregon, and Kalama, Woodland and Cowlitz County in Washington. Flows began leveling off, the heavy rains abated and rivers began to recede in mid-February. Despite the extensive flooding, overall more than $3.2 billion in flood damages were prevented throughout the region.

The lower Columbia River is used for navigation throughout its length. The navigation channel has been deepened to 40 feet to accommodate large ocean-going vessels. The 40-foot channel is maintained from the Portland area to the sea, and a 55-foot-deep entrance channel is maintained at the river's mouth. Upstream from Vancouver, a 17-foot-deep channel is maintained for river traffic to Bonneville Dam. Barges, log rafts, pleasure boats, and smaller ocean-going vessels use that part of the river. In addition to deep channels and turning basins maintained at Portland and Vancouver, there are many smaller harbor projects along the river.

The Portland District administers the Corps of Engineers projects in the Lower Columbia River Basin. In this chapter, flood control and navigation projects along the lower Columbia River are described. Upstream storage dams with influence on floodflows of the lower Columbia are described in the chapters for the Willamette, Middle Columbia, and Snake river basins.

Flood Damage Reduction Projects

Existing and Authorized Projects

Flood control works in the Lower Columbia River Basin have been constructed under authorities granted by Congress in the 1936 and 1950 Flood Control Acts. Both acts authorized construction of levees and improvements of existing projects. In addition, bank-protection works were authorized in the 1950 act.

Levees and Improvements to Existing Projects

Flood Control Act of 1936

The 1936 act authorized construction or rehabilitation of projects in 30 diking or drainage districts along the lower Columbia River in Oregon. The total federal cost for work done under that authority was about $6.1 million. The cumulative benefits through 1996 amount to more than $1.73 billion.

Costs and cumulative benefits through fiscal year 1999 for the 30 projects are listed in the following tabulation in downstream to upstream order. Costs are for original work. Benefits shown for five districts— Woodson, Midland, Rainier, Sauvie Island, and Multnomah 1— include those due to additional work authorized in 1950 as well as work done under the 1936 Act.

Location[1]	Drainage (Dr.D.) or Diking District (Dik.D)	Federal Cost	Cumulative Benefits
2	City of Warrenton[2] Dik.D.#1	$69,500	$43,600,000
2	City of Warrenton[2] Dik.D.#2	117,100	16,100,000
2	City of Warrenton[2] Dik.D.#3	74,600	11,100,000
3	Clatsop County[3] Dik.D.#2 & 5	68,800	16,100,000
3,5	Clatsop County[3] Dik.D.#8,#11	158,400	3,300,000
4	Clatsop County[4] Dik.D.#9	248,800	9,400,000
4,5	Clatsop County[4] Dik.D.#13	66,900	200,000
4,5	Clatsop County Dik.D.#14	33,100	990,000
26	Clatsop County Dik.D.#10	25,800	730,000
27	Clatsop County[5] Dik.D.#12	18,800	170,000
28	Clatsop County Dr.D.#1	241,000	6,100,000
29	Clatsop County Dik.D.#7 (Blind Slough)	163,400	3,000,000

Location[1]	Drainage (Dr.D.) or Diking District (Dik.D)	Federal Cost	Cumulative Benefits
35	Clatsop County Dik.D.#6[5]	133,800	1,100,000
	Dik.D.#15	40,700	1,840,000
45	Westland Dist. Improvement Co.	205,500	9,200,000
46	Woodson Dr.D.	32,800	5,900,000
47	Webb Dist. Improvement Co.	84,600	9,400,000
48	Marshland Dr.D.	39,500	16,700,000
49	Midland Dr.D.	77,700	20,500,000
50	Magruder Dr.D.	61,200	12,700,000
53	Beaver Dr.D.	274,600	125,300,000
65	Rainier Dr.D.	47,700	18,400,000
80	Deer Island Dr.D.	574,100	11,100,000
94	Scappoose Dr.D.	424,300	80,400,000
100	Sauvie Island Dr.D.	1,623,500	179,100,000
106	Peninsula Dr.D.#1	211,200	64,800,000
107	Peninsula Dr.D.#2	241,100	113,500,000
114	Multnomah County Dr.D.#1	610,700	762,900,000
120	Sandy Dr.D.	139,000	182,900,000
Totals		**$6,098,200**	**$1,727,530,000**

1 Locations are given in river miles upstream from the mouth of Columbia River; all footnoted locations are areas tributary to the Columbia between river miles nine and 18.

2 On Youngs Bay

3 On Lewis and Clark River

4 On Youngs River

5 Project no longer in federal program (benefits no longer accruing).

Flood Control Act of 1950

Improvements to existing levee projects were authorized in the Flood Control Act of 1950, supplementing and extending projects authorized in the 1936 act. Work under the 1950 authorization has been completed at the following district.

Woodson Drainage District

Construction began in 1963 and was completed the same year. The work included reinforcement of about 6,200 linear feet of existing levee, installation of toe drains, removal of a pump-discharge line, and construction of a new pumping plant. The total federal costs were $162,500, not including local cooperation costs.

Drainage and Diking Districts

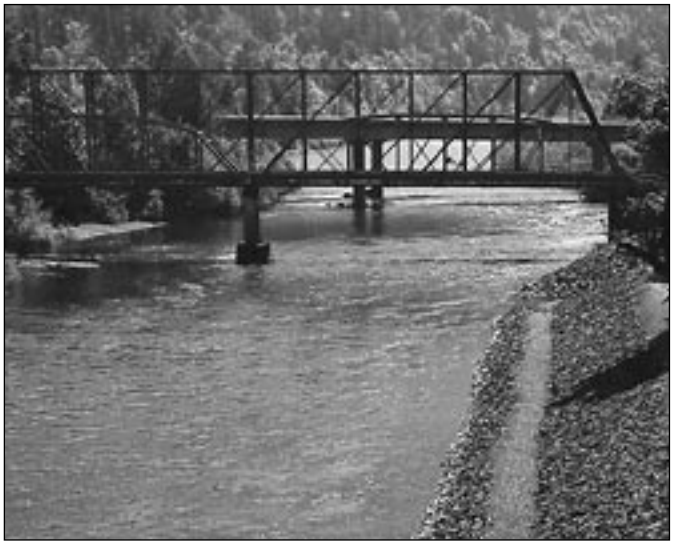
Proposed improvements, including modifications of existing levees and provision of drainage works, were not started because local cooperation requirements were not met.

Other improvements to existing projects authorized in the 1950 Flood Control Act have been reclassified inactive or deferred because local cooperation or economic feasibility was lacking. Work has been authorized at the following districts: Clatsop County Drainage District No. 1, Columbia Drainage District No. 1, John Drainage District, and Magruder Drainage District. Work authorized for the Sandy Drainage District was constructed in 1954 by that district at no cost to the federal government.

Work proposed for Clatskanie Drainage District and for Clatsop Diking Districts No. 4 and 6 has been deauthorized under the provisions of the 1974 Water Resources Development Act. Work proposed for Deer Island Drainage District has been deauthorized under the provisions of the 1986 Water Resources Development Act (PL 99-662).

Bank Protection Works

In addition to the levee work discussed earlier, the 1950 Flood Control Act authorized the construction of bank protection works, such as revetments, groins, and channel clearing along the lower Columbia River and its principal tributaries between Troutdale, Oregon, and the Pacific Ocean. The Lower Columbia River Basin Bank Protection program provides for study and construction of 224,000 linear feet of bank protection works at 96 locations along the lower Columbia River below river mile 125 and along principal tributaries in this reach to protect existing improvements such as levees and developed industrial lands from further erosion. Projects are accomplished at the request of non-federal sponsors who are willing and able to cost-share the implementation costs. Projects require congressional approval for construction.



The existing project is a unit of the general comprehensive plan for flood control, navigation, and other purposes in the Columbia River Basin. The Flood Control Act of 1950 requires that local interests furnish lands and rights-of-way; make necessary highway, highway bridge, and utility alterations; hold the United States free from damages; and maintain and oper-

ate completed works. Under Section 103 of the Water Resources Development Act of 1986, local interests also are required to make a cash contribution for construction at each site. Estimated costs for all requirements of local cooperation are $2,000,000. Sponsors of improvements along the Columbia River include local ports and drainage and diking districts. Construction started in 1961 and is 88 percent complete. A total of 191,000 linear feet of bank protection work at 84 locations has been completed. Estimated total federal cost of the improvements is $28000,000 (1999). The federal cost through September 1999 is $21,200,000. Through fiscal year 1999, flood damages prevented were $31,700,000.

Navigation Development

Navigation development in the basin by the Portland District, U.S. Army Corps of Engineers, includes principal developments at the mouth of the Columbia River, the Columbia and Willamette rivers below Vancouver and Portland, and the Columbia River between Vancouver and The Dalles. Those projects provide water access from the ocean to upstream points in Oregon and Washington. Smaller channels from the Columbia River channel to several communities have been constructed under separate authorizations.

The three main projects and smaller projects are described below. Although the lower Willamette River and Multnomah Channel actually lie within the Willamette River Basin, they are included here due to their close relationship to navigation along the lower Columbia River. The project between Vancouver, Washington, and The Dalles, Oregon, which is partly in the Middle Columbia River Basin, is discussed here for the same reason.

Existing Projects

Columbia River at the Mouth, Oregon and Washington

This project provides a stabilized entrance channel across the Columbia River bar. In the early days, the bar had a bad reputation with mariners. Its rapidly shifting sands grounded hundreds of vessels on treacherous shoals. Construction on this project started in the 1880s. The project as most recently modified in 1984 provides a one-half mile wide entrance channel 48 feet deep in the southern portion and 55 feet deep in the northernmost 2,000-foot width. The channel across the bar is secured by two converging stone jetties, which extend seaward from the Washington and Oregon shores. The entrance channel is five miles long, extending two miles seaward and three miles landward from the outer ends of the north and south jetties. The upstream end of the channel is stabilized by spur-jetty "A," which extends south perpendicular to the channel from Cape Disappointment, Washington. Three pile dikes near jetty "A" also help stabilize the channel.

The total costs through September 1999 from federal funds were $198,438,600. Of that, $24,913,700 was for construction, $7,322,900 for jetty restoration, and $166,202,000 for maintenance. Total waterborne traffic through the mouth of the Columbia River in 1999 was 38,970,000 tons. The average annual traffic for the five-year period 1995-1999 was 39,338,800 tons.

Recreation facilities have been jointly developed at Fort Stevens and Fort Canby state parks with the states of Oregon and Washington, respectively. Both of these state parks contain project lands leased by the states from the federal government.

Both parks are included on the National Register of Historic Places. Explorers Lewis and Clark first viewed the Pacific Ocean from these sites, and military facilities here are over 100 years old.

Columbia and Lower Willamette Rivers Below Vancouver and Portland

The project was first authorized in 1877, and the channel has been deepened at intervals since that time. The project authorization, as modified by Congress in 1962, covers 14.6 miles of Willamette River below Portland, Oregon, and 103.5 miles of Columbia River below Vancouver, Washington. Work on the authorized 40-foot-deep channel from Portland and Vancouver to the sea was complete in 1976. The Willamette River channel, from the Broadway Bridge (river mile 11.6) to the mouth (river mile 0), varies in width from 600 to 1,900 feet. On the Columbia River, the project provides for a channel 35 feet deep and 500 feet wide from the I-5 Interstate Bridge to the Burlington Northern Railroad bridge (river mile 106.5 to 105.5). The Columbia River channel for the four miles between the mouth of the Willamette River and the railroad bridge at Vancouver is being maintained to a 500-foot width until the need for a wider channel is demonstrated by traffic. The rest of the Columbia River from the railroad bridge to near the river's mouth (river mile 3) is 40 feet deep and 600 feet wide. Turning basins on the Columbia River are provided at Vancouver, Longview, and Astoria. The project

also includes 30- and 24-foot-deep auxiliary channels from the Columbia River channel at St. Helens (river mile 87) and Rainier (river mile 68), respectively.

Emergency dredging of a nine-mile reach of the Columbia River navigation channel was necessary after the May 18, 1980, eruption of Mount St. Helens, which clogged the river with more than 55 million cubic yards of volcanic material. At the mouth of the Cowlitz River near Longview, Washington, the silt-filled Columbia channel was only 15 feet deep. Within five days, Corps-owned dredges and the Port of Portland dredge, Oregon, under contract with the Corps, had cleared the channel to allow shallow-draft vessels to navigate on an intermittent basis. The $44-million emergency excavation reopened the 40-foot-deep by 600-foot-wide navigation channel by November 1980.

In 1998, a $787,000 contract was awarded to repair the Peninsula Drainage District #2 south levee which was damaged during the spring freshet. If the levee were to fail, the Portland International Airport and other highly valuable commercial industrial properties would have been jeopardized.

The total federal cost of the project through September 1999 was $434,864,300 . Of that total, $28,349,300 was for construction and $406,515,000 was for maintenance. In addition, $666,000 was expended from contributed funds.

Current facilities along the Columbia River, with planned extensions, are considered adequate for existing commerce. At Portland, there are six Port of Portland terminals consisting of 43 berths equipped to handle general cargo, bulk cargo, lumber, automobiles, lift-on-lift-off and roll-on-roll-off containers, and bulkhead vessels. The Port of Portland owns and operates a major ship repair yard, which includes the west coast's largest, and the world's third largest, floating dry dock. Also available in the harbor area are privately operated facilities for receiving, storing, and outloading petroleum, wood chips, grain, logs, sand and gravel, cement, and steel products. At Vancouver, Washington, there are municipal facilities capable of berthing five ships simultaneously. Each berth is completely outfitted with mechanical and lift facilities for receiving and handling all types of cargo. The port has a low dock to handle roll-on-roll-off and side-port discharging vessels. The grain terminal has a storage capacity of 4,500,000 bushels. Port of Kalama has two berthing areas, one port-owned and one private. Port of Longview has a public terminal on the Columbia River and a privately owned grain elevator with a capacity of 6,900,000 bushels. This port also has a heavy-lift facility with a capacity of 600 tons. At Astoria, there is a terminal with facilities for receiving and handling all types of general cargo. At other locations between Portland and the Columbia River entrance, there are sufficient private facilities to accommodate river vessels and fishing craft. Waterborne traffic through the project in 1999 was 51,096,000 tons. The average annual traffic for the five-year period 1995-1999 was 52,948,400 tons.

Channel maintenance was heavily impacted by floods in the winter of 1995-96. A total of 9.6 million cubic yards of material was removed by dredges. In 1999, the easternmost 400 feet of the East Astoria Boat Basin North Breakwater was repaired with new steel sheetpile. Cost of the repair was about $5.2 million.

A feasibility study for deepening the Columbia and Lower Willamette navigation channel is being conducted in cooperation with the Association of Lower Columbia River Ports.

Columbia River Between Vancouver and The Dalles

The project authorization provides for a channel 27 feet deep, 300 feet wide, and about 85 miles long between Vancouver, Washington, and The Dalles, Oregon. It also includes a channel 10 feet deep and 200 feet wide at the upstream entrance of Oregon Slough; a turning basin near Camas and Washougal, Washington; a 10-foot-deep boat basin at Hood River, with a 10-foot-deep connecting channel and a breakwater on the east side; a 10-foot barge channel to Bingen, Washington; and a small-boat harbor at The Dalles, including a breakwater and shear-boom-protected, eight-foot-deep basin.

From 1949 to 1957, the channel from Vancouver to The

Dalles was used commercially only for barge transportation and log towing. It was maintained to a 15-foot depth. Beginning in 1957, the project was deepened to the authorized 27-foot depth. The channel between Bonneville and The Dalles was completed in 1959. The channel between Vancouver and Bonneville was finished in 1960, except for some dredging and removal of submerged rock. The downstream entrance to the Bonneville lock was improved in 1961. At present, the channel is used only by tows and log rafts and is maintained to a 17-foot depth. Construction of a new navigation lock at Bonneville Dam was completed in 1993. This is described in more detail in the Middle Columbia Basin section.

Other work under the project authorization was completed in the early 1960s. The Hood River boat basin and the Camas-Washougal turning basin were constructed in 1962.

Barge-channel dredging and bank protection works near Bingen, Washington, were completed in 1963. A separate channel, 15 feet deep and 300 feet wide, under the fixed span on the I-5 Interstate Bridge between Vancouver and Portland, was completed in 1963, under authority of Section 107 of the 1960 Rivers and Harbors Act. That channel provides passage for smaller craft, decreasing the number of times the vertical-lift drawspan over the main channel must be raised. Also under Section 107, a small boat recreation channel 100 feet wide and six feet deep at South Channel Government Island was completed in 1985. A survey

study for a small-boat access channel to Mayer State Park, between Hood River and The Dalles, was completed in 1974. The study showed that due to redesign of the park and predicted higher pool elevations in Lake Bonneville, small boat access will be available without further construction.

The total project costs through September 1999 were $21,182,900. Of that total, $5,989,500 was for construction and $15,193,400 was for maintenance.

At numerous locations along the entire waterway, there are facilities for transfer of logs to water from trucks, and public and private boat basins. Facilities are considered adequate for present commerce. At Vancouver, Washington, upstream of the Interstate Bridge at river mile 108.1 on the site of a former shipyard, there are numerous ship-building facilities equipped with railway and river moorage facilities. Also in this area are a paper-storage warehouse with barge slip, two boat-building businesses, and a storage dock with gantry crane. At Camas, Washington, about 13.5 miles upstream from Vancouver, there is a private wharf used for transfer of paper-mill supplies and paper to and from barges, and facilities for discharging bulk oils from barges. At Port of The Dalles (mile 44 above Bonneville), there is a municipal wharf 125 by 1,100 feet for use by tugs and barges. There is a one-story timber and corrugated iron warehouse on this wharf. A private elevator with a capacity of 40,000 bushels and a public elevator of 1,113,800-bushel capacity for handling bulk grain to barges are also at The Dalles. The public elevator has rail, truck, and water connections. There is a port-owned rail connection about three-quarters of a mile below the municipal wharf where certain types of cargo may be handled between railroad cars and barges. Waterborne traffic in 1999 was 9,396,000 tons. From 1995-1999, the average annual traffic was 10,517,600 tons.

Skipanon Channel

The Skipanon River enters the Columbia River near Warrenton. The project provides for a 30-foot-deep, 200-foot-wide, 1.8-mile-long channel from the Columbia up the Skipanon to the railroad bridge at Warrenton; a 12-foot-deep mooring basin at Warrenton; and a seven-foot-deep, 40-foot-wide, 4,500-foot-long channel upstream from the railroad bridge, with greater log dumps and terminals. In recent years, however, the project has been maintained to a depth of 16 feet to accommodate traffic using the channel. The channel work and turning basin were completed in 1939. The small-boat mooring basin was completed in 1957 and fill stabilization work was completed in 1958. The total costs through September 1999 were $4,423,745 of which $280,900 was for construction and $4,142,845 was for maintenance.

The city of Warrenton owns a wharf with a 300-foot frontage which is open to the public. One privately owned cannery wharf with a 300-foot frontage is used for unloading fish and handling fish nets. One privately owned boatyard has floats and moorage facilities for use by a maximum of 80 small boats. The small-boat

basin has facilities for numerous fishing and recreation craft. A privately owned lumber mill has a barge loading facility for chips and lumber. Facilities are considered adequate for existing commerce. Waterborne traffic through the channel totaled 58,000 tons in 1999. The average annual traffic for the five-year period 1995-1999 was 58,600 tons.

Multnomah Channel

Multnomah Channel, a 21-mile-long side channel of the Willamette River, connects the Willamette with the Columbia River. Sauvie Island lies between Multnomah Channel and the Columbia. The project provides for two 25-foot-deep ship channels and for removal of sunken logs throughout the waterway. The lower channel, 300 feet wide, extends 5,000 feet upstream from the Columbia River at St. Helens. The upper channel, 250 feet wide, extends 9,500 feet downstream from the Willamette River. Total costs through September 1999 were 437,700, all of which were for construction. Waterborne traffic through the channel in 1999 was 1,203,000 tons; average annual traffic for the five-year period 1995-1999 was 1,429,400 tons.

Oregon Slough

Oregon Slough is a side channel of the Columbia River in the North Portland-Vancouver area. The slough is parallel to and about one-half mile south of the Columbia River channel.

The project provides a 40-foot-deep by 400-foot-wide channel from the Columbia River to Oregon Slough (river mile 1.5) and a 20-foot-deep, 200-foot-wide channel from that point to Oregon Slough (river mile 3.8). The project was completed in 1913. Total federal costs through September 1999 were $107,400— $16,900 for construction and $90,500 for maintenance. Waterborne traffic through the channel in 1999 was 3,717,000 tons. Average annual traffic for the period 1995-1999 was 3,389,600 tons.

A study to investigate the feasibility of providing a larger channel was completed in 1973. The study recommended increased channel dimensions to accommodate deep-draft vessels. Authorized by Congress in July 1976, the project was completed by local interests and no federal maintenance has yet been required.

Columbia River, Vancouver Deep Draft Anchorage, Washington

The deep draft anchorage is located on the Oregon side of the existing federally authorized 40-foot Columbia River channel, near Vancouver, Washington, between river miles 102 and 103. It includes the U.S. Coast Guard designed anchorage area near Hayden Island.

Safe anchoring in the Columbia River is dependent upon a combination of several factors: water and wind currents, tides, vessel size (overall length, draft, and cargo volume), and the level of congestion in the anchoring area. The procedure being used was for the Columbia River pilots to decide where to anchor a vessel. At the recommendation of the pilots, the vessel either dropped one or two bow anchors. At the onset of anchoring, the vessel would be outside of the boundary of the 40-foot navigation channel. As wind conditions changed, the probability of a vessel tending to swing on its anchor increased. This then created a hazardous

condition for vessels navigating the main channel as they attempted to maneuver around anchored vessels that were partially in the channel.

Work was authorized under special continuing authority contained in Section 107 of the Rivers and Harbors Act of 1960, as amended, for navigation purposes. The project consists of two anchorage areas in the Columbia River by placement of two stern anchor buoys, one at each location. The downstream buoy, placed in the river 300 feet off the existing channel, is designated as a deep site for loaded or fully laden vessels. A second buoy, which is designated for light laden vessels or empty vessels, is placed 725 feet off the existing channel. The Ports of Portland and Vancouver signed Project Cooperation Agreements on January 3, 1994. The cost for preparation of the plans and specifications and for the construction of the project was $376,791, of which $282,593 was federal and $94,198 was non-federal. The non-federal sponsors, Port of Portland and Port of Vancouver, provided $53,698 and $40,500, respectively. The contract for construction of the project was awarded in August 1994 and completed in September 1994.

Continuing Authority Projects

South Channel at Government Island

A small boat recreation channel, South Channel at Government Island was constructed in fiscal year 1985 at a federal cost of $119,800.

Fox Creek Stream Restoration

Fox Creek is located at Rainier at river mile 67 across the Columbia River from Longview, Washington. From its mouth at the Columbia for approximately 650 feet upstream, Fox Creek was encased in a 72-inch corrugated metal pipe during a 1985 operation and maintenance dredging action and then buried by dredged material. Upstream access for anadromous fish including winter steelhead and coho salmon is effectively precluded except when creek flows are high. Erosion along the Columbia River shoreline at the mouth of Fox Creek has begun to destroy the outer segments of the pipe, making fish access even more difficult.

The local community has requested Corps assistance in restoring Fox Creek habitats and fish runs. A study conducted under Section 1135(b) of the Water Resources Development Act of 1986 recommends removal of the pipe and restoration of Fox Creek to a natural streambed, as well as placement of riparian plantings. Originally scheduled for construction in October 1997, the project is being reevaluated in light of other infrastructure improvements in the area being contemplated by the City of Rainier.

Multnomah Channel Improvements

Channel improvements in Multnomah Channel and Scappoose Bay requested by the Port of St. Helens were constructed under provisions of Section 107 of the 1960 Rivers and Harbors Act.

Improvements include a 2,950-foot channel extension at the downstream end of Multnomah Channel and a 7,080-foot channel branching from the new extension into Scappoose Bay. Both new channels are 10 feet deep. The work was accomplished in fiscal year 1984 at a total federal cost of $419,600.

Trestle Bay Restoration

A 500-foot section of the Columbia River south jetty at river mile seven was lowered under Section 1135(b) of the Water Resources Development Act of 1986. This modification, which lowers the section to -5.6 mean sea level, allows fisheries resources access to 603 acres of intertidal habitat and increases nutrient availability for support populations of estuarine, marine, and anadromous fish stocks. It benefits an estimated 27 additional fish species previously not utilizing Trestle Bay, including chinook and sockeye salmon stocks which are federally listed as endangered species.

Construction was completed in September 1995, and post-construction monitoring continued through 1998. Total cost for this modification, including all design and construction, is $237,600, of which $178,200 is federal and $59,400 is non-federal. The project sponsor is the Oregon Parks and Recreation Department.

Westport, Oregon— Puget Island (Wahkiakum Ferry), Washington

The Wahkiakum Ferry route extends across the Columbia River at approximately river mile 43, between Westport, Oregon, and Puget Island, Washington. The project consists of a channel extending 1,900 feet from the Wahkiakum Ferry ramp at Puget Island to the existing federally authorized Columbia River Navigation Channel. This channel is nine feet deep (Columbia River Datum), 200 feet wide, and 900 feet long. The remaining length of the channel (1,000 feet) is naturally deep and extends to the Columbia River Navigation Channel. Operation and maintenance dredging is authorized for the full 1,900 feet.

Work was authorized under continuing authority contained in Section 107 of the Rivers and Harbors Act of 1960, as amended, for navigation purposes. This project established a federal channel to ensure safe and efficient operations associated with the existing Wahkiakum ferry. The cost for preparation of the plans and specifications and the construction of the project was $215,853 , of which $194,268 was federal and $21,585 cash was non-federal. Wahkiakum County, Washington, is the non-federal sponsor. The contract for the construction of the project was awarded on December 23, 1993, and completed on February 18, 1994.

Current and Recent Studies

Columbia River Channel Improvements

The seven ports on the lower Columbia River requested a study to evaluate the feasibility of deepening the existing channel that runs from the Pacific Ocean to Portland from its current depth of 40 feet to a possible maximum of 43 feet. The ports are Astoria, St. Helens, and Portland in Oregon and Longview, Kalama, Woodland, and Vancouver in Washington. The deeper channel would accommodate larger and more efficient vessels and reduce vessel delays that currently occur when ships must schedule their movements to coincide with high tides. The five-year feasibility study was initiated in 1994 and is expected to be completed in fiscal year 2000.

The project plan consists of deepening a segment of the Columbia and Willamette Rivers by three feet to 43 feet. The project begins at the mouth of the Columbia River and extends upstream to the vicinity of the Port of Vancouver, Washington (approximately river mile 105) and also includes the Lower Willamette River from its confluence with the Columbia River (river mile 101.5) upstream to the vicinity of downtown Portland (approxi-

mately river mile 11). Project cost-sharing will include requirements for non-federal interests to pay 25 percent of the project cost during construction and an additional 10 percent to be repaid over a period not exceeding 30 years. Cost of construction is estimated at $196 million.

In fiscal year 1996, effort focused on environmental, engineering, and economic concerns. Project representatives began fish and benthic sampling (relating to nutrients found on the ocean bottom and channel) and drafted two Environmental Impact Statements: one on the project itself and another dealing with dredged material management. Engineers used global positioning equipment to determine where ships actually travel in the channel, and economists developed commodity and fleet projections to calculate potential benefits of the project.

In 1999, the Final Integrated Feasibility Report for Channel Improvements and Environmental Impact Statement: Columbia and Lower Willamette River Federal Navigation Channel was released for public comment. The Chief of Engineers' Report was scheduled to be forwarded to Congress in fiscal year 2000 to request funding.

Peninsula Drainage District No. 1

Peninsula Drainage District No. 1 is located within the City of Portland in Multnomah County, along the Columbia River between river miles 105.6 and 106.5. The drainage district's flood-protective works did not provide dependable protection from major flood events of the Columbia River. The City of Portland Parks and Recreation Department requested Corps assistance in providing improvements to the existing flood protection system of Peninsula Drainage District No. 1 under Section 205 of the Flood Control Act of 1948, as amended.

A feasibility study was completed in September 1996. The study recommends a 100-year level of protection by reinforcing sections of the existing levee and modifying the existing pumping plant outlet pipe.

The project consisted of reinforcing the flood protective system in order to protect against the 100-year reoccurrence frequency flood event. This will be accomplished by reinforcing 2,000 feet of the landward side of the railroad embankment at the southwest corner of the drainage district and raising the outlet pipes of the pumping station to above-designed flood level of 28.7 feet. The railroad embankment will be reinforced by constructing a sand embankment structure against the landward slope of the railroad embankment having a 12-foot wide crown and one vertical to five horizontal side slopes. The catch point along a portion of this fill is in a golf course water hazard and the embankment will cover existing golf course tees. As a consequence, a 200-linear foot gabion retaining wall will confine the fill and allow construction of a flat bench so the tees can be re-established. The height of the retaining wall will vary from two to nine feet. Estimated cost for preparation of plans and specifications and construction of the project is $1,484,000 of which $1,113,000 is federal and $371,000 is non-federal. Construction was completed in September 1998. In 1999, safety issues were addressed by adding a boat barrier to preclude access to the outlet.

Brookfield-Welch Island reach

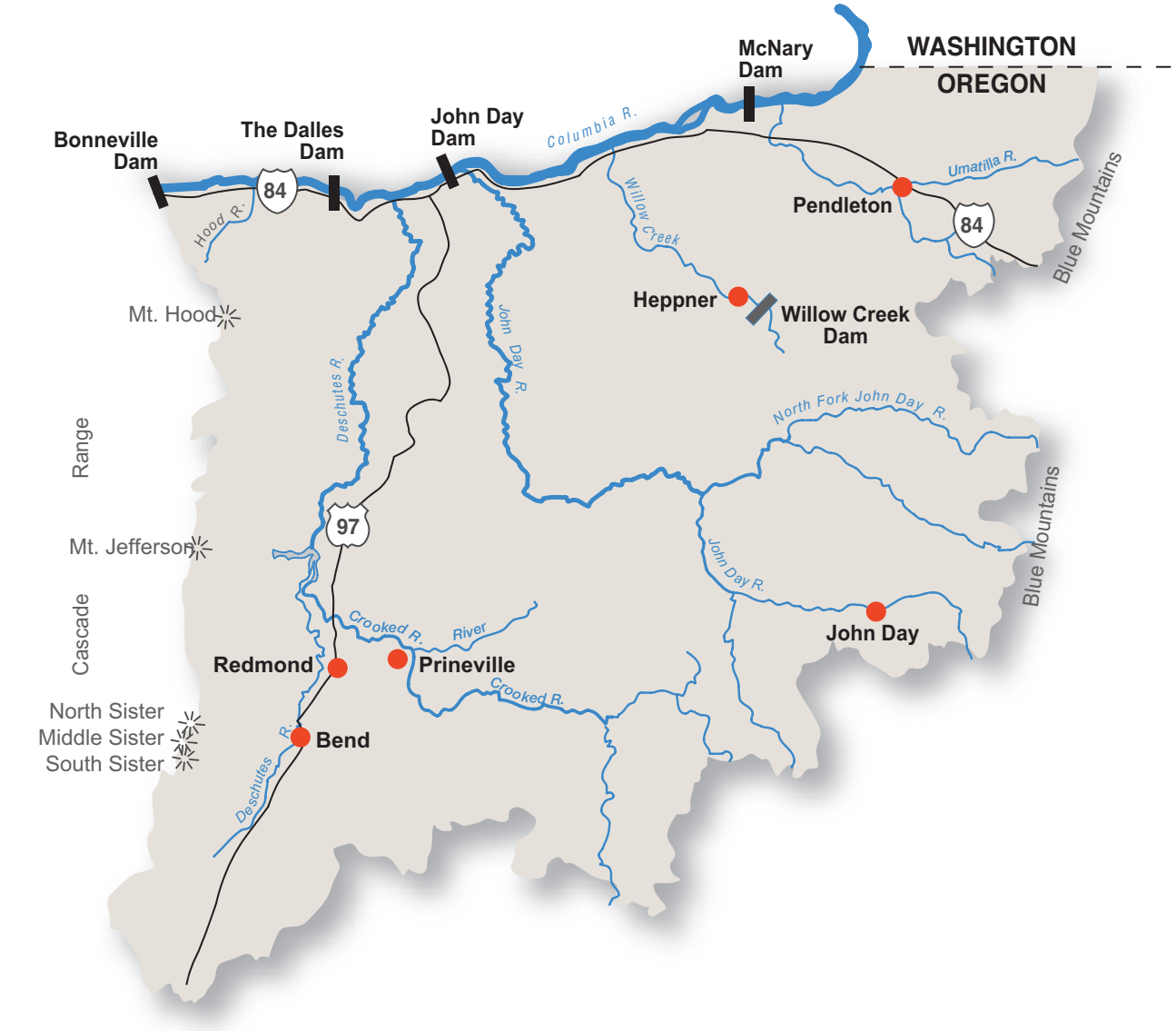
Ship simulation models of te Brookfield-Welch Island reach in the Columbia River began in 1997 to determine whether conditions warranted changes to improve navigability for ships transiting through two turns in the channel at this location. The budget authorized $400,000 for ship simulation to study the conditions; $2 million is allocated to correct the turns if warranted. After inconclusive results, a second series of model runs and alternatives were conducted in fiscal year 1999..

Columbia Slough Ecological Study

The 1998 budget allocated $150,000 to study potential restoration of the Columbia Slough ecosystem. The study will evaluate potential improvements to include flow management options and habitat restoration in the columbia Slough corridor. The first phase of the plan will include completion of an addendum to the existing reconnaissance report, preparation of a project study plan, negotiation of a feasibility cost-sharing agreement to reflect 50 percent federal and 50 percent local sponsor participation, and initiation of the feasibility study. The City of Portland, Bureau of Environmental Services is the local sponsor. A Feasiility Cost Sharing Agreement for $1,023,000 was signed in 1998 with the City of Portland to split costs equally between the two agencies.

For fiscal year 1999-2000, $275,000 in federal funds were appropriated for study of modification of culverts, channels and habitat in Buffalo slough and Whitaker Slough, habitat restoration near MCDD Pump Station #4, and water transfer between the Columbia River and upper Columbia Slough by construction of a gated structure through the main flood control levee near MCDD Pump Station #4. Early study indicated that the gated structure through the main flood control levee would not prove feasible, due to a very limited environmental restoration improvements and to costs and maintenance issues for fish screens at the culverts. Other restoration alternatives were then considered in the feasibility study, including construction of wetland benches along the main Columbia Slough, and numerous riparian restoration sites near the slough corridor.

Middle Columbia River Basin



Middle Columbia River Basin

The Middle Columbia Basin includes the 160-mile stretch of the Columbia River from Bonneville Dam to Lake Wallula behind McNary Dam, and the Oregon river basins tributary to this stretch of the Columbia. All of the basin is in the Corps' Portland District, except for the extreme northeast portion which is in the Walla Walla District.

The Middle Columbia Basin in Oregon has an area of 24,100 square miles. Important Oregon tributaries of the Columbia include the Umatilla, John Day, Deschutes, and Hood rivers. The headwaters of the Walla Walla River, which enters the Columbia in Washington, are in Oregon in the northeast corner of the Middle Columbia Basin. Where the Columbia enters the basin, its average flow is about 185,200 cubic feet per second (cfs). At Bonneville Dam, where it leaves the basin, its average flow is about 198,000 cfs.

In most of the Columbia Basin, the climate and vegetation are typical of a semi-arid region. At the extreme western edge, along the Cascade Range and in the Columbia River Gorge, there are evergreen forests and a rainy climate. The Blue Mountains in the headwaters of the John Day, Umatilla, and Walla Walla rivers are also forested, but receive less rainfall than the Cascade Range at similar elevations.

The Middle Columbia Basin has mile after mile of open country, with population centers widely scattered. The only Oregon cities in the basin over 10,000 population are Pendleton, Bend, and The Dalles.

Four large dams on the Columbia River and one on Willow Creek at Heppner have been constructed and are operated by the Corps of Engineers. Bonneville, The Dalles, John Day, and McNary dams generate power and provide slack water and lockage for river navigation. In addition, John Day Dam provides about a half-million acre-feet of storage space for control of Columbia River floods. Also constructed as part of the reservoir projects were levees to protect adjacent lands from overflow and shoreline revetments to protect against wave damage.

McNary Dam is operated by the Walla Walla District, and Bonneville, The Dalles, John Day, and Willow Creek by the Portland District.

Multipurpose Development

Existing Projects

Bonneville Lock and Dam (Lake Bonneville)

Bonneville Dam, the first dam built by the Corps of Engineers on the Columbia River, is at the limit of tidal influence about 145 miles upstream from the mouth of the river and 40 miles east of Portland. The authorized primary project purposes are navigation and power generation. The project includes a spillway, two powerhouses, a navigation lock, fish-passage facilities, and visitor centers. The navigation lock and powerhouses are founded on andesite, whereas the main dam rests on

a solidified sedimentary rock of volcanic origin. The lake created by the dam provides a navigable channel 27 feet deep between Bonneville and The Dalles dams, a distance of 47 river miles.

Navigation. The original lock at Bonneville Dam was the smallest of eight locks on the Columbia-Snake Inland Waterway. Completed in January 1938, it was the first of eight locks constructed on the waterway. The original single-lift navigation lock was 76 feet wide, 500 feet long, had a water depth over the sill of 24 feet and a 66-foot maximum lift. To pass through the original lock at Bonneville, tows with three or more standard-sized barges (42 feet by 220 feet) had to be separated and passed through the locks in smaller units, then recombined to continue on their way. This resulted in a transit time at Bonneville which was two or three times greater than transit times at the larger upstream locks. Bonneville, the farthest downstream of the eight-lock system, handled the largest volume of commercial tonnage of all the locks in the system. The capacity of the Bonneville original lock was estimated at 13 million tons per year. Congestion delays were increasing and the

waterway capacity was being constrained as the waterborne commerce through the lock neared its capacity.

Construction of a new navigation lock was authorized in the fiscal year 1985 Supplemental Appropriations Act, PL 99-88. In accordance with the Water Resources Development Act of 1986, the Inland Waterway Trust Fund shared 50 percent of the project cost. Relocation of the Union Pacific railroad, required prior to lock construction, was completed in 1987. Construction of a new navigation lock at Bonneville began in the summer of 1987 and opened to traffic in May 1993. The new lock is located south of the original lock on the Oregon shore.

The new navigation lock at Bonneville is 86 feet wide and 675 feet long, with a water depth over the sill of 19 feet, corresponding to the seven locks upriver. Construction of the new lock with a capacity of 30 million tons per year was needed to reduce delays for commercial navigation at Bonneville and to improve hazardous conditions at the lock approaches. The navigation lock was completed in 1993 at an estimated cost of $348.1 million. Waterborne commerce through the lock in 1999 was 9,218,000 tons.

Power Generation. Construction was started in 1933 and operation of the first powerhouse at Bonneville began in 1938. During World War II, the first powerhouse was enlarged and additional generators were installed. Construction for the second powerhouse started in 1974 on the Washington side of the Columbia River at the former site of the town of North Bonneville, which had been relocated approximately 1.5 miles downstream.

Construction of a new townsite and municipal facilities for North Bonneville was essentially complete in October 1977. Corps and town officials exchanged deeds in March 1978, giving the town possession of municipal facilities and utilities in the new town. Plans call for additional federal land to be turned over for industrial purposes, including parcels in and around North Bonneville and about 60 acres on Hamilton Island. Other work completed in the early stages of the powerhouse project included relocation of about four miles of Washington Highway 14 and three

miles of the Burlington Northern railroad.

Modifications to allow use of Lake Bonneville to smooth out water released from upstream power plants during the production of peaking power were completed in 1978. The total cost of modifications for peaking— including structural changes and fish facility modifications— was $27,195,000.

While powerhouse construction was in progress, a significant archeological site was excavated in an area now in the middle of the new river channel downstream of the second powerhouse. This was the only known, relatively undisturbed site along the lower Columbia River with evidence of a sequence of occupation from prehistoric through historic times. The archeological site, which is identified by the Native Americans as "Clah-Cleh-Lah" in the Sahaptian language, was assigned a Smithsonian number, 45SA11. The site was first noted in the journals of explorers Lewis and Clark and has been listed as a contributing property to the North Bonneville Archaeological District on the National Register of Historic Places. Evidence at the site spans about 500 years, from the time of Native American occupation to the early European settlements in the mid-1800s. Excavation and analysis of the archeological site was completed in the summer of 1979 at a cost of $1.2 million. The collection has been accessioned and curated with the Yakama Nation Cultural Heritage Center Museum. It is currently used for scientific research and public information and education.

Other contributing properties within the North Bonneville Archaeological District include 45SA5, or the Caples site, a pit house village and midden site which predates the 45SA11 property. At least seven other historic and prehistoric sites are included within the North Bonneville Archeological District, and these range from pioneer-military historic properties to small, prehistoric task/fishing sites.

Project lands two miles downstream, covered by material excavated for the powerhouse construction, have been restored for public use. Development of a recreation facility essentially completed at Home Valley, 10 miles upstream, is being cost-shared with Skamania County.

The second powerhouse adds 560,000 kilowatts of generating capacity with eight main units, slightly more than doubling the project's previous capacity. Power from the second powerhouse came on line in May 1981 and power from all eight units was on line by October 1982. The second powerhouse, essentially completed in 1983, joins Cascades Island and the Washington shore. The second powerhouse was dedicated June 1, 1983, with Senator Henry M. Jackson of Washington and Senator Mark O. Hatfield of Oregon as principal speakers.

The two powerhouses have a total generating capacity of 1,145,700 kilowatts, with 18 main generating units and three smaller auxiliary units. During fiscal 1999, 5,946,491,000 kilowatt-hours of electrical power energy were generated of which 5,918,077,000 were delivered to the Bonneville Power Administration. Since the project began operating in 1938, revenues of $671 million from the sale of electricity have been deposited in the U.S. Treasury.

In 1997, a contract for restoration work on Hamilton Island was awarded and completed. Other maintenance included the rewedge of Unit 11; purchase of Powerhouse I exciters; navigation lock gate retensioning; and dredging of the forebay. Approximately 75,000 cubic yards of sediment and woody debris carried downstream by unusually high flows over the last couple of years had collected at the face of the dam near the project's second powerhouse and prevented the adult fish passage facility from working as effectively as possible. During the summer of 1997, pressure build up from the debris caused a number of gratings in the second powerhouse fish ladder to dislodge, exposing openings to the dam's auxiliary water supply. The forebay was dredged and the gratings repaired and replaced.

As authorized by the Water Resources Development Act of 1996, about 81 acres of property was transferred in the 1998 fiscal year to North Bonneville. That same year, Unit 15 stator winding and rewedge repairs were initiated along with retensioning of the navigation lock gate. In 1999, similar maintenance was conducted for Unit 16.

Through September 1999, the total cost of the Bonneville project was $1,520,767,900, of which $1,205,145,600 was for construction and $315,622,360 was for operation and maintenance. Scheduled completion for the entire project, including landscaping, visitor facilities, and modifications of the bypass facility for juvenile fish, is 1996.

Beginning in 1999, the routine operation, maintenance and minor repair costs at Corps-owned and Corps-operated hydropower projects including Bonneville were funded directly by the Bonneville Power Administration.

Bonneville Major Rehabilitation. Work began on the rehabilitation of the first powerhouse in June 1993. Phase I work included replacement of circuit breakers and transformers; rehabilitation of the governor oil

tanks; rehabilitation of the project's switchyard; and replacement of all main unit transformers. Plans were made to install hubs and blades which will improve fish survival, based on results of testing of fish-friendly turbine blades. Phase I work was completed in 1997 at a cost of $24,120,000.

Phase II work was contracted in 1994 and is scheduled to be completed in 2009. Phase II work consists of replacing the windings of five generators and replacing turbine units one through 10 in the first powerhouse. Phase II will cost an estimated $104,600,000.

Fish Bypass. Fish-passage facilities at the project include adult fish collection systems at the downstream sides of each powerhouse, three fish ladders (one on Bradford Island, a second on Cascades Island, and a third on the Washington shore), fish locks on the Oregon shore side of the first powerhouse, and a bypass system at each powerhouse for downstream passage of fingerlings.

At Bonneville Lock and Dam, work during fiscal year 1996 included continued design of fish monitoring facilities using funds provided by the Bonneville Power Administration. Other plans call for construction of a 9,000-foot-long transportation flume extending from the second powerhouse and two outfall structures for above-water releases. All construction will be in Washington; a major portion of the flume will be underground. The existing system at the second powerhouse includes submersible vertical traveling screens to guide juvenile salmon away from the turbines and into a conduit which takes the fish through the dam and returns them to the river below. Those areas support populations of predatory fish. The improvements will release the fingerlings into deeper, faster-moving water where predators are less likely to congregate.

In 1997, a contract was awarded for construction of a surface bypass prototype for the first powerhouse. In 1998, construction on a surface bypass for the second powerhouse continued; a contract was awarded for construction of bypass improvements inside the powerhouse, a transportation flume to the new outfall and juvenile fish monitoring facility; biological analysis was performed of a surface collection prototype system; and extended lengthy screens at the first powerhouse.

In 1999, activities included continued construction of a new juvenile bypass outfall for the second powerhouse, construction of bypass improvements inside the powerhouse, a transportation flume to the new outfall, and continued construction of the juvenile fish monitoring facility. An evaluation was initiated of improvements for fish guidance efficiency at Bonneville second powerhouse, and a biological analysis was performed of the surface collection prototype system at the first powerhouse. The Bradford Island and Washington shore ladders have facilities where visitors can watch salmon and other fish migrating upstream. The salmon hatchery near the Oregon

entrance provides partial mitigation for the loss of fall chinook caused by construction of the John Day Dam.

Hatchery. The Bonneville Hatchery on Tanner Creek is one of the oldest hatcheries in Oregon. The hatchery was built by the Corps of Engineers and is operated by the Oregon Department of Fish and Wildlife. A major expansion was completed in 1976 and provides for doubling the previous annual production of eight million salmon fingerlings. Operation

of the hatchery is funded by the Corps of Engineers, Oregon Department of Fish and Wildlife, and National Marine Fisheries Service.

Recreation. Bonneville Lock and Dam and Lake Bonneville are in the Columbia River Gorge, one of the most scenic areas in the Pacific Northwest. The walls of the gorge rise 2,000 feet above Lake Bonneville in many places and can be seen from any of the 10 recreation areas around the reservoir, including the Bradford Island Visitor Center at the dam, Eagle Creek Campground (U.S. Forest Service), Cascade Locks Park (Port of Cascade Locks), Koberg Beach, Memaloose and Mayer state parks, boat basins at Hood River and The Dalles, and two other areas. In 1999, about 3,098,200 recreation visits were made to Bonneville project areas.

Columbia River Treaty Fishing Access Sites, Washington and Oregon. Through treaties signed in the 1850s, Indian tribes in the Pacific Northwest reserved the right to access and fish at usual and accustomed fishing stations along the Columbia River. In the mid-1930s, fishing sites were submerged or destroyed during the construction of Bonneville Dam. In response to this, the United States entered into an agreement with Northwest

Tribes. The Secretary of the Army was authorized to acquire lands and provide facilities in Oregon and Washington to replace Indian fishing grounds along the Columbia River "in-lieu" of those sites inundated by the Bonneville Dam. The Rivers and Harbors Act of 1945 provided authority and funding to implement the agreement. The Corps purchased and improved five sites totaling 40 acres. Construction began in 1952. By 1963, Indian fishing ground campsites had been completed at Big White Salmon, Little White Salmon, and Wind River in Washington; and Lone Pine and Cascade Locks in Oregon. Several years later, additional improvements were completed at all sites except one in Oregon. In 1974, modifications were completed to protect the Indian fishing sites from Lake Bonneville pool fluctuations due to peaking power production.

In 1988, Congress authorized the improvement and transfer of additional lands in order to provide equitable satisfaction of the United States' commitment to compensate for fishing site losses that occurred because of the construction of Bonneville Dam. Congress authorized through PL 100-581 the implementation of a wide range of land management, transfer, acquisition, and development actions required to improve fishing access. Improvements will include all-weather access roads, camping facilities, boat ramps, docks, sanitation, and fish-cleaning facilities.

In 1996, Congress authorized adjustments in site boundaries. The boundary changes will minimize impacts to public facilities and the environment, and reduce site development costs. Construction in 1996 included a new site in the Bonneville area and rehabilitation of three in-lieu sites: Cascade Locks and Lone Pine in Oregon, and Underwood in Washington. Two additional sites were acquired from willing sellers in Lyle, Washington, and Stanley Rock, Oregon. A subdivision that would have blocked access to Lyle Point was challenged in court by Indian groups, but access was restored when the Corps purchased two lots to be used as a support area for the in-lieu fishing site.

All 31 sites of the $67 million project are scheduled to be completed by the year 2000. As sites are completed, they are turned over to the Department of the Interior, Bureau of Indian Affairs. They will provide fishing access along the Columbia River for Indian tribes who exercise treaty fishing rights. Construction and rehabilitation of these facilities will greatly improve access to the Columbia River in Zone 6, an area comprised of Bonneville, The Dalles, and John Day pools. This area is most heavily used for treaty fishing by four Pacific Northwest Indian Tribes: the Nez Perce Tribe, the Confederated Tribes of the Umatilla Indian Reservation, the Confederated Tribes of the Warm Springs Reservation of Oregon, and the Confederated Tribes and Bands of the Yakama Indian Nation.

By the end of the 1999 fiscal year, 16 sites had been completed. Land acquisition, plans and specifications, and construction for Phase Two continues.

The Dalles Lock and Dam (Lake Celilo)

The Dalles Dam is at the head of Lake Bonneville, 192 miles upstream from the mouth of the Columbia River and two miles east of the city of The Dalles. Construction began in 1952, and the project began operating five years later. The authorized primary project purposes are navigation and power generation. The project consists of a navigation lock, spillway, powerhouse, fish-passage facilities, and the nonoverflow sections of the dam. Various recreational facilities are provided along Lake Celilo, the 24-mile-long impoundment.

Navigation. When Lake Celilo was first filled, it inundated Celilo Falls, an ancient and modern Indian fishing ground, as well as The Dalles-Celilo Canal, which had been used since 1915 to move river traffic

past the tumultuous rapids in that reach of the Columbia. Now the lake provides slack-water navigation at a minimum depth of 15 feet in the main channel. The project's navigation lock, on the Washington shore, is 86 feet wide and 675 feet long. It has an 88-foot normal lift and provides a 15-foot minimum depth over the sills. Waterborne traffic through the lock in 1999 was 8,670,000 tons.

Power Generation. The powerhouse, with 1,807,000 kilowatts of installed generating capacity, has 22 main generators— 14 original units rated at 78,000 kilowatts and eight newer units rated at 86,000 kilowatts— and two auxiliary units of 13,500 kilowatts each. The auxiliary units also provide water to attract adult migrating fish to the fish ladders. All eight new units were generating power by the end of 1973. During 1996, the 22-unit powerplant generated 7.4 billion kilowatt-hours.

Through September 1999, the total cost of the project with 22 generators was $528,608,000— $303,260,300 for construction; $11,780,531 for rehabilitation; and $213,567,179 for operation and maintenance. In 1999, 7,898,934,000 kilowatt-hours of electrical power energy were generated of which 7,881,453,000 kilowatt-hours were delivered to the Bonneville Power Administration. Through September 1999, power generation totaled 299.6 billion kilowatt-hours. Of the gross income from sale of this power by Bonneville Power Administration, $427.4 million was reimbursed to the U.S. Treasury to recover Corps of Engineers project investment and operating costs.

Rehabilitation. A study conducted under the Major Rehabilitation program was approved in 1995 to replace blades on 12 of the initial 14 turbine units and refurbish blades on the remaining two units. All of the original generator windings of units 1-14 will be replaced during rehabilitation. Total cost is estimated at $94 million; completion is expected in 2008. In 1998, the rewind of Unit 11 was completed, rewinding of Unit 2 begun and work begun on the bridge cranes. In 1999, two more generator rewindings began, along with design work for rewinding the remaining generators.

Fish Bypass. Facilities to move fish past the dam include two fish ladders, powerhouse collection systems and transportation channel, and the lock. Each ladder is about one-third mile long. Visitors can observe migrating fish at both ladders. As part of the Columbia River Fish Mitigation Program, work continues on design of the juvenile bypass system and testing of the prototype submerged extended fish screen. Studies of sluiceway and spillway juvenile fish survival continued, along with development of future bypass system alternatives, and continued design work for relocation of the sluiceway outfall and for provision of emergency auxiliary water for adult fishways.

Recreation. Facilities have been developed in a number of recreation areas, both in the immediate vicinity of the dam and upstream along the river. Seufert Visitors Center was completed and open to the public in fall of 1980. Seufert Park on the Oregon shore, operated by the Corps of Engineers, has a good view of the downstream side of the dam. A small project tourist train stops at Seufert Park. Visitors are given a guided tour of the powerhouse and dam and may stop at points

of interest along the way.

Celilo Park on Lake Celilo, also operated by the Corps, has facilities for picnicking, fishing, swimming, and boat launching. The park, which is near the site of the former Indian fishing grounds at Celilo Falls, is directly accessible from Interstate 84 about 12 miles east of The Dalles. Deschutes State Park, located on the eastern shore of the Deschutes River arm of Lake Celilo, was developed by the state of Oregon and has both day-use and camping areas. Boat launching and fishing are available at Heritage Landing on the west shore of the Deschutes River, also run by the state of Oregon. Five areas on the Washington shore of Lake Celilo also have been developed— Hess, Spearfish, and Avery parks, managed by the Corps of Engineers; and Maryhill and Horsethief parks, operated by Washington State Parks Department. About 981,500 recreation visits were made to The Dalles project areas in 1999.

John Day Lock and Dam (Lake Umatilla)

John Day Dam is located at the head of Lake Celilo, 216 miles upstream from the mouth of the Columbia River and 24 miles upstream from The Dalles. The authorized primary project purposes are flood control, navigation, and power generation. The project consists of a navigation lock, spillway, powerhouse, nonoverflow sections, and fish-passage facilities on both shores. Construction began in 1958; the first power generator went into operation in 1968. Lake Umatilla, impounded by the dam, extends upstream about 76 miles to the foot of McNary Dam.

Navigation. Lake Umatilla provides slack water for navigation, with a minimum 15-foot depth in the main channel. The navigation lock, located on the Washington shore, is 86 feet wide, 669 feet long, and provides 15 feet of water depth over the sills. With a 113-foot maximum lift, it is one of the highest single-lift locks in the world. Lock traffic in 1999 was 8,259,000 tons.

Flood Control. Unlike the other dams on the Middle Columbia River, John Day Dam is also operated for flood control. When high runoff is forecast, the Lake Umatilla pool is lowered to provide space for control of about 500,000 acre-feet of floodwaters. Through September 1999, the project had prevented almost $13.4 million in flood damages.

Power Generation. The powerhouse, with 16 main generators of 135,000 kilowatt capacity each, has a total generating capacity of 2,160,000 kilowatts. The last of the 16 generators went on line in November 1971. Skeleton units to accommodate four additional generators have already been constructed in the powerhouse, providing for an eventual total capacity of 2,700,000 kilowatts. Through September 1999, power generation totaled 326.5 billion kilowatt-hours. Of the gross income from sale of this power by Bonneville Power Administration, $465.8 million was reimbursed to the U.S. Treasury to recover Corps of Engineers project investment and operating costs. In 1999, the project generated 11,727,274,000 kilowatt-hours of electrical power of which 11,707,647,000 kilowatt-hours were delivered to the Bonneville Power Administration.

The total construction cost for the project through September 1999 was $789,515,463— $512,400,426 for construction; $44,005,128 for major rehabilitation; and $233,110,089 for operation and maintenance.

Rehabilitation. The final major contract for rewinding of five generators was completed in 1999, and construction and implementation of the data acquisition control system continued.

Fish Bypass. Fish-passage facilities are provided on both the Oregon and Washington shores. On the Oregon side of the project, an underwater fish viewing room is provided where visitors can see migrating fish pass at eye level and displays identifying species. Visitors can take a self-guided tour through the powerhouse. Modifications to the downstream fish bypass facilities utilize screens to intercept fingerlings entering the turbine intakes and transport them downstream.

As part of the Columbia River Juvenile Fish

Mitigation Program, contracts were awarded in 1996 for a new fish passage system and flow deflectors. The fish passage system will include a 1,200-foot-long, five-foot-wide, 20-foot-deep chute extending along the Oregon shore from the powerhouse to the dewatering building. From the dewatering building, the young fish will travel through a three-foot-diameter flume to the sampling and monitoring building. After being monitored, the fish will be returned to the river downstream of the power-

house. The project, originally scheduled for completion in 1997, will be delayed for a year due to construction problems. Changes in construction requirements will increase the cost of the project by about $3 million to an estimated $24 million. Work was completed on a new juvenile fish monitoring facility in 1998, and spillway flow detectors were constructed in bays 2 through 19.

Juvenile fish also pass through John Day Dam through the spillway. Spilled water often becomes supersaturated with gas, which can cause fish to develop a condition similar to the bends in human divers. Flow deflectors, also called "flip lips," will be attached to the downstream face of the spillway, keeping spill water from plunging as deeply beneath the river's surface and reducing gas supersaturation.

Planning and design for the potential drawdown of the reservoir to minimum operating pool continues. Phase I of the John Day drawdown study was initiated, and testing continued of extended length (40 foot) bypass screens for potential replacement of existing 20-foot screens associated with the existing juvenile bypass system.

Hatchery. Spring Creek Hatchery on the Washington shore of the Bonneville pool provides partial mitigation for loss of fall chinook caused by construction of John Day Dam. It is operated by the U.S. Fish and Wildlife Service. The balance of mitigation is provided by the Bonneville Hatchery, operated by the Oregon Department of Fish and Wildlife.

Recreation. In addition to the two visitor areas at John Day Dam, recreation is available at more than a dozen areas along Lake Umatilla. Most of the areas are managed by the Corps of Engineers, but include parks operated by local entities at Arlington, Boardman, Umatilla, and Irrigon in Oregon. Boardman Park, about 65 miles upstream from John Day Dam, and LePage Park on the John Day River arm of Lake Umatilla just above the dam, have swimming, picnicking, and camping facilities. Philippi Park, further up the John Day arm, is a Corps-operated campground accessible only by boat. Recreation facilities for boating and camping are also available at Cliffs Park, Giles French Park, Quesnel Park, and Rock Creek Park. Day-use recreation areas at Railroad Island, Roosevelt Park, and Sundale Park have boat access ramps and picnic sites. About 1,890,900 recreation visits were made to John Day project areas in 1999.

McNary Lock and Dam (Lake Wallula)

McNary Dam is about 292 miles upstream from the mouth of the Columbia River and three miles east of the town of Umatilla. The authorized primary project purposes are navigation and power generation, but it also provides for irrigation and other incidental uses. The project includes a navigation lock, powerhouse, gate-controlled spillway, abutment sections, and fish-passage facilities.

Construction began in 1947 and was substantially completed in 1953, when the navigation lock and the

first power unit were put into service. The last power unit went on line in 1956.

Navigation. The single-lift navigation lock is 675 feet long and 86 feet wide, has a 82-foot maximum lift and provides a minimum water depth over the sills of 15 feet. Lake Wallula, behind the dam, is 64 miles long. It provides slack-water navigation upstream to the ports of Walla Walla, Pasco, and Kennewick; to the Richland area on the Columbia River; and to Ice Harbor Dam on the Snake River. In 1999, 6,727,000 tons of commerce passed through the navigation lock.

Power Generation. The powerhouse, with 14 units of 70,000 kilowatts each, has a generating capacity of 980,000 kilowatts. The plant generates over six billion kilowatt-hours of energy annually. A second powerhouse at McNary Dam was authorized for construction in the Water Resources Development Act of 1986 (PL 99-662) and deauthorized five years later in 1991. The federal cost of the McNary project through September 1999 was $360,103,408 for construction and $269,985,700 for operation and maintenance. The powerplant generated 6.6 billion kilowatt-hours of electricity.

Fish Bypass. There are two fish ladders, one on each shore. A powerhouse fish collection system is also provided. As part of the Columbia River Juvenile Fish Mitigation Program, the plan of improvement at McNary includes the following: submerged extended fish screens; gantry crane modifications; collection and bypass facilities; transport, holding, and loading facilities; gate raise modifications; and an extended screen rehabilitation facility. Construction is complete on the prototype extended fish screens and on the collection, bypass, holding, and loading facilities. The fish facility includes a public visitor center that opened in 1995.

Recreation. On the Oregon side of Lake Wallula, upstream from the McNary Dam, recreation areas include McNary Beach, Hatrock State Park, Warehouse Beach, and Sand Station.

Recreation areas on Lake Wallula include 19 sites offering day-use or picnicking, five campgrounds, 14

boat launching ramps, and nine swimming areas. The Pacific Salmon Visitor Information Center at McNary Lock and Dam, staffed by park rangers, provides a regional overview of Corps efforts in salmon recovery issues. More than 4,237,800 recreation visits were made to McNary Dam and recreation areas along Lake Wallula in 1996.

Flood Damage Reduction Projects

Three flood control projects have been completed in the Middle Columbia Basin. The Walla Walla River project, one of the existing projects, is under the jurisdiction of the Walla Walla District. The Umatilla River and Willow Creek projects are under Portland District's jurisdiction.

Existing Projects

Walla Walla River at Milton-Freewater

Levees were originally authorized for about seven miles along the Walla Walla River near Milton-Freewater by the Flood Control Act of 1941. Levees and revetments in the lower 5.3-mile reach from McCoy Bridge to the Milton powerplant were completed in 1952. After the floods in December 1964 and January 1965, those works required reconstruction which was completed in October 1967. Federal investment in the levees under various authorities has totaled $2,338,000. Costs to local interests have totaled $65,900. Clearing and channel improvement of the upper 1.7 miles under the original authorization have been postponed indefinitely pending renewal of interest by local sponsors.

Willow Creek Lake

The Willow Creek project was authorized by the Flood Control Act of 1965. The Willow Creek Dam is located immediately upstream from Heppner. It is a 160-foot-high, roller compacted, concrete structure with ancillary features which include a center uncontrolled spillway, outlet works, minor flow works, and diversion works. The reservoir has a gross storage capacity of 13,250 acre-feet. The project provides flood protection to the city of Heppner and downstream areas by controlling runoff from a drainage area of 96 square miles. In addition to flood control, the project serves the purposes of irrigation, fish and wildlife enhancement, and recreation.

Construction of the dam was completed in July 1983. Through September 1999, the total cost of the project was $44,662,550- $37,260,100 for construction and $7,402,450 for operation and maintenance.

Willow Creek Parks and Recreation District has leased recreation facilities at Willow Creek Lake. A courtesy handling dock was constructed by the recreation district utilizing Oregon State Marine Board funds. A playfield area below the dam has been leased to the city of Heppner. More than 46,400 recreation visits were made to Willow Creek Lake in 1996.

Umatilla River near Pendleton

Levees along the river through the city of Pendleton

and in the state hospital area were authorized by Congress in 1936 and constructed in 1938. The Flood Control Act of 1950 authorized raising, rehabilitating, and strengthening those levees in addition to building a new levee system in the Riverside area. Except for the Riverside area, that project was completed in 1960 and is now identified as Zone 1. No work has been accomplished in the Riverside area, and that portion of the project was deauthorized in 1986 (PL 99-662). Total federal costs in Zone 1 have been $393,000. A downstream extension of the levees was completed in 1960 under the provisions of Section 205 of the 1948 Flood Control Act, as amended.

Navigation Development

Current Study

Port of Morrow

The Port of Morrow is located on the Columbia River in the John Day pool near Boardman. Under the continuing authority of section 107, a feasibility study is underway to consider the need for a turning basin to improve vessel handling and operations.

Snake River Basin of Oregon

Snake River Basin of Oregon

The Snake River Basin of Oregon includes a 230-mile reach of the Snake River and all its Oregon tributaries. The Snake River rises in Yellowstone Park, Wyoming, follows a huge crescent across southern Idaho, turns north along Idaho's common boundary with Oregon and Washington to Lewiston, Idaho, and then flows west through Washington to its confluence with the Columbia River. In Oregon, the area drained by the Snake River is about 18,900 square miles, and the most important tributaries are the Owyhee, Malheur, Powder, and Grande Ronde rivers.

Although the hydrologic boundaries do not quite coincide with the county lines, the area drained by the Snake in Oregon is essentially Malheur, Baker, Union, and Wallowa counties. The population of those four counties is about 72,000 (1990 census). The principal communities are La Grande, Union, Elgin, Baker City, Enterprise, Joseph, Ontario, Nyssa, and Vale.

The basin has the semiarid climate characteristic of eastern Oregon. The lower areas are sagebrush-covered except where farms have been established. Ponderosa pine forests grow in the uplands. The Blue Mountains and Steens Mountains define the western boundary of the basin. In the north are the Wallowas, one of America's premier mountain wilderness areas. Just to the east, the Snake River flows through Hells Canyon, an immense gorge deeper at its greatest drop than Arizona's Grand Canyon. The Blue Mountains rise above La Grande and Baker City, the two largest cities in the basin.

Most economic development in the basin is concentrated in three separate areas whose trade centers are Ontario, La Grande, and Baker City. The Snake River Plain (Ontario) has the most population.

Forest products and livestock enterprises supported by irrigated feed bases are the principal activities in the Grande Ronde and Powder River valleys. Row-crop irrigation and associated food-processing plants are basic to the economy of the Snake River Plain. Water is valuable and an important limiting factor in economic development.

Flood Damage Reduction Project

Large floods may occur in the basin at any time from November through May, but usually come while the snowpack is melting in the spring. Warm rainstorms in the winter which melt snow in the higher mountains also cause flooding, but normally those floods are less severe and last for a shorter time. They are also less frequent, because widespread heavy rainfall rarely occurs during the winter months. The flood of December 1964, however, caused extensive damages.

Other than Continuing Authorities small flood control projects, the only projects in the basin con-

structed by the Corps to date are two flood control projects in Malheur County and a navigation project along the Snake River in the extreme northeastern corner of Oregon. A multipurpose project, Catherine Creek Lake, near Union, was deauthorized in 1990. Another multipurpose project, Grande Ronde Lake, and a flood control project, Grande Ronde Valley, were deauthorized in 1986.

Existing Projects

Snake River at Malheur Improvement District

This project, authorized in 1944, is located on the Oregon bank of the Snake River across from Weiser, Idaho. It provides flood protection to about 500 acres of land and an arterial highway. Sixty to 70 farm units, where 45 families live, are in the protected area. Construction of the project began in 1957 and was completed the same year. Federal cost of the work was $56,000.

Malheur River at Vale

Levee and channel works to protect the town of Vale and vicinity were authorized by the Flood Control Act of 1950. The project consists of channel enlargement and levees along the lowermost mile of Bully Creek and along the lowermost two miles of the Malheur River from the mouth of Bully Creek to Nevada Dam, a short distance downstream from Vale. Construction began in 1960 and was completed the following year at a federal cost of $338,580.

Navigation Development

Barge navigation on the Snake River to Lewiston, Idaho, became a reality when a series of four dams with locks, authorized in 1945, were completed. The four are Ice Harbor, Lower Monumental, Little Goose, and Lower Granite. Lower Granite, the furthest upstream, about 30 miles downstream from Lewiston, started operation in 1975. When the reservoir was filled, a new deeper calm-water channel was formed and Idaho was linked with the sea. Shallow-draft, fast-water conditions continue for commercial navigation on the Snake River above Lewiston to Johnson Bar Landing in Hells Canyon.

Existing Project

Snake River from Lewiston to Johnson Bar Landing, Idaho

This project extends in part along Oregon's common boundary with Idaho. Work by the Corps of Engineers on the 92-mile reach of Snake River from Lewiston to Johnson Bar Landing was first authorized by Congress in 1902, and again in 1910 and 1925. Boulders and other obstructions were removed from the channel. In 1949, a wing dam was constructed from the bank into the stream to provide greater depth over Temperance Creek Rapids, about eight miles downstream from Johnson Bar.

The Snake River in this reach provides access and mail service to residents of the canyon area. River launches transport animal feed, household goods, and groceries upstream, wood and other miscellaneous cargo downstream. Many persons are transported into the canyon annually on sight-seeing expeditions. Recreation on this white-water reach of the Snake River includes pleasure boating.

Lower Snake River Fish and Wildlife Compensation Plan

The Lower Snake River Fish and Wildlife Compensation Plan was authorized by the Water Resources Development Act of 1976. The project will mitigate losses caused to the river fishery and wildlife habitat attributed to construction and operation of the four lower Snake River lock and dam projects (Ice Harbor, Lower Monumental, Little Goose, and Lower Granite). The Compensation Plan includes a number of chinook salmon and steelhead trout hatcheries to be constructed in Idaho, Oregon, and Washington that will provide 27 million juvenile fish. These fish will be released into the Snake River drainage for migration to the Pacific Ocean. As returning adults, these fish will provide both sport and commercial fishing opportunities with over four million pounds of fish going to the commercial fisheries. An estimated 132,000 adult fish will return to the project area of the lower Snake River, providing approximately 689,000 additional angler days of sport fishing.

In addition to the anadromous fish, 93,000 pounds of trout will be reared and released in eastern Washington and Idaho tributary streams to provide 45,000 additional angler days of sport fishing. To assure angler access, 740 acres of land have been acquired along streams in the Snake River Basin.

In addition to some 12,500 acres of project lands

that have been developed as replacement riparian habitat, acquisition of 8,400 acres of land adjacent to projects in Washington for wildlife and upland game bird habitat

and 15,000 acres to compensate for lost chukar partridge habitat is required.

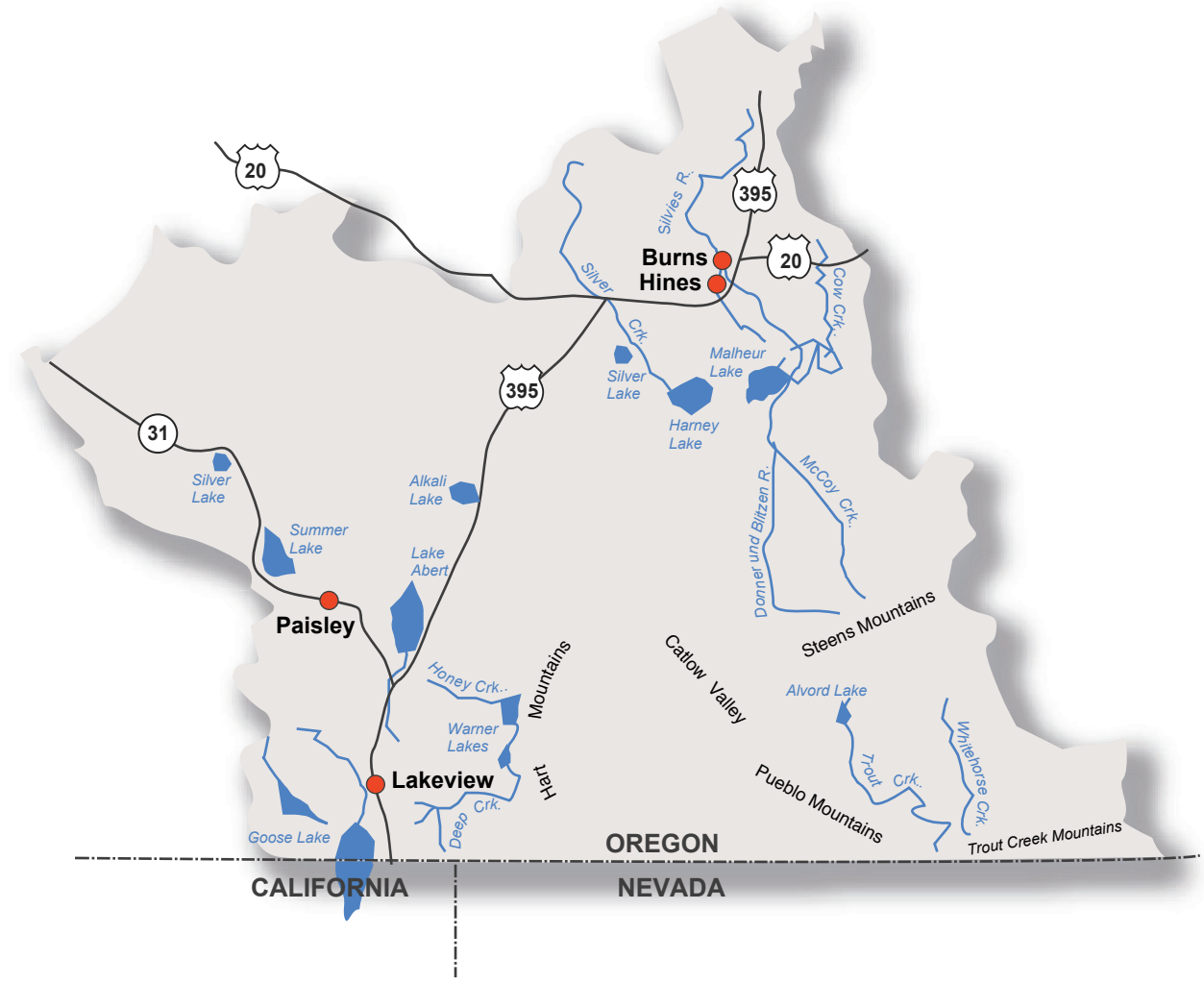
Initial project funding was received in fiscal year 1978 and substantial progress has been made in siting, designing, and constructing the required fish hatcheries.

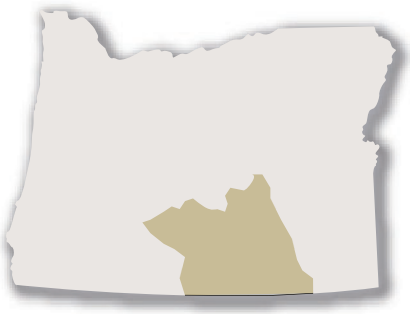
Hatcheries completed and operating in Idaho are McCall Hatchery for summer chinook; Hagerman National Fish Hatchery for steelhead; Dworshak Hatchery (expansion) near Orofino for spring chinook; the Sawtooth Spring Chinook Hatchery near Stanley; and the Magic Valley Hatchery near Buhl for steelhead. Oregon hatcheries include Lookingglass Creek Fish Hatchery near Elgin for spring chinook and Irrigon Hatchery near Irrigon and its companion facility, Wallowa Hatchery near Enterprise, for steelhead. Washington hatcheries are the Lyons Ferry Hatchery near Starbuck for steelhead, spring and fall chinook, and rainbow trout; and its companion facility, Tucannon Hatchery near Dayton, for spring chinook and rainbow trout.

All construction in Washington has been completed. In Idaho, the Clearwater Hatchery was completed in 1992. The facility added another 91,300 pounds of spring chinook salmon production in addition to 350,000 pounds of steelhead trout in the Clearwater Basin.

Federal costs for hatchery and project wildlife habitat acquisition and development through September 1999 are $228,336,000. Estimated total project cost of the Compensation Plan is $232 million.

Oregon Interior Basin





Oregon Interior Basin

The Oregon Interior Basin is the northern extension of the Great Basin, usually associated with Nevada. The basin's few rivers drain to large, shallow lakes (playas) rather than to the ocean. The Great Basin, known to geologists as the Basin and Range Province, consists of many north-south oriented mountain ranges with flat stretches between. The playas— Harney, Malheur, Warner, Summer, Abert, and Goose lakes— occupy the largest flats. The lowest areas in the basin are about 4,000 feet above sea level, while the highest ranges, notably Steens and Hart mountains, rise more than 4,000 feet higher. Sagebrush and widely scattered juniper cover vast areas. Only where farms have been established or in the more elevated parts of the basin is the plant cover significantly different. The forested areas contain mostly ponderosa pine.

The Interior Basin, the least populated and least developed part of Oregon, is very short of water. Small reservoirs along the basin's perimeter have been developed for irrigation water supply, but most of the land in the basin is open dryland range. Two large wildlife refuges— Malheur and Hart Mountains— are managed by the U.S. Fish and Wildlife Service. Burns, Lakeview, and Hines (1990 populations 2,920, 2,625 and 1,530, respectively) are by far the largest incorporated communities in the basin.

The Interior Basin's principal streams are the Silvies River, the Donner und Blitzen River, Silver Creek, the Chewaucan River, Deep and Honey creeks, and Drews and Thomas creeks. The first three of those streams drain to the Harney-Malheur Lake playa, the Chewaucan River to Lake Abert, Deep and Honey creeks to the Warner Lakes, and Drews and Thomas creeks to Goose Lake. All those streams are smaller than most other streams in the Pacific Northwest draining areas of similar size. However, large floodflows sometimes occur during the spring snowmelts or, rarely, during winter rainstorms invading from western Oregon and the Pacific Ocean. On the whole, rainfall is limited. Widespread areas in the basin receive an average of less than 15 inches of precipitation annually.

Emergency repairs to two small flood-control works have been made by the Corps of Engineers and essential public works have been protected at another location. None of the basin's streams are navigable and no multipurpose developments have been constructed. Most of the Interior Basin is in the Corps' Portland District. A small part of the basin draining to Goose Lake is in Sacramento District.

Flood Damage Reduction Projects

Emergency Flood Control Activities

Repairs of flood-protection works have been made at two locations in Lake County, under the provisions of Section 5 of the 1941 Flood Control Act, as amended. That emergency work was accomplished at the Adel location on Deep Creek and at the Lynch location on Honey Creek in Warner Valley. Costs were $20,300 and $19,300 respectively.

Continuing Authorities for Flood Control

Malheur Lake Flood Reduction Study

Malheur Lake is the terminus of a closed drainage basin with no outlet. Malheur Lake, in the closed Harney drainage in southeastern Oregon, had experienced extensive surface elevation increases due to high inflows beginning in 1982. Successive years of high run-off raised the water level of the lake to flood levels. Approximately 100,000 acres had been flooded above the typical historic lake surface area of 40,000 to 60,000 acres. The high lake elevation caused severe economic damage in the region and in Harney County. Damage from flooding continued to occur to private land and ranches, roads, highways, utilities, and a railroad branch line.

A feasibility report regarding alternative solutions to the flooding was completed in 1987. The study included evaluations of three alternatives. The alternative of constructing an outlet channel from the lake through Virginia Valley to control the lake level was strongly opposed by Malheur County and did not have the support of the Governor. The alternative to purchase flood-prone lands for incorporation into the Malheur

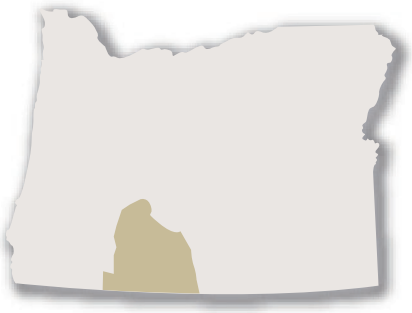
National Wildlife Refuge, along with relocating or raising the flooded branch line of the Union Pacific railroad, was opposed by Harney County. The alternative of raising or relocating the flooded portion of the branch line was not pursued because of Corps policy against federal participation in projects benefiting a single owner. The conclusion was that no plan that the Corps could participate in was acceptable to the local community.

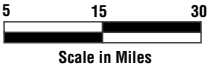
Subsequent to completion of the feasibility report, the Oregon Congressional delegation pursued a plan to raise the flooded portion of the railroad. An exception to the policy of no federal participation in projects benefiting a single owner was granted in May 1988. The exception was granted because of substantial benefits that would accrue to the U.S. Forest Service though increased timber sales receipts. The project was implemented under the Continuing Authorities program. The Malheur Lake project near Burns was completed in fiscal year 1991. The project raised the grade of a railroad line above the flood level of the lake.

Protection of Essential Public Works

Construction of a revetment along the Chewaucan River to protect the Paisley sewage lagoon was completed in December 1972, under provisions of Section 14 of the 1946 Flood Control Act. The total cost of the project was $42,800.

Klamath River Basin of Oregon





Klamath River Basin in Oregon

The upper part of the Klamath River Basin is in southern Oregon. Most of the basin is in California, with the Klamath River emptying into the Pacific Ocean near Crescent City on the northern California coast. Klamath Falls (1992 population, 18,085) is by far the largest community in the basin. The Klamath Basin is within the Corps' San Francisco District.

Multipurpose Development

Feasibility Study

Klamath River Basin

The Klamath River Basin covers an area of about 15,500 square miles of which 5,680 are in Oregon. The study is limited to that portion of the Klamath Basin within Oregon which includes most of Klamath County and small parts of Jackson and Lake counties. The study considers the need for any modification to previous reports for the purposes of development, management, conservation, and environmental enhancement of the water, land, and related resources of the Klamath Basin in Oregon.

The study was started in November 1977 and an initial public meeting was held in January 1978 in Klamath Falls to identify the problems. The water quality of Upper Klamath Lake and Lake Ewauna were identified as the main water resource problems of the study area. Therefore, the main emphasis of the study is on the eutrophication of the lakes and interrelated basin problems.

The San Francisco District prepared a reconnaissance report for the study in September 1979. This report established a course of action for the remainder of the study; however, the study has not been funded, 1982-present.

Oregon Coast Basin

Oregon Coast Basin

The Oregon Coast Basin includes all streams south of the Columbia River which drain directly to the Pacific Ocean. It has three distinct sub-basins: Rogue, Umpqua, and Coastal. The Rogue and Umpqua rivers, both in southern Oregon, rise in the Cascade Range 100 or more miles east of the coastline and breach the coastal mountain ranges before discharging into the Pacific. The Coastal sub-basin is made up of numerous small streams draining only the western slope of the coastal mountain ranges, rising 20 or 30 miles east of the coastline. In the lower reaches of the estuaries, the Rogue and Umpqua rivers appear the same as the coastal streams, except that they are wider. The inland areas of the Rogue and Umpqua basins experience heavy precipitation and high streamflows in winter and prolonged dry periods and low streamflows in the summer. For the Coastal sub-basin, the summer dry season is shorter and less intense than inland. In the reaches along the estuaries, flood problems on all streams are caused as much by high tides as by storm runoff. Harbors require continual maintenance because the estuaries are constantly filling with sediment, especially during winter floods. Jetties must be rebuilt periodically because of wave damage. The entire basin lies within the Corps' Portland District.

Mainstays of the economy are wood products and tourism. Mills ship much of their production via oceangoing freighters. The scenic Oregon coast attracts vacationers from all over the world.

The Oregon Coast Basin encompasses about 17,300 square miles. The Rogue and Umpqua rivers each drain about 5,000 square miles, and discharge an average of about six million acre-feet of water annually to the Pacific Ocean. Flows in the lower reaches of both streams run as low as 1,000 cubic feet per second (cfs) during the dry summer, but have reached nearly 300,000 cfs during floods. The coastal streams drain considerably smaller areas. The Nehalem, Trask, Wilson, Nestucca, Siletz, Yaquina, Alsea, Siuslaw, Coos, Coquille, and Chetco rivers are the main streams. Many smaller streams also drain directly to the ocean.

The Army Corps of Engineers has constructed many projects in the basin and others are authorized or under study. Thirteen harbor projects and two inland waterways have been constructed to provide improved navigation.

Three multipurpose reservoirs have been authorized for construction in the Rogue River Basin: Lost Creek Lake, Applegate Lake, and Elk Creek Lake. These Rogue River Basin projects are the first in Oregon to have fish and wildlife enhancement, municipal and

industrial water supply, water quality control, and recreation as authorized primary purposes. Lost Creek Lake on the Rogue River began operating in 1977. Construction of Applegate Lake on the Applegate River was completed in 1981. Construction of a third project, Elk Creek Lake on Elk Creek, was stopped by a legal injunction. Several single-purpose flood control projects have been constructed in the coast basin and numerous improvements and repairs have been made under continuing authorities for flood damage reduction.

Multipurpose Development

Existing Projects

Lost Creek Lake

Lost Creek Lake on the Rogue River is one of three multiple-purpose storage projects authorized by Congress in 1962 to provide flood control and water resource development in the Rogue River Basin. Construction started in 1967, the dam was essentially completed in 1976, and the lake began filling in February 1977. The authorized primary project purposes are flood control, power generation, recreation, and irrigation. The project, located about 27 miles northeast of Medford, also is operated for municipal and industrial water supply, fish and wildlife enhancement, and water quality control. In 1996, the dam and intake structure were renamed for William L. Jess, who was instrumental in getting the original project completed.

The William L. Jess Dam and Intake Structure is a 327-foot-high rockfill embankment structure. A regulating outlet tunnel, power penstock, and intake tower with multi-level intakes are located in the dam's right abutment; a gate-controlled concrete chute spillway is located in the left abutment. The powerhouse has a generating capacity of 49,000 kilowatts.

Runoff from a drainage area of 674 square miles pools into Lost Creek Lake. The lake provides 465,000 acre-feet of total storage. It has an area of 3,430 acres when full.

Through September 1999, Lost Creek Lake project costs totaled $196,584,400 ($136,408,200 for construction and $60,176,200 for operation and maintenance. During 1999, the William L. Jess powerhouse generated 320,461,000 kilowatt-hours of electricity of which 316,405,000 was delivered to the Bonneville Power Administration. Through September 1999, the project had prevented an estimated $31 million (unadjusted) in flood damages. During the same period, power generation totaled 6.4 billion kilowatt-hours. Of the gross income from sale of this power by Bonneville Power Administration, $ 36.3 million was reimbursed to the U.S. Treasury to recover Corps of Engineers project investment and operating costs.

Three recreation areas and a trail system along 30 miles of shoreline have been developed by the Corps. Stewart State Park, operated by Oregon State Parks, provides camping, picnicking, boating, and swimming facilities. River's Edge and McGregor parks, operated by the Corps just downstream from the dam, are day-use areas with a visitor center and riverside access. The Takelma boat ramp on the north shore of the lake is operated by the Corps. In 1999, about 502,500 recreation visits were made to Lost Creek Lake project recreation areas.

As mitigation for project-caused loss of spawning and rearing areas, the Corps built Cole M. Rivers Fish Hatchery, one of the largest in Oregon. It was designed with sufficient capacity to compensate for fishery losses caused by all three authorized Rogue Basin dams.

The hatchery is operated by the Oregon Department of Fish and Wildlife with federal funds. To enhance salmon and steelhead fishery in the Rogue River downstream, stored water is released from Lost Creek Lake at controlled temperatures. Temperature control is achieved by withdrawing water from various levels of the reservoir using the project's multiple-level intake tower.

Applegate Lake

The Applegate project also was authorized in 1962 as an element of the plan for flood control and water resource development in the Rogue River Basin. Authorized primary project purposes are flood control, fish and wildlife enhancement, municipal and industrial water supply, irrigation, water quality control, and recreation. The project is on the Applegate River about 24 miles southwest of Medford. Work on the main dam started in 1978. The project began providing flood control in the fall of 1980.

The project consists of a 242-foot-high rockfill embankment dam, a gate-controlled concrete-chute spillway, a regulating outlet conduit, and an intake tower with multi-level intakes capable of withdrawing water from several levels of the reservoir for downstream temperature control. The reservoir provides 82,200 acre-feet of total storage for flood control and water conservation use, and controls runoff from a drainage area of 220 square miles. No fish-passage facilities are provided, but Cole M. Rivers Fish Hatchery near William L. Jess Dam provides compensation for loss of salmon and steelhead spawning and rearing areas. Fishery enhancement is provided by release of stored water to control downstream temperatures and increase streamflows during annual low-water periods.

Eight recreation sites with picnicking, camping, trails, and boating are an integral part of the project. They were developed by the Corps in coordination with the U.S. Forest Service, which administers surrounding lands in the Rogue River National Forest.

Through September 1999, project costs totaled $ 101,964,000— $91,642,500 for construction and $10,321,500 for operation and maintenance. Through September 1999, Applegate project had prevented nearly $19.3 million in flood damages since flood storage began in December 1980.

Authorized Project

Elk Creek Lake

Elk Creek Lake is the remaining element of the Rogue River Basin project which would complete the plan as authorized in 1962 for flood control and water resource development in the basin. The project is located on Elk Creek in Jackson County about 1.7 miles from its confluence with the Rogue and about 26 miles northeast of Medford. Upon completion, the Elk Creek project would consist of a 249-foot-high, 2,600-foot-long roller-compacted concrete gravity dam, a gate-controlled concrete chute spillway, and a multi-purpose intake tower with multi-level intakes to control lake releases. The lake would provide 101,000 acre-feet of total storage for flood control and water conservation uses, and would control runoff from a drainage area of 135 square miles. The project would be operated to provide flood control, recreation, irrigation, municipal and industrial water supply, fish and wildlife enhancement, and water quality control. Elk Creek would be operated with Lost Creek Lake as a two-dam system to provide project benefits. The estimated federal cost of the project is $174 million (1999).

Construction began in January 1986. The structure was scheduled to be completed by fall of 1989. However, lawsuits were filed to stop construction of the dam. After the initial hearing, the U.S. District Court ruled that the Corps could proceed with construction. In response to an environmental group's appeal of the initial court decision, the Ninth Circuit Court of Appeals directed the District Court to issue an injunction to stop construction. The roller-compacted concrete placement was completed to the court-permitted height of 83 feet on January 5, 1988. The Department of Justice petitioned the U.S. Supreme Court for a review of the Ninth Circuit Court's decision. In May 1989, the U.S. Supreme Court repealed the District Court decision, except for the issue of a cumulative impacts analysis of the three dams in the basin.

To respond to the court order, additional studies of

water temperature and turbidity, and fish and wildlife were conducted. A Supplemental Environmental Impact Statement (EISS) was prepared to address cumulative effects. Through this environmental review, the Corps selected an alternative which, if completed, would operate the project for flood control purposes only, without a permanent reservoir. In July 1992, the Department of Justice petitioned the U.S. District Court for removal of the injunction.

In fiscal year 1993, Congress added $2.5 million for design necessary to complete the project, pending removal of the injunction. No additional construction has been done, due to ongoing legal challenges. In April 1995, a Ninth Circuit Court of Appeals opinion left in place an injunction against completing the Elk Creek Lake project and required a comprehensive review of a wide range of issues under the National Environmental Policy Act (NEPA). Since significant work and money would be required to address these issues with no assurance that the Court's injunction against development of the project would be lifted, the Corps did not complete the NEPA review. Instead, the Corps began considering options for managing Elk Creek Dam over the long term without completing the structure.

In September 1996, President Clinton signed the Energy and Water Development Appropriations Act for the fiscal year 1997 budget, granting authorization to use previously appropriated funds to plan and implement long-term management of the Elk Creek project. The long-term management plan will be implemented in two phases. The goal of the first phase is to develop a passive fish passage system through modification or partial removal of the dam's spillway to reduce annual costs and improve biological conditions for anadromous fish. The second phase will include evaluation of land management actions, disposition of stockpiled gravel and equipment, and the restoration of the streambed and surrounding areas.

In 1998, a plan for improving anadromous fish passage at Elk Creek Dam was completed. Further activity was postponed due to lack of funds. However, the plan calls for recreating the pre-project stream alignment by removing a section of the dam's spillway and left abutment, placing features in the stream and streambank to maintain adequate flow velocities for fish passage, and realigning the stream above and below the dam. The cut through the dam will be about 150 feet wide at the base of the dam and 225 feet wide at the top. The size of the cut was designed to meet fish passage velocity criteria at a flow of 10 cubic feet per second (cfs) to 5,000 cfs (a range of flows coordinated with and recommended by state and federal fishery resource agencies). The modification would eliminate the trap and haul system which required the fish to be physically handled while not precluding completion of the project in the future, should that decision be made. Estimated cost for the work is about $7 million.

Flood Damage Reduction Projects

Completed Projects

Nehalem River near Nehalem

This original federal project, which protects 904 acres of farmland, was authorized by the Flood Control Act of 1944. Construction was completed in 1951 at a cost of $46,000. The Sunset Drainage District operates and maintains the levees and interior drainage system. The drainage district is on the left bank of the Nehalem River, between river miles one and seven. The district includes seven dairy farms, a sewage treatment plant, and a cable television facility. Since completion, the project has prevented an estimated $1,900,000 in flood damages.

Yaquina River, Mill Four Drainage District

This project is about six miles southeast of Newport on the north bank of the Yaquina River, along Boone and Nute sloughs. It consists of two levees, about 1,100 and 960 feet long, with tide gates and pile bulkheads. The project was completed in 1948 at a federal cost of $118,000; in addition, $6,000 was contributed by local interests. Since completion, the project has prevented an estimated $1,365,000 in flood damages.

Umpqua River and Tributaries

The 1941 Flood Control Act project authorization allowed for constructing revetments and rebuilding levees along critical sections of a downstream reach of the Smith River, rehabilitating about a mile of levee at Gardiner Flats, strengthening about one mile of levee at Leeds Island, constructing two dikes at Reedsport, widening the outlet at Loon Lake, clearing the channel and placing 900 linear feet of revetment in the Melrose area, and clearing the channel and removing a gravel bar at Conn Ford. The project was completed in 1951 at a total cost of $429,000. Since completion, it has prevented an estimated $10,800,000 in flood damages.

Improvement of project levees at Reedsport, under provisions of Section 205 of the 1948 Flood Control Act, as amended, was completed in 1969.

Continuing Authorities for Flood Control

Rogue River at Grants Pass

Under the continuing authority contained in Section 14 of the Flood Control Act of 1946, a project was completed to stop erosion along approximately 40 linear feet of bankline adjacent to the Grants Pass water treatment plant. The site is within the city limits, on the right bank of the Rogue River at river mile 101.8, immediately downstream of the State Highway 199 bridge. Completed in 1995, the project provides support for the riverbank through placement of a concrete plug in an

erosion pocket, located in the face of the nearly vertical 40-foot-high bank. Included in the project is a drainage layer to relieve groundwater seepage from the slope. Total federal project cost through fiscal year 1999 was $148,700, of which $121,500 was federal and $27,200 was non-federal.

Navigation Development

The Army Corps of Engineers has been involved in maintaining Pacific Coast harbors since 1866. The work includes improving and maintaining channels, and building, improving, and maintaining jetties and breakwaters. The Portland District is responsible for 15 projects along the Oregon Coast and for the channel in the lower Columbia River linking the Portland-Vancouver area to the ocean and to upper Columbia River ports (see chapter for Lower Columbia Basin). Four potential projects also are under study. The existing projects described below are listed in north-to-south order beginning just south of the Columbia River mouth.

Existing and Authorized Projects

Nehalem Bay

Nehalem Bay is about 40 miles south of the Columbia River. The project provides a stabilized channel of unspecified width and depth across the ocean bar at the bay entrance. The channel, completed in 1918, is secured by two rubblemound jetties. The shore end of the south jetty was constructed by the Port of Nehalem. The federal cost of the project was $330,000 and $305,000 was contributed by local interests. Rehabilitation of the jetties was completed in 1982, at a cost of $12,088,000.

Tillamook Bay

Tillamook Bay is about 50 miles south of the mouth of the Columbia River. The project provides an 18-foot-deep channel over the ocean bar at the entrance, secured by two jetties; an 18-foot-deep, 200-foot-wide, three-mile-long channel to Miami Cove; a turning basin at Miami Cove; and a 12-foot-deep access channel to the Garibaldi small-boat basin. The project also includes protection of Bayocean Peninsula to preserve the present entrance channel to the bay. For that purpose, a 1.4-mile-long dike was constructed to close a breach in the peninsula between Pitcher Point and the abandoned town of Bayocean. The channel to Miami Cove was completed in 1927, the Bayocean dike in 1956, and the small-boat basin of Garibaldi in 1958. The 18-foot channel to Miami Cove is inactive due to a mill closure.

The 5,700-foot-long north jetty was constructed in 1933, rehabilitated in 1965, and again in 1991. In 1965, construction of a south jetty 8,000 feet long was authorized. Work began in 1969 and the first segment was finished in 1971. Construction of the second segment was completed in 1974. Construction of the third segment— 1,500 feet to complete the 8,000-foot jetty— started in 1978 and was completed in 1979.

The federal cost of the project through September 1999 was $ 32,080,100— $22,434,800 for construction, $2,839,800 for major rehabilitation, and $6,805,500 for maintenance. In addition, $593,000 for construction and $6,000 for maintenance have been contributed by non-federal interests.

Salmon River

The Salmon River, a small stream, enters the Pacific Ocean 84 miles south of the mouth of the Columbia River. The project provided for removal of rocks from the river just downstream from the settlement of Three Rocks and was completed in 1948 at a cost of $2,000.

Depoe Bay

This small-boat harbor is about 100 miles south of the mouth of the Columbia River. The project provides two breakwaters north of the entrance, an eight-foot-deep, 50-foot-wide entrance channel, an inner basin with a retaining wall on the east side of the bay, and a sediment basin near the mouth of Depoe Bay Creek. The most recent improvements to the project were completed in 1966. Facilities in the inner basin consist of landings and floats to accommodate operators of excursion

and commercial fishing boats. Facilities are considered adequate for existing commerce.

The total cost through September 1999 was $2,124,600 , of which $367,400 was for construction and $1,757,200 was for maintenance.

Yaquina Bay and Harbor

Yaquina Bay is located on the coast 113 miles south of the mouth of the Columbia River. It is one of the oldest navigation projects on the Oregon coast. Work on the Yaquina jetties started in the 1880s. The project authorization was last modified in 1958 by Congress to provide for extension of the jetties; a 40-foot-deep, 400-foot-wide entrance channel; a 30-foot-deep, 300-foot-wide bay channel leading to a turning basin at Newport; an 18-foot-deep, 200-foot-wide, 4.5-mile-long channel from Newport to Yaquina; two small-boat basins at Newport; two small-boat turning basins at Newport; and a 1,300-foot-long breakwater to protect the Newport South Beach Marina. A breakwater for a small-boat basin on the north shore was authorized in 1946 to protect commercial fishing boats. The timber structure is 2,650 feet long. The marina, which provides shelter for 232 boats, is maintained by the Port of Newport to a depth of 10 feet.

The north jetty, completed in 1896, was extended in 1966 and repaired in 1978 and 1988. The south jetty, also completed in 1896, was extended in 1971. The small-boat basin was completed in 1949. In 1998, sand was removed from approximately 1,000 feet of the south jetty, the jetty was sealed with rock and filter fabric, and the sand was replaced to protect public safety and prevent sand migration through the structure. In 1999, 41,217 tons of displaced jetty stone were removed from the entrance channel to alleviate dangerous navigation conditions.

Through September 1999, total federal cost of the project was $ 69,834,700— $19,242,000 for construction, $12,000 for rehabilitation, and $50,580,700 for operation and maintenance. In addition, $729,000 was expended from contributed funds.

Yaquina River

The Yaquina River flows into Yaquina Bay at the town of Yaquina. The project provides a 10-foot-deep, 150-foot-wide, 10-mile-long channel in the river from Yaquina to Toledo and a 200-foot-wide channel in Depoe Slough at Toledo. In addition, two dikes were constructed by local interests. The project was completed in 1914. A study completed in 1974 showed that deepening the channel from Yaquina to Toledo was not economically feasible.

Improvement of about 7,300 feet of the Yaquina River upstream from Toledo was made under provisions of Section 107 of the 1960 Rivers and Harbors Act. The improvement included a 10-foot-deep, 150-foot-wide channel and a 10-foot-deep turning basin near Olalla Creek. The project was completed in 1968.

Total federal costs through September 1999 were $ 1,491,600— $28,800 for construction and $1,462,800 for maintenance. In addition, $3,000 was contributed by local interests.

Yaquina Bay Small-Boat Basin

The project, completed in 1978, provides for 2,500 lineal feet of stone breakwaters and an access channel 100 feet wide, 10 feet deep, and 1,960 feet long. Total federal cost was $833,839. Contributed funds by Port of Newport toward general navigation facilities were $306,843.

Siuslaw River

The Siuslaw River enters the Pacific Ocean about 160 miles south of the mouth of the Columbia River. The project, as originally authorized, provided for an 18-foot-deep, 300-foot-wide channel across the bar, secured by two jetties; a 16-foot-deep, 200-foot-wide, five-mile-long channel to Florence, and a 12-foot-deep, 150-foot-wide, 2.5-mile-long channel to Cushman. The jetties were completed in 1917, and the channel was completed in 1930. The north jetty was rehabilitated in 1958 and the south jetty in 1962.

The project authorization, as modified in 1958,

provided for an 18-foot-deep entrance channel; a 16-foot-deep river channel to Florence; a turning basin 400 feet wide and 600 feet long at Florence; and a 600-foot extension of the north jetty. Dredging of the river channel was completed in 1968 and of the entrance channel in 1969. Extension of a 12-foot-deep channel from Cushman to near Mapleton was approved under authority of Section 107 of the 1960 Rivers and Harbors Act. This work, completed in 1975, cost $329,000. The fiscal year 1981 Energy and Water Development Appropriations Act authorized the extension of the north jetty by 1,900 feet and south jetty by 2,300 feet, with 400-foot spur dikes on the seaward side of each. The work was completed in 1986.

The total federal cost of the project through September 1999 was $ 47,643,800 , of which $29,502,200 was for construction, $879,300 for jetty restoration, and $17,262,300 for maintenance. Local interests contributed $323,000.

Umpqua River

The Umpqua River flows into the Pacific Ocean about 180 miles south of the mouth of the Columbia River. The project authorization provided for two jetties at the entrance; a 26-foot-deep entrance channel; a 22-foot-deep, 11-mile-long river channel to Reedsport, with a turning basin at Reedsport; two side channels to the docks in Winchester Bay, with mooring and turning basins at the inner end; and a 22-foot-deep side channel from the main channel to Gardiner, with a turning basin at Gardiner.

Extension of the original south jetty was completed in 1938 and the north jetty was completed in 1940. Construction of a new training jetty on the south side of the entrance to the Umpqua River was completed in 1951. The south jetty was rehabilitated in 1963, and the north jetty rehabilitation was completed in 1978. Work to connect the Umpqua River training jetty to the tip of the south jetty started in 1979. The 2,600-foot training jetty extension is designed to control the dangerous cross currents caused by the angle between the north and

south jetties. The training jetty extension was completed in late 1980 at an estimated cost of $16 million.

Extension of the training jetty allowed increased wave energy to reach farther into the Umpqua River Estuary, causing damage to existing facilities and shoreline on both sides. Damage on the north shore was relatively minor; more severe damage occurred along the west spit which protects the Salmon Harbor small-boat basin. Work to mitigate the damage was completed in 1995 under the special continuing authority in Section 111 of the Rivers and Harbors Acts and Flood Control Act of 1968, which allow mitigation of shoreline damage caused by federal navigation projects. The project consists of 2,760 feet of stone revetment along the west face of the spit. Project costs totaled $644,300.

Local interests requested the navigation channel at Winchester Bay Boat Basin, near the mouth of the Umpqua River, be deepened to 16 feet. Construction included deepening the existing access channel and turning basin to 16 feet, enlarging the turning basin, and establishing a new access channel to a new, locally-contracted basin. Deepening of the Winchester Bay east channel and construction of the new west channel were completed in 1984 under Section 107 authority. The total federal cost was $1,616,400.

In fiscal year 1994, the U.S. hopper dredge Yaquina removed 229,039 cubic yards of material and the contract pipeline dredge Nehalem removed 29,588 cubic yards of material from the entrance channels of Winchester Bay. This material was pumped to the north spit of the Umpqua River to create about eight acres of nesting habitat for the western snowy plover and two acres of wetland habitat. This project was a cooperative effort with the U.S. Forest Service, Oregon Dunes National Recreation Area, Oregon Department of Fish and Wildlife, U.S. Environmental Protection Agency, U.S. Fish and Wildlife Service, and Port of Umpqua under the Coastal America program.

Total federal cost of work through September 1999 was $ 54,869,100 , of which $17,718,900 was for construction, $2,500,700 for major rehabilitation, and $34,649,500 for maintenance. Local interests contributed $227,000.

Coos Bay

This project is located about 200 miles south of the mouth of the Columbia River. The project authorization, modified by the Rivers and Harbors Act of 1970, provides for two jetties at the entrance; an entrance channel 45 feet deep and 700 feet wide; a channel 35 feet deep and 300 feet wide to river mile nine and from there 35 feet deep and 400 feet wide to river mile 15; and turning basins and anchorage areas along the channel. Deepening of the channel from the entrance to river mile 15 was completed in 1979.

The Coos Bay project also includes a 22-foot-deep, 150-foot-wide channel from the mouth of Isthmus Slough to Millington; a 17-foot-deep, 150-foot-wide, 3,200-foot-long connecting channel from deep water in Coos Bay; a channel extension in South Slough, 16 feet deep and 150 feet wide, to the highway bridge at Charleston; and a mooring basin, breakwater, and bulkhead at Charleston.

The jetties at the main entrance were completed in 1928-29. The south jetty was rehabilitated in 1963 and the north jetty was repaired in 1989. The main channel was dredged to 24 feet in 1937 and excavated to 30 feet in 1951. Construction of the Charleston channel and small-boat basin was completed in 1956. Breakwater rehabilitation and extension of the small-boat basin

were completed in 1979 at a cost of $1.9 million. Local interests requested the boat basin entrance channel be deepened to 15 feet and extended to serve a new moorage area. Deepening of the Charleston channel and turning basin was completed in 1985 under Section 107 of the Rivers and Harbors Act of 1960. The total federal cost was $1.2 million.

A modification to the existing project was authorized in the fiscal year 1996 Energy and Water Development Appropriations Act, PL 104-46, to deepen the Coos Bay channel by two feet to 47 feet at the bar and 37 feet up the 15-mile channel. The turning basin at river mile 12 was also deepened by two feet and expanded by 100 feet, from 800 by 1,000 feet to 900 by 1,000 feet. The project was completed in 1998, except

for post-construction monitoring, which will continue through fiscal year 2000. The cost of the project was $11,616,000, of which $8,116,000 was federal and $3,500,000 was non-federal. In addition, the sponsor, the International Port of Coos Bay, paid 100 percent of the estimated cost for dredging the berth areas.

The total federal cost of the project through September 1999 was $158,637,020— $37,866,092 for construction; $2,335,966 for major rehabilitation, and $114,572,905 for maintenance. Local interests contributed $3,862,057.

Coos and Millicoma Rivers

The South Fork Coos River and the Millicoma River join to form the Coos River five miles upstream from the mouth of the Coos River on Coos Bay. The channel provides a five-foot-deep, 50-foot-wide channel from the mouth of Coos Bay to Allegany (river mile 13.8) on the Millicoma River; a channel with the same dimensions to Dellwood (river mile 14) on the South Fork; and from there, a channel three feet deep and 50 feet wide to river mile 14.7 on the South Fork. Channel improvement was completed in 1966. The total cost through September 1999 was $2,503,100— $350,200 for construction and $2,152,900 for maintenance.

Coquille River

The Coquille River project is about 225 miles south of the mouth of the Columbia River. There are two jetties at the river mouth. The south jetty is 2,700 feet long and the north 3,450 feet long. There is a channel 13 feet deep from the sea to a point one mile upstream from the old Coquille River lighthouse. Project authorization also calls for removing snags from the channel up to the highway bridge at Coquille. The jetties were completed in 1908 and the entrance channel in 1933. The north jetty was rebuilt in 1942, extended in 1951, and repaired in 1956. The south jetty was repaired in 1954. Restoration of the historic Coquille lighthouse was completed in 1976.

The Port of Bandon constructed a boat basin facility in conjunction with protective breakwater and 300-foot-

long entrance channel construction, under Section 107 authorization in 1985. Also under authority of Section 107 of the Rivers and Harbors Act of 1960, a study was completed in 1987 to deepen the entrance channel at the mouth of the Coquille River. The existing project provides a 13-foot-deep channel. A plan to deepen the entrance channel of the Coquille River from 13 feet to 18 feet was approved in May 1988. The economics were reevaluated in fiscal year 1993. The project is not economically feasible at this time. Terminal facilities at Bandon include a publicly owned wharf and a small-boat basin.

Total federal cost of the project through September 1999 was $9,648,300— $693,400 for construction and $8,954,900 for maintenance. Local interests contributed $73,000.

Port Orford

Port Orford is about 250 miles south of the mouth of the Columbia River. The project consists of a 550-foot extension of a locally-constructed breakwater and a 16-foot-deep mooring basin. Construction of the extension was completed in 1968 and of the mooring basin in 1971. The project authorization was modified by the Water Resources Development Act of 1992 to allow the Corps to maintain the authorized navigation channel within 50 feet of the port facility.

Federal project costs through September 1999 were $ 7,937,400 ($758,700 for construction and $7,178,700 for maintenance. Local interests contributed $10,000.

Rogue River

This project is at Gold Beach, 264 miles south of the mouth of the Columbia River. The project provides two jetties at the river entrance and a 13-foot-deep, 300-foot-wide channel from the ocean to a turning basin about one-quarter mile downstream of the state highway bridge. Construction of both jetties was completed in 1960. The north jetty was damaged in the 1964 flood and repaired in 1966. In 1998, in cooperation with Port of Gold Beach, the boat basin channel was relocated approximately 1,000 feet upstream to a new opening in the breakwater provided by the Port of Gold Beach.

The total federal cost of the project through September 1999 was $24,070,400, of which $4,156,300 was for construction, $635,800 for major rehabilitation, and $19,278,300 for maintenance.

Chetco River

The Chetco River rises in the Siskiyou Mountains of the Coast Range and flows 51 miles before emptying into the Pacific Ocean. The Chetco River project is located at Brookings, about 300 miles south of the

mouth of the Columbia River. The project authorization provides for stabilization of a channel through the bar at the mouth of the Chetco River by constructing jetties and dredging. The jetties were completed in 1957. Rock pinnacles and an abandoned bridge were removed in 1959. A small-boat basin and barge slip downstream from the town of Harbor have been constructed with private funds. Modifications to the project, authorized in 1965, include an entrance channel 14 feet deep and 120 feet wide, increasing the elevation of the north jetty and extending it 450 feet, a 14-foot-deep barge-turning basin, a protective dike about 1,800 feet long, and a small-boat access channel 12 feet deep and 100 feet wide. Those improvements were completed in 1970.

In addition to a public boat launching ramp, the Port of Brookings has developed two large-boat basins, one for commercial fishing boats and the other for sport boats. There are four fish-receiving docks and a seagoing barge dock for lumber loading and storage. There is also a privately owned marina and a Coast Guard station. The maintenance authorization for the Chetco River navigation project was modified by the Water Resources Development Act of 1992, which directed the Corps to assume maintenance of the access channel to the south commercial boat basin in lieu of maintenance of the previously authorized small-boat access channel.

The total federal cost of the project through September 1999 was $12,283,800— $2,043,700 for construction and $10,240,100 for maintenance. Local interests contributed $17,700.

Continuing Authority Projects

Coos Bay Western Snowy Plover Habitat Restoration

This project, authorized under Section 1135 of the Water Resources Development Act, restores Western Snowy Plover habitat on the North Spit of Coos Bay by reintroducing pink sandverbena, a native plant species, as a replacement for European beachgrass and constructing a fence to limit predation and restrict human and vehicular access to the project area. Construction of the project began in 1996 and was completed in 1998. The estimated total project cost is $224,000, of which $168,000 is federal and $56,000 is non-federal. The project sponsor is the International Port of Coos Bay.

Current and Recent Studies

Newport North Marina Breakwater

A reconnaissance study of the Newport north marina breakwater, completed in fiscal year 1994 under Section 107 of the Rivers and Harbors Act of 1960, evaluated the potential for providing additional protection to the docks and vessels against waves and tidal surge. A feasibility study was initiated in fiscal year 1994 and completed in May 1996. Findings indicate that an extension to the existing breakwater is economically justified. A 180-foot-long rubblemound would reduce waves from entering the western end of the marina. The project was completed in 1998 at a cost of $1,421,740 of which $1,299,500 was federal and $122,240 non-federal money. The structure extends the existing breakwater to the northwest and provides a 125-foot entrance into the marina.

Rogue River at Gold Beach

A survey report was authorized by Congress in 1964 to determine the advisability of modifying the existing navigation project, with particular reference to providing an extension of the north jetty. Model studies to identify

means of alleviating shoaling problems near the river's mouth have been completed. A technical report presenting study findings to date was completed in 1984. The document identified three potential project options: intensive maintenance dredging; jetty extension and maintenance dredging; and a new entrance and maintenance dredging.

Three timber-pile groins were constructed in 1984 as a five-year test of their ability to reduce shoaling of the small-boat basin access channel. In 1989, the test period was extended for five more years for two of the three test groins. The report concluded that relocation of the boat basin channel approximately 1,000 feet upstream to a new opening in the breakwater provided by the Port of Gold Beach was more cost-effective.

Chetco River

A feasibility report recommending extension of the north and south jetties and deepening of the entrance channel and turning basin has been forwarded to Congress. Public Law 97-88 authorized design and construction of the project in accordance with Chief of Engineers Report dated May 2, 1977. A General Design Memorandum has been completed.

Tillamook County

A 30-month feasibility study to analyze flood damage reduction and ecosystem alternatives for the Tillamook Bay watershed was begun in August 1999 at the request of the Tillamook County Soil and Water Conservation District. The study will evaluate a full range of alternatives to reduce flood damages, while emphasizing environmentally sensitive and non-structural measures, such as permanent floodplain evacuation. A key component of the study is the creation of a hydrodynamic model of the lower watershed. The model will capture the current condition of the area's five rivers including tidal fluctuations. The model might serve as a basis for a flood warning system in the future. Total cost of the study is estimated at $3.5 million.

Glossary

Acre-foot: A volume of water equivalent to one acre of land covered to a depth of one foot.

Anadromous fish: Fish that hatch in fresh water rivers and tributaries, migrate to and mature in the ocean, and return to their place of origin as adults to spawn.

Andesite: A gray, fine-grained volcanic rock, chiefly plagioclase and feldspar.

Appropriation: The setting aside of money by Congress, through legislation, for a specific use.

Authorization: House and Senate Public Works Committee resolutions or specific legislation which provide the legal basis for conducting studies or constructing projects. The money necessary for accomplishing the work is not a part of the authorization, but must come from an appropriation by Congress.

Basin: (1) Drainage area of a lake or stream, such as a river basin; (2) A naturally or artificially enclosed harbor for small craft, such as a small-boat basin.

Chukar partridge: A largely gray and black Indian partridge introduced into dry parts of the western U.S.

Concrete-gravity structure: A type of concrete structure in which resistance to overturning and sliding is provided by its own weight.

Confluence: The place where streams meet.

Dam: A barrier constructed across a valley for impounding water or creating a reservoir.

Damages prevented: The difference between damages that would occur without a project and damages occurring with a project in place.

Deep-draft harbor: A harbor designed to accommodate commercial cargo vessels with drafts greater than about 15 feet.

Dike: An embankment to confine or control water and/or soil.

Diversion channel: (1) An artificial channel constructed around a town or other point of high potential flood damages to divert water from the main channel to minimize flood damages; (2) a channel carrying water from a diversion channel.

Downstream: In the direction of the flow of a stream.

Draft: The vertical distance from the waterline to the bottom of a floating vessel.

Dredged material: The material removed in excavation or dredging of access canals, boat or navigation channels, drainage ditches, and lakes.

Earthfill dam: A dam, the main section of which is composed principally of earth, gravel, sand, silt, and clay.

Environmental impact statement (EIS): A report required by Section 102(2)(c) of Public Law 91-190 for all federal actions which significantly impact the quality of the human environment or are environmentally controversial. The EIS is a detailed and formal evaluation of the favorable and adverse environmental and social impacts of a proposed project and its alternatives.

Eutrophication: The process by which a body of water becomes, either naturally or by pollution, rich in dissolved nutrients (such as phosphates) and often shallow with a seasonal deficiency in dissolved oxygen.

Flood plain: Valley land along the course of a stream which is subject to inundation during periods of high water that exceed normal bankfull elevation.

Habitat: The total of the environmental conditions which affect the life of plants and animals.

Impoundment: The collection or confinement of water, as in a lake.

Jetty: A linear placement of large rocks or concrete shapes, usually built at the mouth of a river, to help deepen and stabilize a channel to provide a navigable river entrance.

Left or right bank of river: The left-hand or right-hand bank of a stream when the observer faces downstream.

Levee: A dike or embankment, generally constructed close to the banks of a stream, lake, or other body of water, intended to protect the land side from inundation or to confine the streamflow to its regular channel.

Lift: The difference in elevation between the upstream and downstream water surface levels in a lock and dam system.

Lock: An enclosed part of a canal or waterway equipped with gates so that the level of the water can be changed to raise or lower boats from one level to another.

Midden: A dunghill or refuse heap of a primitive habitation.

Mouth of river: The exit or point of discharge of a stream into another stream, a lake, or the sea.

Plover: Any of numerous shore-inhabiting birds that differ from the sandpipers in having a short hard-tipped bill and usually a stouter, more compact build.

Pool: A small and rather deep body of quiet water, as water behind a dam.

Reach: A length, distance, or leg of a channel or other watercourse.

Rehabilitation: A major repair job which usually involves considerable reconstruction of already-existing structures.

Reservoir: A pond, lake, tank, basin, or other space, either natural or created in whole or in part by the building of a structure such as a dam, which is used for storage, regulation, control, and release of water.

Revetment: (1) A facing of stone, concrete, or sandbags to protect a streambank from erosion; (2) a retaining

wall.

Riprap: A layer, facing, or protective mound of randomly placed stones to prevent erosion, scour, or sloughing of a structure or embankment. The stone so used for this purpose is also called riprap.

Rubblemound: A type of breakwater built of large quarried rocks dumped on top of each other and built to an elevation that storm waves cannot overtop.

Shoal: A place in any body of water where the water is especially shallow.

Sill: A horizontal beam forming the bottom of the entrance to a lock.

Slough: (1) A small, muddy marshland or tidal waterway, which usually connects other tidal areas; (2) A side channel or inlet, as from a river or bayou; may be connected at both ends to a parent body of water.

Spillway: A waterway over a dam or other hydraulic structure used to discharge excess water to avoid overtopping of a dam.

Tributary: A stream or other body of water that contributes its water to another stream or body of water.

Turning basin: A widened area in a navigation channel or harbor area intended to allow vessels to turn around.

Uncontrolled spillway: An overflow spillway having no control gates.

Upland: Land or an area of land lying above the level where water flows or where flooding occurs.

Upstream: At or toward the source of a stream.

Waterfowl: A swimming bird, such as a goose or duck, usually frequenting freshwater areas; swimming game birds collectively.

Watershed: The whole surface drainage area that contributes water to a collecting river or lake.

Wave-absorbing breakwater: A breakwater is a structure protecting a shore area, harbor, anchorage, or basin from waves. A wave-absorbing breakwater protects by absorbing, not reflecting, the waves.

Wetlands: Areas such as tidal flats or swamps that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support a prevalence of vegetation typically adapted for life in saturated soil conditions.

Wing dam: A wall, crib, row of pilings, stone jetty, or other barrier projecting from the bank into a stream for protecting the bank from erosion, arresting sand movement, or for concentrating the low flow of a stream into a smaller channel.

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