

IV. FUNCTIONAL ACCOMPLISHMENTS

*Flood Damages Electric Energy Irrigation Navigation Recreation Water Quality
Fisheries Operation Special Operations*

The hydrological conditions and the reservoir regulation described in the preceding two chapters have produced significant effects on many aspects of life in the Pacific Northwest. These effects are discussed and quantified within the following benefit categories: flood control, energy generation, irrigation, navigation, recreation, water quality, and fishery operation. These discussions are not intended to be thorough or complete but are cursory and contain only the salient features. For more information contact either the appropriate agency whose [Water Management Group members](#) are listed inside the back cover of this report or contact the Group officers, also listed inside the back cover.

A. FLOOD DAMAGES

The effect of reservoir regulation on downstream river flow is determined by routing (the calculation of travel time, diversions, etc) and comparing regulated and unregulated (*ie* natural or pre-project) flows. The flood damages given in [Table 18](#) are for selected sites associated with reservoir flood control operation and show both the observed flows and damages and the unregulated flows (those that would have been observed without the flood control dams) and the damages prevented (the additional damages that would have occurred without the flood control reservoir operation). The reduction in the river stage or flow that resulted from the reservoir regulation was used to index the value of damages prevented. This year both the observed and prevented damages in northwestern Oregon were difficult to determine because of the multiple floods that occurred in the same locations and the damages from the earlier floods that were still unrepaired at the time of the subsequent flood events.

The flood damage prevented by reservoir operation in the Northwest was \$1,605,450,000. Damages prevented in the Willamette Basin constituted 79% of this total and over 3% of the total was in the Snake Basin. Two-thirds of the Snake Basin prevented damages occurred in the Boise sub-basin.

The damages prevented this year, \$1.6 billion, were high compared to the \$89 million last year, low compared to the \$3.9 billion in WY-97 and the \$2.1 billion of WY-96 which included the seawall extension in downtown Portland. These tables of damages and damages prevented are for Corps projects and do not include damages on uncontrolled streams or at Section 7 projects.

[Table 19](#) is a tabulation of damages prevented by major flood control projects in the Columbia Basin for the period since 1948 through 1999. Damages prevented for the lower Columbia and for the entire Columbia Basin represent the damage for the cost and development of the year of occurrence. At today's cost and development level, the amounts in past years would be much larger. The damage prevented by control of winter floods on tributary streams is not shown.

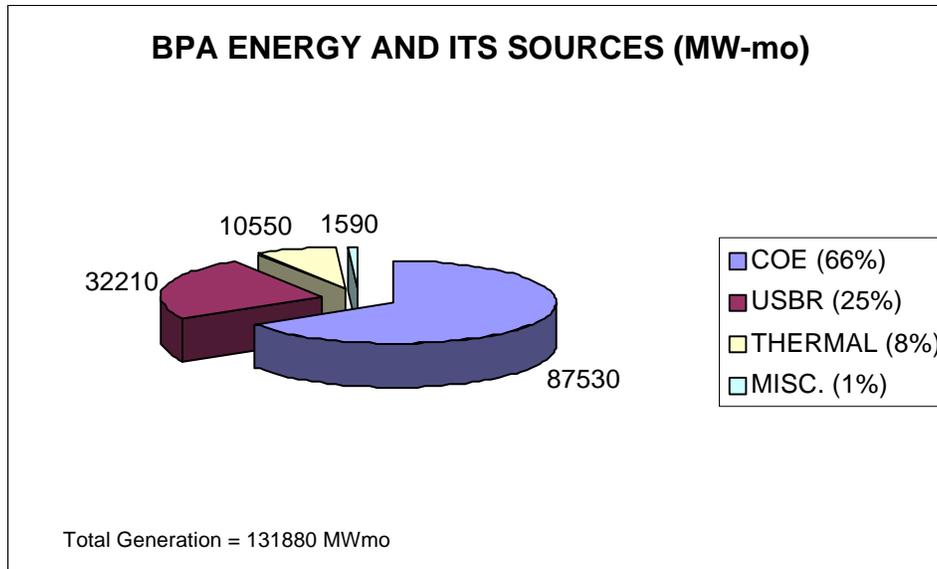
B. ELECTRIC ENERGY

As a federal agency under the U.S. Department of Energy, BPA provides about half of the electrical power and more than three-quarters of the high-voltage transmission in the Pacific Northwest. BPA is a self-funding agency, which pays for its costs through power and transmission sales. Both power and transmission are sold at cost, and BPA repays any borrowing from the U.S. Treasury with interest. BPA's customers include publicly owned and investor-owned utilities, as well as some large industries. BPA also sells or exchanges power with utilities in Canada and the western United States. Revenues BPA earns help it fulfill public responsibilities that include low-cost and reliable power and investments in energy conservation and renewable resources. BPA also funds the region's efforts to protect and rebuild fish and wildlife populations in

the Columbia River Basin.

BPA markets wholesale power to more than 130 utilities in Washington, Oregon, Idaho, and Montana and directly to some aluminum companies. The low-cost power is produced by the Federal Columbia River Power System (FCRPS). The FCRPS is made up of the region's 29 federal hydroelectric dams, which are operated by the U.S. Army Corps of Engineers and the Bureau of Reclamation, and the region's only operating nuclear plant, Energy Northwest's Plant 2 (formerly Washington Public Power Supply System Plant #2). Figure 11 displays the breakdown of Federal generation between the Corps, Reclamation, thermal and miscellaneous energy sources.

Figure 11. Generation Received in Water Year 1999



1. Power Operations

Although participants of the Coordinated System operate their own reservoirs, the power system is operated as a “one owner” system to optimize both energy production and management of the water resources in the Pacific Northwest.

The Coordinated System storage level at the beginning of the 1998-99 operating year was 99.4% full as of July 31, 1998 as measured in the Pacific Coordination Agreement (PNCA) Actual Energy Regulation (AER). The Treaty Storage operation in the AER is fixed from the Treaty Storage Regulation (TSR) study. Since the system was 99.4% full, first-year firm energy load carrying capability (FELCC) was adopted for the U.S. system from the PNCA critical period studies. Due to above normal streamflows throughout the year, the system generally operated to Operating Rule Curve (ORC) or flood control for the entire period, producing large amounts of surplus energy. The system storage energy reached 99.9% full on July 31, 1999, as measured in the AER, and the system adopted first-year FELCC from the 1999-2000 PNCA Final Regulation study.

2. Marketing

FY-99 was a successful year for Bulk Power secondary marketing. The fact that the January through July volume runoff was higher than normal, coupled with higher than normal late summer streamflows contributed significantly to that success. The higher late summer streamflows supported large surplus secondary energy sales throughout a high valued period. The unusually late runoff, however, was at the expense of a lower than expected spring runoff and consequently, it was necessary to purchase power in the late spring. Power purchases for the October 1998 through September 1999 period totaled approximately \$140 million.

BPA's Power Business Line (PBL) marketing to the California Power Exchange (PX) and Independent System Operator (ISO) was again a significant contribution toward the Bulk Hub revenue target this past fiscal year. As the deregulated California power market continued to evolve, PBL traders were able to integrate the California market with our other bulk power marketing throughout FY-99.

3. Industry Changes brought about by Deregulation

The already deregulated electricity market in California continues to evolve rapidly with significant changes to market and product structures occurring regularly. BPA continues to track and adapt to these ongoing changes and to participate in both the PX and ISO markets where it fits our needs and abilities. The ISO price limit, set at \$250/MWh initially, was raised to \$750/MWh as of October 1, 1999, increasing the range over which prices can fluctuate. Some prices above \$250 have already occurred. The full effect of this change may not be seen until there are high load conditions, such as a winter cold snap or a summer heat wave, or system outages that significantly reduce supplies of power.

The ISO faces numerous issues revolving around the challenge of using competitive markets to assure system reliability. The most troublesome questions are those that create potential risks to system reliability in the process of enhancing competition. Two areas of major concern are auctions for reserves and the process of obtaining energy to balance loads in real time. Another major issue is how to manage real time schedule curtailments that change prices from initial awards in the competitive market.

California has been a laboratory for a massive experiment in deregulation, and everyone involved is a pioneer exploring uncharted territory. Changes will continue as startup costs are paid off, and when the PX loses its captive market of the California utility loads that are required to buy and sell their power through the PX. The PX is working to establish a long-term role for itself through product innovations and customer service. The rapid pace of change and shifting opportunities are likely to continue for at least a few more years.

The Federal Energy Regulatory Commission (FERC) published a draft Notice of Proposed Rulemaking (NOPR) regarding the creation of Regional Transmission Organizations (RTOs) this year. It focused on defining four key minimum characteristics and seven key functions that every RTO should have. Outside of those items, the NOPR proposes allowing regions a very flexible approach to RTO design. It also proposes that RTOs should be in place by December 15, 2001-- a very aggressive schedule. BPA provided comments to Department of Energy on the NOPR, many of which were forwarded to FERC. A final ruling is expected no later than early 2000. The final FERC rule will form a basis for moving forward with discussions regarding formations of a Northwest RTO. Several workshops were held in the Northwest this year to initiate discussions about forming an RTO. BPA's Transmission Business Line (TBL) is actively participating in these discussions. TBL, with ownership of approximately 75% of the region's high voltage transmission capacity, expects to play a key role in the potential future development of a NWRTO. PBL expects to be greatly affected in the areas of transmission and reserve services for all of our customers and transactions should a Northwest RTO form.

4. Power Subscription

In December 1998, BPA unveiled its Power Subscription Strategy, a strategy for selling wholesale electricity in the 21st century. The Power Subscription Strategy outlined a process that will enable the people of the Northwest to share the benefits of the Federal Columbia River Power System after 2001 when current rates and most firm power contracts expire. BPA aims to maintain its primary wholesale rate at or about the 1996 level through 2006. The agency will put more than 6,000 average megawatts on the block. The sales will commence in 2001. The marketing strategy is the outgrowth of an 18-month public process initiated by the governors of Washington, Oregon, Idaho, and Montana under their Comprehensive Review of the Northwest Energy System. The strategy was revised after extensive public comment. It contains the following key components:

- ! Spread the benefits of the Federal Columbia River Power System as broadly as possible, with special

attention given to the residential and rural customers of the region;

! Avoid rate increases through a creative and businesslike response to markets and additional aggressive cost reductions;

! Allow BPA to fulfill its fish and wildlife obligations while assuring a high probability of U.S. Treasury payment; and

! Provide market incentives for the development of energy conservation and renewable resources as part of a broader BPA leadership role in the regional effort to capture the value of these and other emerging technologies.

BPA's PBL is moving toward its goal of completing and signing Subscription contracts by September 2000.

During the development of the Subscription Strategy, a group of NW public utilities that own and operate generating resources proposed an arrangement for obtaining power and capabilities of the FCRPS. The basic premise of the proposal, called the "Slice of the System" (Slice), is that a purchaser would pay a fixed percent of BPA's power costs in exchange for a fixed percent of FCRPS generation and capabilities. After evaluating the proposal with its customers, BPA decided to proceed with the development of the Slice product as a Subscription product.

In mid-August 1999, the BPA published its initial rate proposal in the Federal Register for FY 2002-2006 wholesale power rates. The initial rate proposal describes how BPA intends to develop rates to implement BPA's Power Subscription Strategy. BPA will make a final decision on its rates in early to mid-2000 after the administrator considers the record developed through the formal rate hearing process.

Because of wholesale electricity deregulation, BPA is for the first time splitting its rate-making activities into two parts to determine rates for BPA's Power Business Line and Transmission Business Line for the post-2001 period. Certain issues will be addressed in the power rate case that affect whether costs are recovered in power, transmission or ancillary service rates.

5. BPA Fiscal Obligations

BPA's FY-99 payment to the U.S. Department of Treasury was \$628 million. This payment includes \$421 million in interest that actually provides a return to the federal government on its investment in the Federal Columbia River Power System. In addition, \$191 million went to principal and \$16 million went to operations and maintenance at the federal dams primarily for fish hatcheries linked to the lower Snake River dams.

Besides the current treasury repayment, BPA for the first time ever provided \$141 million in direct funding for the entire operations and maintenance at the U.S. Army Corps of Engineers and the Bureau of Reclamation facilities in the Pacific Northwest. In the past, Congress appropriated the money and BPA reimbursed the Treasury at the end of the year. BPA also paid \$4 million in U.S. Treasury bond premiums.

6. Energy Licensing and Regulation

As of the end of the water year, the Federal Energy River Regulatory Commission (Commission or FERC) had a total of 140 outstanding licenses and 107 exemptions in the Columbia River Water Management Group area, which the Commission's Portland Regional Office staff inspects for compliance with its dam safety program and other terms and conditions of project authorization. Also, 18 applications for license involving new hydropower capacity were pending within the area. In all, the Commission has 265 projects under its supervision in the area, consisting of either outstanding licenses, exemptions issued, or applications for license. [Table 20](#) is a breakdown of these categories by state.

Construction inspections were conducted at 20 projects during the reporting period representing an expenditure of \$35,008,500. The total estimated cost of construction on these projects is \$132,973,000.

C. IRRIGATION

Irrigation service from Bureau of Reclamation projects was available to an estimated 2,870,000 acres in 1999 and there were no reported water shortages. The water came from 52 reservoirs with an active capacity of about 10,090,000 af. This does not include 8,214,000 af of storage in Franklin D. Roosevelt Lake (behind Grand Coulee Dam) and Hungry Horse Reservoir in western Montana.

D. NAVIGATION

The Corps of Engineers operates navigation locks on three waterways in the Pacific Northwest: the Columbia-Snake River Inland Waterway in Washington, Oregon, and Idaho, the Willamette Falls Lock in western Oregon, and the Lake Washington Ship Canal in Seattle. The Columbia-Snake River Inland Waterway, [Figure 12](#), extending 465 river miles from the Pacific Ocean to Lewiston, Idaho, provides safe passage for ocean-going vessels for more than 100 river miles up to Vancouver, Washington, (on the Columbia River) and Portland (on the Willamette River) and for shallow-draft tugs, barges, log rafts, and recreational vessels from Portland, Oregon, to Lewiston, Idaho. Four of the nation's top 100 ports, based on total domestic and foreign cargo tonnage, are located on the Columbia/Willamette rivers, downstream of the dams and navigation locks. The combined tonnage of these ports would place them twelfth in the nation, more than that of either Los Angeles or Norfolk Harbor. The major commodities exported through these ports are farm and timber products while the imports are petroleum products and chemicals.

Navigation on the shallow draft portion of the Columbia Inland Waterway from Portland to Pasco, Washington, is made possible by four locks that elevate the river from 8 ft mean sea level (msl) below Bonneville Dam (river mile 146), 42 miles east of Portland, to the mouth of the Snake River (river mile 324) in McNary Reservoir at an elevation of 340 ft msl. This latter pool extends to Pasco on the Columbia and to Ice Harbor Dam (river mile 9.7) on the Snake River. Navigation on the Snake River from its confluence with the Columbia near Pasco, to Lewiston (river mile 140), is made possible by four locks which elevate the river from 340 ft at Ice Harbor Dam to 738 ft at Lewiston on the Lower Granite reservoir.

The nominal size of these eight locks are 86 ft wide and 675 ft long. All the locks were closed simultaneously during March for annual maintenance.

Navigational flow requirements on the Columbia and Snake rivers were met by streamflows and pool levels determined from other project requirements. Cargo was generally transported without any special operational requirements, although occasionally some unusual navigation requirements demand special regulation. However, these special requirements did not generally alter the Columbia River regulation enough to have a significant effect on other project purposes.

The special project operations were necessary to meet navigational requirements during this year had to do with vessel groundings, emergency operation at projects, and for transportation and off loading of decommissioned defueled submarine nuclear reactor cores at Hanford, Washington. The latter special operations were required at both upstream and downstream projects to hold the McNary pool at a constant elevation during the several hours required to off load the reactor cores.

Commercial cargo through the Columbia-Snake locks consists chiefly of farm, lumber, and petroleum products with down-bound cargo consists mostly of the first two and up-bound the latter. March tonnages are less than other months due to the annual closure for maintenance. More information on these projects can be found on the Corps' web site at: www.wrsc.usace.army.mil/ndc/.

The Willamette Falls Lock, located on the Willamette River at Oregon City, uses four chambers to lock vessels, loaded mainly with sand and gravel or wood by-products, around the 40-foot high Willamette Falls. Efforts to rebuild the locks with a single chamber have never been funded. More information on this project can be found on the Corps' web site at: www.nwp.usace.army.mil/co/st/nl/index.htm.

The Hiram M. Chittenden Locks at the west end of Lake Washington Ship Canal provides ship travel between the saltwater of Puget Sound and the freshwater of Salmon Bay, Lake Union, and Lake Washington. The major cargo through the locks is sand, gravel, and wood products. However, because of its proximity to the heart of Seattle the majority (54%) of its lockages and 95% of the vessels locked are pleasure craft,

especially in the summer. A large portion of the Seattle commercial fishing fleet, consisting of trawlers and gillnetters, is moored in Salmon Bay, immediately above the locks. During the commercial fishing season these vessels are major users of the locks. Tour boats and government vessels, especially NOAA vessels based on Lake Washington, and Coast Guard vessels moored above the locks, also use the locks. More information on this project can be found on the Corps' web site at: www.nws.usace.army.mil/opdiv/lwsc/lakewsc.htm.

E. RECREATION

Although many agencies provide recreational facilities, the only agencies to also have project operational activities are the Corps of Engineers and the Bureau of Reclamation. These operational activities include not only those activities for which the projects were authorized but also those ancillary activities which benefit the public without adversely impacting the authorized operations. The added benefits include maintaining some reservoirs within certain elevation ranges throughout the recreation season while at other projects it may be regulating downstream discharges for the activities. Recreational activities include boating, fishing, sailing, hunting, rafting, wind surfing, hydroplane racing, and cross channel swimming. In some cases, the reservoirs are maintained at high elevations during the camping and picnicking season for aesthetic reasons.

Historically, the Corps and Reclamation use different methods to count visitation-days and consequently they could not be directly compared. Now both agencies will be using the visitor-hour/visitor-day method. The difference in the two systems used in the past was that a recreation-day equaled a visit by one person to an area for all of or any part of a 24-hour day; whereas a visitor-hour equated to actual time spent on an area. Twelve visitor-hours equals one visitor day.

1. Corps of Engineers

The total capital investment in recreation development is over \$45 million which generates significant benefits each year. Recreational use at Corps administered water resource projects was an estimated 9.0 million 12-hour visitor-days, or 110 million visitor-hours. Three Corps projects each exceeded half-million visitor-days of use and one project, Bonneville Dam, exceeded 1 million visitor-days.

Sightseeing continues to be the leading recreation activity. Facilities such as visitor centers, overlooks, and interpretive facilities are provided to accommodate this use. Swimming, boating, fishing, and general day use activities are other recreational opportunities sought by visitors to Corps projects. Wind surfing, particularly on the Columbia River projects, has become a highly visible activity over the past several years.

2. Bureau of Reclamation

Reclamation reservoirs provide water-based recreation opportunities unique to the surrounding areas in some of the more arid portions of the region. Reclamation's Pacific Northwest (PN) Region has 79 recreation areas on 66 reservoirs, providing 395,000 acres of water surface and 2,400 miles of shoreline. Reclamation works cooperatively with state, county, irrigation districts, and federal agencies, as well as private concessionaires in developing and managing many of the recreation areas at Reclamation reservoirs. Recreation facilities include 6,250 campsites in 148 campgrounds; 150 picnic areas; 39 swimming beaches, and 196 boat launch ramps. Recreation facilities are evaluated in terms of visitor safety and accessibility and upgraded as needed.

The major focus and direction of Reclamation's recreation activities is to develop partnerships to manage and administer the recreation areas and resources at Reclamation projects. These partnerships with state and local governments require that Reclamation participate, on a cost-sharing basis, in the planning, development and expansion of the recreation facilities to meet the recreation and resource needs associated with the area.

The PN Region continued to support the Catch A Special Thrill (C.A.S.T.) program through four events. Children that range in age from 7-16 years old and that have a variety of physical or developmental disabilities or in some cases, a terminal illness, are invited to participate. The events this year were at the Black Canyon Park near Boise, at Potholes Reservoir in eastern Washington, at Henry Hagg Lake near Portland, and Prineville Reservoir near Bend, Oregon.

F. WATER QUALITY

The Corps of Engineers and the Bureau of Reclamation conducted operations-related water quality activities, checking for impacts of project performance in relation to federal and state water quality standards and their effects on stream water quality. Most of these activities were carried out during the juvenile fish migration season.

1. Total Dissolved Gas (TDG) Monitoring

The Columbia/Snake River Total Dissolved Gas Monitoring Program is an annual continuing activity started in 1984. Its primary objective is to collect total dissolved gas and water temperature data needed to schedule real-time reservoir releases and spill operations during the anadromous fish migration season (April-August). Monitoring also continued at a few stations past August and through the following winter season. Field data collection has been a Districts responsibility since 1996, but program coordination and data management including data storage continue to be conducted in the Division Headquarters.

In 1999, a total of 41 instruments were used at various forebay and tailwater stations during the juvenile migration season. These included 27 instruments operated by the Corps, four by the Bureau of Reclamation, and ten by the mid-Columbia PUDs (Figure 13). Two new stations, Columbia River at Pasco and Snake River near Anatone, were added, Wauna Mills and Kalama were removed, the Libby tailwater station was never activated for lack of spill at the project. Year-round monitoring involved 11 stations, including International Boundary, Dworshak tailwater, Lower Granite forebay, Lower Granite tailrace, Ice Harbor forebay, Ice Harbor tailwater, McNary forebay (Washington side of the river), McNary forebay (Oregon side), McNary tailrace, Bonneville forebay and Warrendale, Oregon, below Bonneville Dam.

All the data collection instruments were fully automated. All data were compiled and posted along with pertinent reservoir and flow information on the CROHMS data base, and the Technical Management Team (TMT), Portland and Walla Walla District homepages. As was done in the previous five years, the National Marine Fisheries Service (NMFS) obtained waivers from Oregon and Washington to allow spill to occur above the state standards. Nez Perce did not grant waivers this year, for spill above the standard at Dworshak. However, EPA worked closely with the tribe and EPA ultimately issued several temporary waivers that applied earlier - mid August. Because of a well distributed runoff pattern in 1999 the TDG levels were maintained below the waived standards for most of the season at most sites. A detailed report on the Corps' Dissolved Gas and Water Temperature monitoring activities during 1999 reference the following web site:

www.nwd-wc.usace.army.mil/TMT/1999/documents .

2. Water Temperature Monitoring

Monitoring of water temperature conditions throughout the Columbia and Snake river mainstems was conducted as part of the dissolved gas monitoring. Water temperature has also been recorded at the project turbine scroll case (or comparable location) since construction of each project. These daily data provide an historical database of water temperatures since project construction.

3. Other Water Quality Activities

a. BUREAU OF RECLAMATION. The primary emphasis of Reclamation water quality activities is to identify problems associated with management of operating projects and to develop appropriate corrective strategies.

! Reclamation continued a reconnaissance level study of potential water quality improvement measures at Lake Lowell, an off stream storage facility on the Boise Project which is included in Deer Flat National Wildlife Refuge.

! Reclamation initiated development of feasibility level designs for three structural alternatives to abate total dissolved gas at Grand Coulee Dam under the Grand Coulee Gas Management Study in 1999. Cross sectional physical models were constructed to assist in designing (1) extended outlet tubes, (2) spillway flow deflectors, and (3) forebay pipe with cascade structural alternatives for gas abatement.

! The Burnt River Basin Water Temperature Modeling Study was continued, in cooperation with the Oregon Water Resources Congress and Powder River Basin Watershed Council, to provide a broadly acceptable scientific basis to assist in the development of a water temperature plan for the Burnt River basin.

! Reclamation continued cooperative water quality data gathering and modeling with the University of Idaho and the Mid-Snake Watershed Advisory Group in the Middle Snake River area between Minidoka Dam and King Hill. The data provides baseline information on water quality in the middle Snake River and in irrigation returns to the river for use in nutrient management planning, and evaluating impacts of the salmon migration flow augmentation program on threatened and endangered snail populations in the Snake River.

! Reclamation participated in multi-agency efforts to develop water quality management plans for the lower Boise and Payette rivers. Work on irrigation waste water reuse assessments continued in the lower Payette watershed.

! The Oregon Department of Health has issued a fish consumption advisory for Owyhee Reservoir in response to studies confirming elevated fish tissue mercury in excess of EPA's 0.6 mg/kg screening level. Reclamation conducted sampling of mercury in sediment and water at a number of reservoir locations and stream nodes to assist in defining mercury sources and fate and transport within the reservoir. Mapping of mercury-containing mineral sources in the reservoir watershed was also initiated using an infra-red imaging spectrophotometer. Investigations are scheduled for completion in 2000.

! The Minidoka North Side Pumping Division was designed and constructed by the Bureau of Reclamation in the 1950's, using injection wells (which are subject to State of Idaho regulations) for disposal of most irrigation return flows and storm water runoff. Drain water and storm water entering the injection wells for the quality of injected water.

! Work on Reclamation's reservoir water quality surveillance program focused on reservoirs supplying small projects in eastern Oregon. The program provides for long-term systematic collection of chemical, physical, and biological data needed to manage water quality in Reclamation reservoirs and downstream releases.

! Long-term water quality monitoring of irrigation supplies and returns continued with primary emphasis on the Boise, Columbia Basin, Minidoka, Tualatin, and Yakima projects. Additional data was gathered for assessment of non-point source irrigation impacts in the Owyhee, Grande Ronde, Malheur, Powder, and Burnt river basins.

b. CORPS OF ENGINEERS Other water quality work by the Corps is discussed by districts.

Portland District

! Water quality monitoring for nutrients and limnological parameters continued at Lost Creek and Applegate reservoirs in the Rogue River Basin for modeling purposes to help improve downstream water temperatures for fish enhancement.

! Mercury studies, in cooperation with the Oregon Department of Environmental Quality, continued at Dorena and Cottage Grove reservoirs in the Willamette basin to see if methyl-mercury is generated in the anoxic region of the lakes or in their wetland regions.

! At Willow Creek Lake nutrient, methane, hydrogen sulfide and other limnological data were collected to determine the feasibility of outflow temperature control.

! Botanists from Portland State University performed a survey of nuisance aquatic plants at all reservoirs in the District. Preliminary results suggest that nuisance plants do not affect most of the reservoirs and that the Fern Ridge and Dexter projects in the Willamette Basin have the greatest diversity of plants.

! Sediment samples were obtained at two Federal navigation projects in the Lower Columbia River Management Area: the reach from Vancouver to The Dalles and in Portland Harbor. Bulk physical and chemical analyses were performed on samples to determine compliance with water quality standards, and in some cases suitability for ocean disposal.

Seattle District

! Control of saltwater intrusion continued to be an issue at the Hiram M. Chittenden Locks. Real-time water quality data collection from five stations and transmission to the District Office, computer models and *in situ* operations are being used to make decisions on more efficiently control saltwater to improve smolt passage over the dam.

! Studies continued on the effects of increased conservation storage at Howard Hanson Dam on both in-reservoir and downstream water quality in anticipation of fish and wildlife restoration. A thermal budget model was used to simulate several selective withdrawal and fish bypass system operation alternatives.

! Libby water temperature monitoring continued and the District successfully used a numerical model to assist a multi-agency sturgeon recovery team in planning Libby Dam releases that would encourage white sturgeon spawning in the Kootenai River.

! The District conducted meetings with the Department of Interior, Colville Confederated Tribes, and local net pen operators to address the effects of high TDG levels in Lake Rufus Woods above Chief Joseph Dam.

! Albeni Falls treated 15 acres of Eurasian Watermilfoil in Albeni Cove, on Lake Pend Oreille with the aquatic herbicide Renovate. This chemical was used under an EPA granted experimental use permit (EUP). The area treated was limited primarily by funding constraints.

! The District completed a spill test in June and is continuing to address the issues of dissolved gas abatement within the System Configuration Team for the Columbia River.

Walla Walla District

! A series of water quality studies were conducted in 1999 to support the Lower Snake River Juvenile Salmon Migration Feasibility Study (LSRFS), including:

The Baseline Limnological Study continued for the fifth year, as necessary for the affected environment portion of the EIS and to provide existing condition empirical data to compare to the model results.

! A sediment GIS database was completed to aid in the evaluation, distribution, and possible redistribution of sediments likely in the case of reservoir drawdown or during and after proposed dam breaching.

! Additional sediment studies were made to support the Dredge Material Management Study for the Lower Snake River and McNary Reservoir.

! At the four lower Snake projects, Lucky Peak, and Dworshak reservoirs, water samples for analysis for nutrients and chlorophyll and vertical water quality profiles were taken quarterly.

North Pacific Region Office

! The Northwestern Division, North Pacific Region, Water Quality Section has been active in the Water Quality Team, previously called the Dissolved Gas Team (DGT), in discussing issues which include:

"To determine if the current regional temperature monitoring networks are adequate for answering "regionally critical questions,"

" Is the information exchange adequate between concerned parties, and

" Continue the evaluation and improvements in the EPA's "Water Temperature Model."

Operations/TMT

! The Technical Management Team (TMT) considers proposed operations throughout the in-season management process. Summertime operations often involve scheduling of water-temperatures related reservoir operations that are timed to coincide with adult returns.

! The U.S. Fish and Wildlife Service has been studying ways to time releases from Brownlee to better complement juvenile outmigration of fall chinook and is continuing to monitor release survival as it relates to temperature.

G. FISHERY OPERATIONS

Fishery operations were implemented in accordance with the Corps' Fish Passage Plan (FPP), which describes the manner in which the Corps' mainstem projects on the lower Snake and Columbia rivers will operate throughout the year to provide safe fish passage. This was in compliance with both the National Marine Fisheries Service (NMFS) Biological Opinion (BiOp), dated 1995 and with the NMFS 1998 Supplemental BiOp. The latter contains other measures, including flow augmentation in the Columbia River, additional 427 kcf from the upper Snake River, in-season water management process, and operating the lower Snake River reservoirs at minimum operating pool (MOP) and John Day reservoir to the minimum level needed for irrigation pumping. In-season management of river operations was again provided by the Technical Management Team (TMT) while dispute resolution and policy guidance was provided by the Implementation Team (IT) and Executive Committee (EC) which are made up of representatives from the Corps, Reclamation, BPA, NMFS, USFWS, ODFW, WDFW, and IDFG. This year the state of Montana returned to the in-season process. CRITFC still remained withdrawn from the in-season process although they participated in some meetings and made system operations requests.

1. Actual Operation

This year the Columbia basin runoff ranged from 108% to 132% of normal. The late arrival of the freshet this year resulted in Dworshak being drafted more than anticipated for spring fish flow augmentation. Because of this extra drafting Dworshak was unable to totally fill this year.

Significant operations for fish at other projects included:

! Bonneville, special releases for fall chinook and chum salmon spawning and spill for the Spring Creek hatchery release,

! The Dalles, spill for juvenile fish passage was alternated between 30% and 64% to test juvenile fish passage and survival in conjunction with a daytime spill test at John Day;

! Libby, a discharge pulse was provided for sturgeon spawning attraction, and

! Dworshak, cold water was released to reduce water temperatures in the Snake River. A new item this year was special operations to minimize juvenile fish stranding in the Hanford Reach. This operation was designed to reduce river fluctuations when juvenile fish were in the Columbia River below Priest Rapids Dam.

2. Spill and Flows for Fish

This year the spill for juvenile fish passage was provided in accordance with the 1998 supplemental BiOp. The 1998 BiOp had a goal of mostly spilling the maximum amount (up to the TDG limiting cap). Individual projects vary in the timing and amount of spill. Because of the increased amount of spill ([Table 21](#)) minimum generation requirements were in place. The early start of juvenile fish migration necessitated an early beginning of spring spill for fish passage. Spring spill started on April 2 at the lower Snake projects instead of the normal April 3 and on April 11 at the lower Columbia projects instead of the normal April 20. Pre-April 20 spill at the lower Columbia projects was less than what the 1998 supplemental BiOp required. Spill at projects that were transporting fish in the summer (McNary, Lower Monumental, Little Goose, Lower Granite dams) stopped on June 20 at the lower Snake projects and on June 30 at McNary. All other spill for fish stopped at midnight August 31. Spill at the projects was modified for brief periods of time for navigation concerns and to allow the fish transport barges to load. The seasonal flow objectives were managed on a weekly basis by the TMT and Federal action agencies. Both spring and summer flow objectives (100 kcfs and 54 kcfs, respectively, as measured at Lower Granite Dam) were exceeded for the Snake River. Weekly flows exceeded the seasonal objective six of ten weeks in the spring at Lower Granite and three of ten weeks in the summer at Lower Granite. Columbia River flows at McNary Dam exceeded the seasonal flow objective in both the spring (260 kcfs) and the summer (200 kcfs). Weekly flows exceeded the flow objective at McNary in nine of ten weeks in the spring and exceeded the summer seasonal objective at McNary in eight of nine weeks. The spring flow objective at Priest Rapids of 135 kcfs was exceeded ten of eleven weeks. See Chapter III for more details.

3. Juvenile Fish Runs

Salmonids were hatched either in hatcheries or in the river (called wild fish) where they grow until their time for migration to the ocean. In some case, selected hatchery fry are placed in the river to grow in a natural setting before they began their natural migration to the ocean. Some species begin their migration in the year of their hatching while others winter in the river before beginning their migration to the ocean.

Juveniles are subjected to many perils while migrating, including predation from other fish and birds, spill at dams that can cause high levels of total dissolved gas and gas bubble disease, physical injuries that may occur during dam passage, stress, diseases, and other problems. Depending upon the location in the basin of the hatcheries or redds, young fish will have to traverse up to nine dams on their out-migration. To help mitigate these dangers, an alternate method of transportation has been developed using specially designed barges and tanker trucks transport the young fish to a release point downstream of Bonneville Dam. This reduces their travel and predatory mortality rate for most species while at the same time maintaining their biological timing for arrival at the ocean.

a. HATCHERY RELEASES. Hatchery fish released into the Columbia Basin streams and rivers above Bonneville Dam totaled approximately 79.4 million juvenile salmon, about 5 million less than in 1998. The major difference in the totals for these years was in the reduced number of tule fall chinook released this year into the Columbia River from Spring Creek National Fish Hatchery, almost 13 million less from that hatchery alone. Thus, most other agencies and hatcheries showed an increase in release totals this year. This year's release of summer chinook from hatcheries on the Snake was about twice last year's total with yearling spring chinook in the Columbia Basin also increased this year. The release of steelhead was near normal in the Snake and upper Columbia rivers. Release of sub-yearling and yearling fall chinook was near normal with exception of the tule fall chinook which was above normal.

b. COLLECTION OF JUVENILES. Lower Granite, Little Goose, Lower Monumental, and McNary dams are "collector dams" that are equipped with submersible traveling screens, bypass facilities, and raceways capable of holding large number of fish for later transport past the dams in barges or trucks. Operation of the fish collection facilities at Lower Granite, Little Goose, and Lower Monumental continued through October while the facility at McNary was scheduled to operate as long as fish were present and passing the project, and while conditions permitted. It should be noted in the onset that the number of juveniles collected, bypassed, or transported is not a good indicator of the size of the juvenile fish run. Collection efficiency, spill rate and timing, and other factors all play key rolls in juvenile passage. With the high flows this year the fish managers decided to let more of the juveniles migrate in the river, despite the higher TDG values. The number of juvenile fish collected this year was 116% of that in 1998 and the number of juvenile fish bypassed was more than twice (228%) that of the previous year. The actual counts of fish collected and bypassed are summarized in [Table 22](#).

c. TRANSPORTATION. Transportation of juveniles was initiated in the early 1970's to reduce juvenile mortality resulting from passage through powerhouse turbines, project reservoirs, and predators. This truck transportation proved effective for most species so specially designed barges were built in 1977 for more effective transportation of large quantities of fish from the lower Snake and Columbia rivers. Now, trucking is limited to periods when daily collection is less than 20,000 fish per day. Juveniles are transported from upstream collector projects to a location downstream of Bonneville, the most downstream dam, where they are released back into the river. This year the juvenile transport season began in March and ended in October at Lower Granite, Little Goose, and Lower Monumental. At McNary transportation began June 24 and remained in operation as long as juvenile fish continued to arrive at the project or until the facilities had to be closed for safety. The total count of juveniles listed by transport mode and project is given in [Table 23](#). The total number of fish transported by barge and truck was slightly greater than last year. The highest count was in 1990, the second highest in 1988, 1999 was third highest, and 1998 was fourth highest.

4. Adult Fish Runs

The number of returning adult fish of many different species were counted at thirteen mainstream Columbia and Snake River dams, however this summary (Table 24) will be limited to the salmonid race and species counts at three major sites: the Bonneville counts are an indication of the total number of adult salmonid returning to the Columbia system to spawn, the McNary counts indicate the number of adults passing the lower Columbia spawning areas and traveling into the mid Columbia and Snake rivers to spawn, the Ice Harbor counts indicating the number returning to the Snake Basin spawning areas, and the difference between the McNary and Ice Harbor counts is an index to the mid-Columbia return.

This was a mixed year in regard to counts on the Columbia and Snake River. Spring chinook adult numbers were less than the 10-year averages and on the whole equal to or less than the 1998 run. Summer chinook adults were higher than the 10-yr averages and 1998 counts on the Columbia but less than both measures on the Snake. All fall chinook adult runs were higher than the 10-yr averages and the 1998 counts. Coho adults in general were higher than the 10-year averages and the 1998 counts. Sockeye counts were in general lower than the 10-year averages but higher than the 1998 counts. Steelhead counts were generally lower than the 10-year counts but higher than 1998. One of the most interesting items this year was the high number of chinook jacks returning. During the spring season chinook jack counts were from 10 to 20 times higher than last year and from two to six times the 10-year averages. This indicates a potential for a large adult run next year for spring chinook.

More detailed information on fish passage can be found on the world wide web at the following sites.

<http://www.nwp.usace.army.mil/op/fishdata/adultfishcounts.htm> (the Corps' new adult count page site)
or <http://www.fpc.org/adult.html> (the Fish Passage Center's adult count page)
or <http://www.cqs.washington.edu/dart/adult.html> (University of Washington adult count page)

H. SPECIAL OPERATIONS

1. Vernita Bar

As in the past, flows were provided at Vernita Bar to encourage fall chinook spawning at low elevations in the channel as required by agreement between Grant County PUD and the Federal Energy Regulatory Commission. During mid-October through late November, daytime discharges at Priest Rapids were kept below 60 kcfs as much as possible to minimize redd building above that level on Vernita Bar. This was accomplished by reverse load factoring at the project, with reduced power generation during daylight hours and higher generation at night to pass the daily average inflow.

2. Libby Arrow Swap

The Canadian and United States entities of the Columbia River Treaty Operation Committee entered into an agreement to store and release water in Libby and Arrow reservoirs in an optimal manner. They agreed to store water in Libby during August 1-31, 1998, and return water to Arrow between September 1, 1998, and January 16, 1999. Due to the abundance of water in WY-99 a Libby/Arrow storage exchange was not needed.