

III. RESERVOIR REGULATION

SYSTEM OPERATION PROJECT OPERATION Mica Revelstoke Keenleyside Libby
Bonners Ferry Duncan Kootenay Lake Birchbank Hungry Horse Columbia Falls Kerr Albeni
Falls Grand Coulee PUDs Yakima Jackson-Palisades Ririe American Falls
Little Wood Owyhee Boise Malheur Payette Weiser Powder Brownlee Dworshak Spalding
Lower Snake Mill Creek Willow John Day Upper Deschutes
Chief Joseph-Bonneville Vancouver Willamette Western Washington

The reservoir system in the Northwest is made up of Federal, municipal, public, and privately owned dams and reservoirs. Regardless of ownership major projects are operated in accordance with the Pacific Northwest Coordinating Agreement. This agreement coordinates the seasonal operation of the system projects for the best use of their collective reservoir storage, and along with some of the other agreements that affect project operation. In this chapter, however, the regulation of the system as a unit is described followed by the regulation of the operation of individual projects, and the effects upon key gages, in downstream order and chronologically from the beginning of the operational year.

The coordinated system of reservoirs is listed in [Appendix C](#). Daily project operations are shown on charts in [Appendix D](#). Charts 5-30 show the storage and streamflow hydrographs from July 1, 1999 through September 30, 2000, for major storage projects, Charts 31-56 present the annual hydrographs for flood storage projects, hydrographs of the spring freshet are shown in Charts 57-79, Chart 80 shows The Dalles discharge hydrograph for regulated and unregulated conditions, Charts 81-84 are the control point hydrographs for the Willamette Basin, Charts 85-88 are the reservoir hydrographs for Section 7 projects, and Charts 89-92 are summary hydrographs for the four key stations.

A. SYSTEM OPERATION

In 2000, the January-July volume runoff at The Dalles was 97.9 MAF, 92.0% of the 30-year average. Based upon the final July 2000 AER, the Coordinated System reservoirs filled to 91.4% for their combined possible full level.

This year's observed peak flow at The Dalles was 169.4 kcfs on 17 May 2001 with a corresponding unregulated peak of 326.9 kcfs on 30 May 2001. Last year's observed peak was 374.6 kcfs.

B. PROJECT OPERATION

The operation of the individual projects is discussed in downstream order, beginning at the headwaters of the Columbia River. Operation of each project is generally discussed chronologically beginning in the summer or early fall of the preceding water year. Exceptions will be noted by including the calendar year. The locations of these projects are shown on the maps in Chapter I, pages 5 through 8.

1. Mica Project

Kinbasket Lake was formed by the construction of Mica Dam near the Big Bend on the upper Columbia River in east-central British Columbia. The project was constructed as part of the Columbia River Treaty between the United States and Canada. It is owned by BC Hydro and Power Authority (BCH) and is operated primarily for power and flood control. This year's operation is graphically shown on [Charts 5 and 57](#).

The Mica Reservoir (Kinbasket Lake) level was at elevation 2450.8 ft on 31 July 2000, 24.2 ft below full pool elevation of 2475 ft. The corresponding Mica Treaty storage account was 94 percent of full at 3331.0 ksfd (6.6 Maf) on that date.

Inflow into Mica reservoir was 91 percent of normal over the period August 2000 to December 2000. The local inflows into Mica reservoir averaged about 36,900 cfs in August, reducing to an average of 4,350 cfs

during December 2000. Mica Treaty storage continued to fill during August, reaching full storage of 3529.2 ksfd (7.0 Maf) on 15 August 2000. Mica outflow varied from a monthly average high of 32,700 cfs in November to a monthly average low of 26,100 cfs in December 2000. From its peak elevation, the reservoir drafted rapidly due to below normal inflow and high load demand. By 31 December 2000, the reservoir reached 2405.8 ft, about 28 ft below the average elevation for that date. By 31 December, Mica Treaty storage was drafted to 2175.6 ksfd. The Mica project had an underrun of 22 ksfd on 31 July 2000, and an overrun of 6 ksfd on 31 December 2000.

For the period January through March 2001, the inflows averaged about 4000 cfs, gradually increasing in April to 5,800 cfs before the start of the spring freshet. Due to below normal spring temperatures, the freshet was delayed by about one month and inflow did not start appreciably until late May. Inflow into Mica reservoir was 78 percent of normal over the period January 2001 to August 2001. Outflow over this same period varied from a monthly average high of 27,200 cfs in February to a monthly average low of 1,200 cfs in June. The reservoir drafted to the minimum elevation for the year of 2345.0 ft on 26 April 2001, only 4.5 ft higher than the historical low pool elevation of 2340.4 ft on 23 April 1993. The reservoir reached the maximum elevation for the year of 2434.9 ft on 4 September 2001, 40.1 ft below the full pool elevation of 2475 ft.

Mica Treaty storage reached minimum on 11 May 2001, with an overdraft of 12.4 ksfd below empty. The overdraft was the result of the Detailed Operating Plan (DOP) Mica minimum flow criteria. Treaty storage gradually refilled with increasing inflow and reached the maximum of 2346.7 ksfd (4.7 Maf) on 24 August 2001. The Mica actual discharges were significantly less than the sum of Mica DOP and Non Treaty Storage Agreement (NTSA) releases from March 2001 through August 2001 due to the flex operation between Mica and Arrow. This resulted in a record underrun of 1141 ksfd by 20 September 2001. The previous historical maximum underrun was 945 ksfd on 6 July 1993. The B.C. Hydro and U.S. NTSA on 31 August 2000 was at 280.8 ksfd and 296.5 ksfd, respectively.

The peak daily inflow was 74.15 kcfs on May 28, 2001, with a corresponding outflow of 0.34 kcfs. Maximum daily outflow was 41.09 kcfs on November 22, 2000. The January-July runoff was 7,441 kaf or 76 percent of normal. The April-September runoff was 12,726 kaf, 77 percent of normal.

2. Revelstoke Project

The Revelstoke project is located on the Columbia River between Mica Dam and Arrow Lakes. It is owned by BC Hydro and Power Authority and is primarily for power generation. This year's operation is graphically shown on [Chart 6](#).

During the 2000-01 operating year, the Revelstoke project was operated as a run-of-river plant with the reservoir level maintained generally within 3.0 ft of its normal full pool elevation of 1880 ft. During the spring freshet, March through July, the reservoir operated as low as elevation 1876.0 ft, or 4 ft below full pool, to provide additional operational space to control high local inflows. Changes in Revelstoke storage levels did not affect Treaty storage operations.

3. Keenleyside Project (Arrow Reservoir)

The Arrow Lakes are two tandem natural lakes on the Columbia River in southeastern British Columbia whose surface elevations are controlled by Keenleyside Dam. At normal operating elevations the land area between the lakes is flooded, creating a single lake. This project was constructed as part of the Columbia River Treaty between the United States and Canada for flood control and downstream power generation. Construction of the dam was completed in 1969. The dam is owned and operated by BC Hydro and Power Authority. The Arrow Lakes Power Company owns the powerhouse that is currently under construction. On March 15, 1999, Columbia Basin Trust and Columbia Power Corporation as joint venture partners under Arrow Lakes Generating Station, initiated construction of a powerhouse with two 85-megawatt turbine and generator units. Construction of the powerhouse should be complete by Spring 2002. This year's operation is graphically shown on [Chart 7](#) and [Chart 58](#).

The reservoir drafted through August and September and reached elevation 1430.0 ft by the end of September 2000. Arrow discharge decreased over the autumn months from an average of 58,200 cfs in

September to 32,600 cfs in October and 37,800 cfs in November. The discharge increased to an average of 58,600 cfs in December. The Arrow Reservoir drafted to elevation 1418.2 ft by 31 December 2000.

The Arrow fisheries operations were conducted under the terms of two Operating Committee agreements, "Operation of Treaty Storage for Enhancement of Mountain Whitefish Spawning for the period of 1 September 2000 through 30 April 2001" and "Operation of Treaty Storage for Nonpower Uses for 1 January through 31 July 2001". These agreements enabled the Arrow project flows to be adjusted to enhance whitefish and rainbow trout spawning and emergence downstream of the Arrow project in BC.

During the period 24 December 2000 to 22 January 2001, Arrow outflow was held near 38,000 cfs to establish river levels during the whitefish-spawning period that could be sustained through the period of emergence in February and March. Unlike the previous operating year where the Arrow TSR flow for January was higher than the preferred whitefish flows, the Arrow TSR flow for January 2001 was closer to the preferred January 2001 whitefish flow. As a result, B.C. Hydro did not need to exercise an available option to store up to 400 ksfd under the agreement to enhance Mountain Whitefish. Arrow outflow through the period of whitefish emergence from 23 January to 23 March averaged 49,000 cfs, which was higher than the whitefish spawning flows. On 24 March, the outflow from Arrow was reduced from 45,000 cfs to 30,000 cfs to meet objectives for rainbow trout spawning under the Non-Power Uses Agreement. Between 10 April and 29 May, Arrow outflow increased to 35,000 cfs, under the same agreement, to permit the U.S. Entity to meet the Vernita Bar salmon flow requirements.

In this operating year, the Columbia River Treaty Operating Committee agreed to use an alternative method for determining the Arrow Variable Refill Curves (VRC's) between January and February 2001. The alternative method, known as the Arrow Local Method uses Mica outflow when computing Arrow's VRC, and on average, results in lower VRC's at Arrow during January through April than the normal method. The Arrow reservoir is still targeted to be full on 31 July. The agreement to use the alternate Arrow Local Method was signed in December 2000, with the expectation that power benefits realized in excess of those expected by the Total Method would be shared equally between BPA and B.C. Hydro. The Operating Committee agreed that operations under the 2001 Arrow Local Agreement resulted in a net generation gain in the U.S. system valued at of 6.48(\$U.S.) million. The B.C. Hydro share of this generation gain will be delivered to B.C. Hydro over the period October to December 2001 in accordance with the agreement.

During the water year 2000-01, the U.S. did not store water in Arrow under the Non-Power Uses Agreement for the purpose of salmon flow augmentation. Inflow to Arrow was below average during the January through March storage period, and outflow needed to be maintained for whitefish spawning and power uses in the U.S. However, due to the low water supply, the Operating Committee did agree to a Summer Treaty Storage Agreement (STS) with mutually agreeable storage opportunities, for the enhancement of summer reservoir levels at Canadian Treaty projects and for the storage of additional water for U.S. Pacific Northwest reliability requirements during the fall and winter of 2001-02. In anticipation of this agreement, which was signed on July 2001, water was stored in Canadian Treaty reservoirs during June and July under the Non-Power Uses Agreement and later transferred to the STS agreement.

The Arrow reservoir drafted to a minimum elevation for the 2000-01 year of 1385.1 ft on 22 May 2001 and only reached a maximum elevation of 1412.1 ft on 3 August 2001, 31.9 ft below the full pool elevation of 1444 ft. The highest Arrow Treaty storage content was 2659.8 ksfd (5.3 Maf) on 19 August 2001. The Coordinated Columbia System was on proportional draft throughout the operating year and Arrow Treaty storage was drafted to 2500.7 ksfd (5.0 Maf) at the end of August 2001.

The peak daily inflow was 91.29 kcfs on May 28, 2001, with a corresponding outflow of 35.43 kcfs. The peak-unregulated inflow was 154.28 kcfs, on the same date. Maximum daily outflow was 83.42 kcfs on December 15, 2000. The January-July runoff was 15,892 kaf or 75 percent of normal. The April-September runoff was 19,340 kaf, or 76 percent of normal.

4. Lake Koocanusa, Libby Dam

Lake Koocanusa and Libby Dam are on the Kootenai River in northwest Montana. This project was constructed as part of the Columbia River Treaty with Canada and is operated by the Corps of Engineers. The lake extends from the dam near Libby, Montana, 60 river miles to the international border and another 30 miles (at full pool) into British Columbia. The project is operated for power, flood control, and recreational benefits. This year's operation is graphically shown on [Chart 8](#) and [Chart 59](#).

Libby inflow in August 2000 was 8.3 kcfs, 85 percent of normal, with the 2000 water year being a near normal water year at 98 percent of average inflow. Libby outflows averaged 8 kcfs in August. The project started releasing 8 kcfs on 3 July after completion of a sturgeon pulse. The 8 kcfs flow was the negotiated flow for bull trout. A peak reservoir elevation was reached on 14 August of 2436.33 ft.

Lake Koocanusa was at elevation 2434.89 ft on August 31, 2000. Libby outflows averaged 7.5 kcfs in September. The end of September elevation was 2432.31 ft. Libby inflow in September was 5.7 kcfs, 86 percent of normal. Precipitation in the Kootenai Division in September was 1.82 inches, 104 percent of normal for the month. The 8 kcfs release was continued through 20 September. Flows were decreased to 6 kcfs in a slow, gradual manner.

For the rest of September and all of October outflows were held at 6,000 cfs. Inflow into Libby began dropping below normal in the fall. Inflow was 70 percent of normal for October. Lake Koocanusa was at elevation 2429.80 ft on October 31.

Precipitation in the Kootenai Division in November was 1.29 inches, 45 percent of normal for the month and inflow in November was 3.14 kcfs, 64 percent of normal. The project continued to release 6 kcfs until 7 November when BPA requested an increase in generation. They requested flows be increased to 12 kcfs. Flows were increased over a two-day period in accordance with the ramping rates from Montana Fish, Wildlife and Parks. These ramping rates will be incorporated in the final USFWS Biological Opinion (scheduled to be released in Dec 2000). Flows varied throughout the month. In general they were lower on weekends and over Thanksgiving. The average outflow for the month was 9.1 kcfs. The end of November elevation was 2420.90 ft.

In December, the region declared a power emergency – without extraordinary measures the region would not be able to meet their firm load requirements. With an arctic front headed into the Northwest, the Northwest Security Coordinator issued a warning of a stage 2 alert on 8 December. The warning was issued at the recommendation of the Regional Emergency Response team, which includes Northwest utilities, federal hydro operation agencies and states. Officially, the warning was called a "Regional Emergency Warning of Potential Alert 2." A level 2 warning is tied to an emergency Alert status (NERC Alert 2) prescribed by the North American Electric Reliability Council. It is called when regional forecasts indicate that firm loads (contractual requirements to supply electricity) can only be met after including extraordinary actions in the projects. In response to this warning, Libby flows were increased to full load for a short time on 11 and 12 December 2000. The Emergency warning was lifted on 12 December and the project gradually decreased flow back to 6,000 cfs. The project reached an end of December elevation of 2411.5 ft, one-half foot above flood control. December inflow averaged 73 percent of normal.

The January Final water supply forecast for 2001 was 4.764 Maf, 74 percent of normal for the period of April through August. The Idaho Fish and Game conducted a burbot study during January to early February. They originally requested flows of 6 kcfs from 1 January – 4 February but after discussions with them in late December, they indicated 4 kcfs was an acceptable flow. Outflow in January 2001 was maintained at 4,000 cfs, the project minimum flow, until 21 January. This operation kept the project from drafting too far below the end of January flood control requirement and aided Idaho Department of Fish and Game's burbot study. Outflow was ramped up to 10,000 cfs on 22 January in response to generation needs for a power emergency. Libby inflow in January averaged 2,500 cfs or 76 percent of normal and the project ended the month at 2405.8 ft, 9.5 ft below the 31 January flood control requirement of 2415.3 ft.

Outflow was maintained at 10,000 cfs until 7 February at which time outflow ramped up to 15,000 cfs to provide additional generation for the power emergency. Additional increases were planned for 13 February, but

the Canadian Entity made a request in accordance with the Libby Coordination Agreement to limit outflow from Libby. A storage exchange agreement was drawn up and signed by the U.S. and Canada. Flow remained at 15,000 cfs through the designated storage period of 13 - 19 February. In exchange for the reduced outflow from Libby, Canada provided additional discharge from Arrow and megawatts to the U.S. Flow was reduced to 6,000 cfs by 23 February and remained there until 4 March. Libby reached an elevation of 2391.2 ft on 28 February, 44.1 ft below the required flood control elevation. February inflow averaged 2,600 cfs, 77 percent of normal. The February final water supply forecast for the period of April through August dropped to 3.936 Maf, or 61.7 percent of normal.

The March release averaged 4,400 cfs. Minimum flow of 4,000 cfs was released from 7 - 6 March when flow was increased to 4,500 cfs from 27 March - 3 April to return the remaining water owed to Canada per the February storage exchange agreement. Lake Koocanusa ended March at elevation 2387.6 ft, 60.4 ft below the flood control elevation. March inflow was 2,700 cfs, which was 74 percent of normal.

Due to the extreme low water forecast, Libby remained at minimum discharge from 4 April - 1 July in an attempt to save water for multipurpose needs later. The project did not perform a sturgeon pulse operation in 2001. Libby inflow averaged 3,800 cfs (47 percent of normal) in April; 16,500 cfs (61 percent of normal) in May; and 17,300 cfs (43 percent of normal) in June. Libby reached end of month elevations of 2387.0 ft in April, 2410.6 ft in May, and 2431.1 ft in June. Water supply forecasts for the April - August period dropped again in April and rebounded slightly in May. The April final forecast was 3.322 Maf (52 percent of normal) and the May final forecast was up slightly to 3.512 Maf (55 percent of normal).

In July outflow was increased to 6,000 cfs for bull trout needs. Also in July the USACE was alerted to an algae problem below Libby Dam. Montana Fish Wildlife and Parks wanted to conduct a pulsing operation at Libby to dislodge the algae from the rocks. During the coordination of the pulse operation, the USACE also received a request to increase outflows to aid in the retrieval of a drowning victim. To meet both requests, flow at Libby was increased to 10,000 cfs for 24 hours and then ramped back down to 6,000 cfs. Both goals of the operation were met. Libby reached an elevation of 2436.6 ft on 31 July, 22.4 ft from full. July inflow averaged 9,900 cfs, 48 percent of normal.

Libby reached its highest level of the year on 02 August at 2436.8 ft, 22.2 ft from full. Outflow in August was held at 6,000 cfs for bull trout. Inflow in August averaged 4,900 cfs, 50 percent of normal. The 31 August elevation for Lake Koocanusa was 2434.9 ft, 4.1 ft below the Biological Opinion interim draft limit of 2439.0 ft. Outflows in September were held at 6,000 cfs for the whole month. Libby had a lake elevation of 2431.0 ft on 30 September.

The peak daily inflow was 38.3 kcfs on May 26, 2001, with a corresponding outflow of 4.0 kcfs. Maximum daily outflow was 20.90 kcfs on December 11, 2000. The January-July runoff was 3341 kaf or 52 percent of normal. The April-September runoff was 3369 kaf, 50 percent of normal.

5. Kootenai River at Bonners Ferry

The Kootenai River at Bonners Ferry, Idaho is a major control point for the flood control operation of Libby Dam. It is located 82 miles downstream of Libby Dam. Stages are affected by both river flow and backwater from Kootenay Lake. Libby Project provides flood control for Bonners Ferry. This year's operation is graphically shown on [Chart 60](#).

The peak-regulated stage was 51.32 ft (gage reading, actual elevation of 1751.32 ft) on December 12, 2000. Libby was releasing 19.3 kcfs at the time of this peak. The unregulated peak stage gage reading would have been 60.7 ft on May 29, 2001. Bankfull is at 66.5 ft. The January-July unregulated runoff was 4248 kaf, 48 percent of normal, while the April-September unregulated runoff was 4213 kaf or 47 percent of normal.

6. Duncan Reservoir

Duncan Lake was formed by Duncan Dam on the Duncan River, a tributary to Kootenay Lake in southeastern British Columbia. This project was constructed as part of the Columbia River Treaty between the United

States and Canada. The project is owned and operated by BC Hydro and Power Authority. Although it has no on-site power-generating facilities, the project is operated for downstream power generation and for flood control. This year's operation is graphically shown on [Chart 9](#) and [Chart 61](#).

The Duncan reservoir was at the full pool elevation of 1892.0 ft on 31 July 2000. For the period September through December 2000, Duncan discharge averaged 7,200 cfs, as the reservoir was drafted to support Kootenay Lake elevations. On 31 December, the reservoir reached elevation 1795.6 ft, 1.4 ft above empty. For the period January through April 2001, the Duncan project passed inflow, keeping the reservoir near empty.

Inflow to Duncan was 74 percent of normal for the period January 2001 to July 2001. Average outflow for this period was 600 cfs. The reservoir reached the maximum elevation for the 2000-01 year of 1875.7 ft on 30 July 2001, 16.3 ft below full pool elevation of 1892 ft.

During August, Duncan discharge was increased to an average of 6,200 cfs to maintain Kootenay Lake elevations close to the maximum summer level permitted under the IJC Order. In doing so, the Duncan reservoir drafted to elevation 1870.7 ft by month end. During September, the Duncan discharge was further increased to 10,000 cfs to enable Kootenay Lake elevation to be raised up to the IJC limit of 1745.32 ft for the period 1 September to 7 January.

The peak daily inflow was 16.95 kcfs on May 28, 2001 with a corresponding outflow of 100 cfs. Maximum daily outflow was 10.03 kcfs on October 09, 2000. The observed January-July volume runoff was 1349 kaf, or 74 percent of normal. The April-September runoff volume was 1725 kaf or 77 percent of normal.

7. Kootenay Lake

Kootenay Lake is a large natural lake on the Kootenay River in southeastern British Columbia. Libby and Duncan Dams regulate most of its inflow. The seasonal regulation of the lake level is governed by rules established by the International Joint Commission (IJC) as agreed upon by the United States and Canada. Outflow from the lake is discharged through a series of in stream powerhouses and/or diverted to the off stream Kootenay Canal before it joins the Columbia River below Brilliant Dam near Castlegar, British Columbia. Although Corra Linn Dam, the project immediately downstream from the lake, controls the lake level, a constriction in the river channel at Grohman Narrows, between the lake and the dam, limits the maximum project outflow both during periods of high flows and when the lake approaches its minimum level. This year's project operation is graphically shown on [Chart 10](#) and [Chart 62](#).

The level of Kootenay Lake at Queens Bay was at elevation 1744.52 ft on 31 July 2000. Kootenay Lake was drafted to elevation 1742.9 ft on 19 August and then filled gradually to near 1743.2 ft by month end as the result of increased Duncan discharge. Kootenay Lake discharge averaged 23,800 cfs in August.

Through the period September through December 2000, Kootenay Lake levels were maintained from between 0.3 ft to 2.8 ft of the IJC limit of 1745.32 ft. The month-end levels for Kootenay over those four months were 1745.02 ft, 1744.66 ft, 1743.70 ft, and 1742.56 ft. The corresponding Kootenay Lake monthly average discharges for the four months were 18,700 cfs, 18,400 cfs, 20,500 cfs, and 18,900 cfs, respectively.

For the month of January, Kootenay Lake drafted to a low elevation of 1740.9 ft in response to low natural inflow and reduced regulated outflow from Duncan. The levels, however, rose to elevation 1741.2 ft by month end due to increase in Libby discharge beginning 23 January. Kootenay Lake discharge averaged 11,300 cfs for the month.

From 10 February to 22 February 2001, the Kootenay Canal was dewatered to perform remediation work on the canal, which required Kootenay Canal plant shutdown during the entire outage period. To facilitate the canal outage, an agreement was made between the Canadian and U.S. Entities, Bonneville Power Administration and B.C. Hydro to provide for the optimal balancing of the storage of water in Libby and Arrow reservoirs from 13 February 2001 through 03 April 2001. As a result of this agreement, 22.7 ksf was stored in Libby reservoir over the period 13 February through to 24 February 2001 with an equal and concurrent release from Arrow

reservoir. All the water stored in Libby was released by 3 April 2001 with an equal and concurrent reduction in release from Arrow reservoir.

In preparation for the canal outage, Kootenay Lake was drafted to a low elevation of 1740.8 ft prior to the start of the outage with an increase in lake discharge. Libby discharge increased beginning 8 February, and that coupled with a constraint on Kootenay Lake discharge during the canal plant outage, resulted in Kootenay Lake rising to an elevation of 1742.0 ft on 23 February before drafting to elevation 1741.7 ft by month end when Libby discharge was reduced. During February 2001, Kootenay Lake discharge ranged from a daily average high of 20,100 cfs to a daily average low of 8,600 cfs.

Kootenay Lake was drafted for all of March as required under the IJC to meet the 1 April limit of 1739.32 ft. Kootenay Lake discharge was adjusted to control the reservoir below the IJC limit while meeting system requirements. Lake discharge averaged 14,200 cfs for the month and by month end Kootenay Lake elevation was at 1738.2 ft.

Kootenay Lake drafted to a minimum elevation of 1738.0 ft on 5 April 2001. Kootenay Lake discharge was then kept near inflow until on 27 April 2001, when the Kootenay Lake Board of Control declared the commencement of spring rise on Kootenay. Following the declaration of spring freshet, Kootenay Lake was operated in accordance to the IJC lowering formula. By month end, Kootenay Lake was at elevation 1739.4 ft.

During April 2001, B.C. Hydro, in response to the low runoff volume forecast in the Kootenay basin, requested West Kootenay Power to seek a temporary variance to the IJC Order during 2001. The proposed variance was to cancel the implementation of the IJC lowering formula during the spring freshet while allowing Kootenay Lake to rise no higher than 1747.8 ft. After the freshet, Kootenay Lake would be regulated to a maximum elevation of 1745.32 ft until 1 September after which the normal IJC Order would apply. The proposed variance was intended to improve the summer elevation of Kootenay Lake resulting in expected power and non-power benefits. On 30 April 2001 the International Kootenay Lake Board of Control approved a very limited variance to the effect that if Kootenay Lake fails to reach elevation 1743.32 ft during the spring freshet, then the lowering formula operation may be terminated and the reservoir can be raised to elevation 1743.43 ft. The operation of Kootenay Lake during 2001 did not trigger the application of the approved variance.

In May, Kootenay Lake level rose sharply in response to the spring freshet inflow. The inflow peaked at 63,400 cfs on 28 May 2001. Kootenay Lake discharge was increased in accordance with the IJC Order for Kootenay Lake. The monthly average was 20,500 cfs, with a peak of 36,000 cfs on 31 May 2001. Kootenay Lake reached its maximum elevation for the year of 1745.1 ft on 29 May 2001, about a month earlier than the previous year.

Beginning in June, Kootenay Lake levels dropped due to receding runoff. The reservoir discharge was kept near inflow in order to control reservoir levels slightly below the IJC limits. The monthly discharge averaged 25,400 cfs. On 13 June 2001, the Kootenay Lake level at Nelson dropped below the Nelson gauge IJC elevation of 1743.32 ft and the lake operation remained constrained to less than 1743.32 ft until 31 August as required by the IJC Order for Kootenay Lake. The month end level at Queen's Bay was 1743.4 ft and at Nelson, 1743.2 ft. Kootenay Lake drafted in this month with the lowest summer reservoir elevation of 1742.8 ft occurring on 22 June 2001, about two months earlier than the previous year.

For the period July to August, as the Kootenay Lake margin below the IJC limit increased due to receding runoff, Duncan discharge was gradually increased beginning late July to support Kootenay River operations until the end of August. Libby outflow was also increased in July and discharge from Kootenay Lake was correspondingly reduced, averaging at 17,900 cfs in July and 16,800 cfs in August. Beginning 20 August, when Brilliant G2 was shutdown for runner upgrade work, Kootenay Lake discharge was adjusted to keep Brilliant discharge at 3-units full load (no spill) for the balance of August. Over the period 5 September to 10 September, Kootenay Lake discharge was increased to 26,000 cfs in accordance with the Kootenay Lake letter agreement for energy exchange between BC Hydro and BPA.

8. Columbia River at Birchbank

The Columbia River at Birchbank, British Columbia, includes the effects of regulation of all the Columbia River Treaty Projects. Its flow is regulated by the use of storage in Kinbasket, Arrow, Koocanusa, Duncan, and Kootenay Lakes. This is the portion of the Grand Coulee inflow contributed by the Columbia and Kootenay Rivers. The Flathead/Pend Oreille River enters the Columbia below the Birchbank gage. This year's operation is graphically shown on [Chart 63](#).

The observed daily peak flow at Birchbank was 80.97 kcfs on May 26, 2001 and the unregulated peak flow was 153.13 kcfs on June 04, 2001. Bankfull and flood stage is 225 kcfs. The unregulated January-July runoff was 23586 kaf, or 61 percent of normal. The unregulated April-September runoff at Birchbank was 25374 kaf, or 62 percent of normal.

9. Hungry Horse Project

Hungry Horse, a Section 7 Project, is owned and operated by the Bureau of Reclamation for flood control, power, recreation, and fisheries. On October 1, 2000, the water surface elevation was 3535.93 feet after filling to elevation 3558.35 on June 30. During the summer of 2000 Hungry Horse was drafted to elevation 3539.78 by August 31. Hungry Horse was drafted throughout the fall to meet the 3,500 cfs minimum flow requirement at Columbia Falls. Since the 2001 water year turned out to be the second driest on record the minimum flow requirements at Columbia Falls and below the dam were reduced to 3,200 cfs and 500 cfs respectively after the March Final forecast. Due to dry conditions from the summer of 2000 and throughout the winter the reservoir was drafted significantly below flood control to meet the minimum flow requirements at Columbia falls. The reservoir reached its maximum draft of 3487.57 on April 24. This year's operation is graphically shown on [Chart 11](#) and [Chart 64](#).

Due to the drought the reservoir did not refill. It reached its maximum elevation of 3543.14 feet on July 11, almost 17 feet from full. The peak observed inflow of 18,762 cfs occurred on May 26, and the maximum outflow of 6,190 cfs occurred on December 11 to provide power during a cold snap. Natural flows at McNary were low throughout the summer and flow targets at McNary were not met on either a weekly or seasonal basis. Releases for Biological Opinion operations started the second week in July at a rate of about 1,400 cfs. Due to the drought, Flathead reservoir downstream from Hungry Horse Dam did not fill. Negotiations took place between Reclamation, PPL- Montana, and Department of Interior to ensure that augmentation water released from Hungry Horse was not trapped in Flathead Lake. The reservoir drafted to 3533.72 by September 30. A minimum flow of at least 3,200 cfs was provided at Columbia Falls for the entire year.

10. Flathead River at Columbia Falls

Discharges on the Flathead River at Columbia Falls, Montana, are partially regulated by Hungry Horse Dam. This year's operation is graphically shown on [Chart 65](#).

January - July volume runoff for the tributary basins above Columbia Falls was 54 percent of normal. The year's peak stage of 9.44 ft, or 23.57 kcfs occurred on May 26, 2001. The Hungry Horse outflow was about 500 cfs during the peak flow. Flood stage at Columbia Falls is 14 ft and major flooding does not occur until 16 ft.

11. Flathead Lake, Kerr Dam

Flathead Lake is a natural lake, the level of which is controlled by Kerr Dam. The dam was sold by Montana Power Company to PPL Montana LLC (effective 17 December 1999) and licensed for operation for power, flood control, and recreation. Spring refill of Flathead Lake is coordinated with the Corps of Engineers' Reservoir Control Center to control flooding of the agricultural lowlands between Kalispell and Flathead Lake. This area is prone to flooding if the lake reaches its full level at a time when the river flow is high. Specifically, flooding begins if the lake

level reaches elevation 2893 ft, coincident with the river flow being above 45 kcfs. This year's operation is shown on [Chart 12](#) and [Chart 66](#).

After the 2000 runoff, Flathead Lake filled to 2093.0 on June 16 and was maintained in its top foot, 2892.0-2893.0 ft through October 09. The lake was then gradually drafted throughout the autumn and winter months for power and flood control, reaching its minimum for the winter, elevation 2884.48 ft on 02 February 2001. On 15 April, project elevation was 2886.24 ft. Per the Memorandum of Understanding Agreement (MOA -- date 1962, revised 1965) between the Corps and Montana Power, Kerr will endeavor to reach 2883 ft on 15 April for flood control. It goes on to say that there is a natural channel restriction at the outlet of the lake, which reduces the outflows at low lake levels and that this elevation might not be attained every year. On 15 April, project elevation was 2886.24 ft. Inflows below Kerr were 50 percent of normal in March of 2001 and 40 percent of normal in April. The April 15 elevation was influenced by a low runoff year. Operations were coordinated between the Corps and the Kerr project pursuant to the MOA.

The Corps coordinates with PPL (Pennsylvania Power & Light) Montana to refill Kerr in a controller manner during the spring freshet. Due to a low water year, no special coordination was required between PPL Montana and the Corps during the refill period. Kerr deviated from its FERC minimum flow requirements 8 May – 25 June to accelerate refill. The Montana congressional delegation, FERC and Department of the Interior were involved in the minimum flow deviations. The project refilled to 2890.0 ft during the Memorial Day weekend and reached a maximum water year pool elevation of 2892.67 ft on June 18, 2001. Because of the low water conditions, the project was only able to operate in its top half foot (2892.5 ft – 2893 ft) through 27 June. The project operated within its top two ft (2891 ft – 2893 ft) until September 13, 2001.

The regulated peak inflow was 30.4 kcfs on May 28. The unregulated peak inflow would have been 47.4 kcfs on the same day. The maximum discharge was 12.69 kcfs on June 30. Average monthly discharges were 8.9, 10.7 and 6.7 kcfs for May, June and July, respectively. The unregulated January-July runoff into Flathead Lake was 54 percent of normal. The unregulated April-September runoff was 53 percent of normal.

12. Pend Oreille Lake, Albeni Falls Dam

Pend Oreille Lake is a natural lake, whose level is partially controlled by Albeni Falls Dam, a Corps project operated for flood control, power, and recreation. Albeni Falls Dam is located 29 miles downstream of Pend Oreille Lake on the Pend Oreille River. Although the dam controls the lake level, the river channel between the lake and the dam limits the project outflow during both high flow periods and when the lake is near its minimum level. Inflow to Albeni Falls Dam is affected by the regulation of upstream impoundments, namely Hungry Horse and Flathead Lake (Kerr Dam) on a seasonal basis, and by two Washington Water Power projects, Noxon Rapids and Cabinet Gorge, on a daily basis. This year's operation is graphically shown on [Chart 13](#) and [Chart 67](#).

Starting in January, the operating range was established as 2053.0 to 2054.0 ft. Average monthly outflow in December, January, February and March averaged respectively 12.9 kcfs, 11.3 kcfs, 7.1 kcfs and 7.6 kcfs. Dry conditions were in effect for the basin. Precipitation in the water year Oct 00 – March 01 was 50 percent of normal. The project maintained its established operating range through May 4. Normally the project starts refilling in April. However, the TMT Salmon Managers requested the project delay refilling until after the Vernita Bar operation was over to help support the Grand Coulee elevation. This was agreed to, and refill was initiated on May 5.

Pend Oreille Lake reached its summer operating range of 2062 ft on June 28. A peak observed inflow of 42.5 kcfs was reached on 15 May. Unregulated peak inflow would have been 56.7 kcfs. Project discharges averaged 23.6 and 21.6 kcfs in May and June, respectively. Peak discharges were 27,000 cubic ft per second on June 01. The project was maintained in its summer operating range, 2062.0-2062.5 ft, from June 28 through September 18.

The unregulated January-July runoff was 7.74 Maf, 50 percent of normal, while the April-September runoff was 7.2 Maf, or 50 percent of average.

13. Grand Coulee Project

Grand Coulee is owned by the Bureau of Reclamation and operated for flood control (under Section 7 of the 1944 Flood Control Act), power, irrigation, recreation, fisheries, and navigation. The project includes Banks Lake, an irrigation/pumped storage reservoir. This year's operation is graphically shown on [Chart 14](#) and [Chart 68](#).

On October 1, 2000, FDR Lake was at elevation 1285.6 and was drafted to elevation 1267.7 by December 31. The 2001 water year was the second driest on record. Typically during the winter, California provides power to the Northwest; however, due to unit outages and increased power demand, the Northwest was providing power to California instead. There were numerous power emergencies so although it was an extreme drought year, Grand Coulee was drafted to a low of 1216.7 on April 20. FDR remained below elevation 1220 feet for about 20 days, which put the Inchelium Ferry out of service. The ferry provides vehicle and passenger service on a daily basis. Three professionals that operate the clinic in Inchelium have to commute via ferry, as do many of the teachers at the school. When the ferry is inoperable, it adds 120 miles to their daily commute.

Due to the drought, FDR only refilled to elevation 1284.55 on July 11. Prior to this year it was thought that Coulee would always refill. As it was a below average water year FDR was drafted to 1278.2 by August 28 in an attempt to help meet target flows at McNary. The maximum daily outflow for the year was 139,100 cfs, which occurred on December 13.

The seasonal *spring* flow objective (260 kcfs April 20 - June 30) at McNary was not met either on a weekly or a seasonal basis, with April 18- June 30 average flow of 124.8 kcfs. The *summer* seasonal flow objective (200 kcfs July - August) at McNary was not met either on a seasonal or weekly basis, with July - August seasonal flow averaging 90.9 kcfs and the highest weekly flows occurring the week of August 26 at 106.2 kcfs. The lowest elevation reached at FDR reservoir for ESA operations was 1278.2 on August 28. The reservoir refilled to elevation 1285.5 feet by September 30.

14. Mid-Columbia River, PUD Projects

Five run-of-river projects located on the mid-Columbia River in central Washington are operated by three separate Public Utility Districts (PUD's) primarily for power, flood control, fishery, and recreation. The five projects, in downstream order, are Wells, Rocky Reach, Rock Island, Wanapum, and Priest Rapids. The three Public Utility Districts are those of Douglas, Chelan, and Grant Counties. Fourteen utilities, in addition to the three PUD's, split ownership of the generating output of these plants. Article 34 of the Federal Energy Regulatory Commission licenses for these projects stipulates that some flood control space be provided, as instructed by the Corps, to replace lost valley storage under certain flood potential conditions. This space was not required this year. The operation of these projects is summarized in the flow of the Columbia River at Priest Rapids, Washington ([Chart 89](#)). The unregulated peak flow was 240.2 kcfs on June 03, 2001, and the observed regulated peak was 129.5 kcfs on June 09, 2001.

Numerous special operations occurred at these projects to assist in the downstream passage of juvenile anadromous fish during the 2001 out-migration, including FERC-required spill. These include: during autumn, a coordinated effort was carried out to operate Priest Rapids to encourage fish to spawn at lower levels in the Vernita Bar area; from mid-October to late November (the primary spawning period), daytime flows were held as low as possible in an attempt to reduce the subsequent minimum flow necessary to protect redds until emergence of fry in early spring. The minimum protection level established for WY 01 was 50 kcfs. Special flow operations were also required of Priest Rapids Dam in the fall and spring for Navy nuclear reactor compartment offloadings at Hanford, Washington. This is described in paragraph 34, Chief Joseph, McNary, The Dalles, and Bonneville Projects.

15. Yakima Project

The 5 storage reservoirs in the Yakima Basin in Eastern Washington were operated by the Bureau of Reclamation during the October 2000 through September 2001 period (Water Year 2001) for irrigation, fish and wildlife, flood control, power, recreation and safety of dam concerns. This year's operation is graphically shown

on [Chart 31](#) and [Chart 32](#).

The October through September natural flow for the Yakima River at Parker was 1.52 MAF, about 47 percent of the 1961-1990 average. The peak daily, observed flow of 2.18 kcfs occurred on April 28, 2001, and the peak daily, unregulated flow of 11.4 kcfs occurred on May 24, 2001. No bypassing of reservoir inflow was necessary, from April through June, to maintain flood control space based on forecast runoff except at Bumping Lake Reservoir.

Total 2001 W.Y. precipitation (total as recorded at 5 reservoir sites) was 134.54 inches, 58.4 percent of average. The Yakima basin snow-pack (Yakima Projects 6th and largest reservoir) was well below normal, averaging 55.8 percent of normal during the 7 months, December through June, of snow season.

The system reached maximum storage for the year on June 3, 2001 at 684,006 AF, and was placed on storage control on June 1, 2001. Runoff in the Yakima River Basin was well below average until the end of irrigation season. The Project storage on September 30, 2001 was 108.11 KAF, 29 percent of average (1961,1990).

All non-pro-ratable water users received a full water supply during the 2001 irrigation season (March 15 to October 22). The pro-ratable water users however received only 37% of their full entitlement. Pro rationing began on May 1st at 28%. With a slightly improved forecast and rigorous water management and cooperation by all water users, (Irrigation Districts, Yakima Nation, BPA, Federal and State Fish and Wildlife Agencies) the pro-rationing level improved over June and July to 37%, which was maintained through the remainder of the 2001 irrigation season. Pro-ratable water districts obtained expedited temporary water transfers from non-pro-ratable water users in excess of 15,000 AF. The Washington State Department of Fish & Wildlife held a small portion of the transferred water in trust for in-stream flow augmentation.

Based on the Total Water Supply Available (TWSA), during July 1 to October 31, the Yakima River Basin was managed to provide target flows of 300 cfs for Yakima River @ Parker, and 300 cfs for Yakima River @ Prosser. These flows are provided for by law in ATITLE XII -- YAKIMA RIVER BASIN WATER ENHANCEMENT PROJECT@, Section 1205.

The Yakima reservoirs were operated to provide both fish spawning conditions during September to mid-October 2000 and incubation/rearing levels mid-October 2000 through March 2001. No bypassing of reservoir inflows to maintain flood space requirements or power rights supported incubation/rearing level flows. With little or no unregulated run-off above the Yakima River near Easton, releases from Keechelus and Kachess were made to support incubation and rearing flows. Incubation/rearing releases from reservoirs included 43.2 kaf from Keechelus, 7.4 kaf from Kachess, 69.9 kaf from Cle Elum, 30.9 kaf from Bumping and 20.5 kaf from Rimrock.

In 2001, both fish spawning operations, @Mini-Flip-Flop@ and AFlip-Flop@ operations were executed in the Yakima River Basin. The @Mini-Flip-Flop@ operation requires increasing outflows from Kachess Reservoir and decreasing outflows from Keechelus Reservoir to supply the demands in the Easton Reach of the Upper Yakima River. This provides for low spawning flows in the Yakima River above Lake Easton. The incubation/rearing level flows required during the winter are then supported by releases from Keechelus Reservoir. The @Mini-Flip-Flop@ operation was implemented during the period of August 26- September 3, 2001. In order to maximize water use from Kachess Reservoir, releases from the Reservoir were at a high level from the later part of July through the month of August. This resulted in higher than normal flows through the Easton reach of the Yakima River.

The Yakima River to Naches River, AFlip-Flop@ operation was executed for the 20th consecutive year. It involved drawing storage from Keechelus, Kachess, and Cle Elum Reservoirs to meet all Yakima River diversions in June, July, and August and the first few days of September. During these months Rimrock and Bumping reservoirs were used only to meet the Naches and Tieton River diversions. In September, when low stages of river flows were required in the Yakima River from Easton to the mouth of the Teanaway, the Yakima River reservoirs were set to meet only the spawning flow levels. Also in 2001, up to 400 cfs was routed around

that reach via the Kittitas Canal at Wasteway 1146. In order to keep flows in the Yakima River Easton to Cle Elum reach moderate, 1146 wasteway was utilized through the month of August. A maximum of 400 cfs was transported through the Kittitas Canal beginning after the Kittitas Reclamation District had used all the pro-ratable water allotted to them for the 2001 irrigation season. The Yakima system below the confluence of the Naches River, as well as the Naches and Tieton diversions, was met with releases from Tieton and Bumping reservoirs. These flows were provided for spring Chinook salmon under a 1980 court order. The @flip-flop@ operation was implemented during the period of September 1-10th, 2001, providing a longer, more environmentally friendly ramping down of flow levels in the upper Yakima River.

In 2001, spawning flows were set at 80 cfs at Yakima River near Crystal Springs, 180 cfs in Yakima River below Easton Dam, and 180 cfs in the Cle Elum River below the reservoir. Due to the fisheries spawning cycle throughout the Yakima River Basin, incubation/rearing flow levels were established the last week of October, 2001 providing for 60 cfs at Yakima River at Keechelus, 80 cfs at Yakima River at Crystal Springs, 162 cfs at Yakima River below Easton Dam, and 162 cfs in the Cle Elum River below the reservoir.

16. Jackson - Palisades Project

Active storage in the Snake River Basin above Heise, Idaho, includes 847,000 acre-feet in Jackson Lake and 1,200,000 acre-feet in Palisades Reservoir for a combined total of 2,047,000 acre-feet. Palisades is a Section 7 project. The system is operated as a multipurpose unit for flood control, irrigation, recreation, fish and wildlife, and power production. Discharge from Jackson Lake is measured at the Snake River at Moran, Wyoming, Gage and discharge from Palisades Reservoir is measured at the Snake River near Irwin, Idaho, gage. Flood regulation curves are designed to maintain flows at Heise at or below 20.0 kcfs. This year's operation is shown graphically on [Chart 33](#), [Chart 34](#), [Chart 69](#), and [Chart 70](#).

The October through July volume runoff above the Snake River near Heise, Idaho, gage was 2,610 kaf, 54 percent of the 30 year average from 1971 to 2000. The unregulated peak flow at the Heise Gage was 25,870 cfs on May 16, and the peak regulated flow was 13,000 cfs on July 8. Flood regulation curves are designed to maintain flows at Heise at or below 20,000 cfs. However, because of the low runoff no flood control releases were made from Jackson Lake Dam. In order to deliver storage water for irrigation, releases were gradually increased to 2,500 cfs in late April and early May then to 4,400 cfs by August 1. Starting August 22 the release was steadily decreased to 2000 cfs by the end of September. Maximum reservoir elevation was 6765.50 feet on May 29. Maximum reservoir content was 758,730 acre-feet.

No flood control releases were made from Palisades Reservoir. Releases to meet irrigation demand began in late April and were gradually increased to the peak release for the year of 12,500 cfs the first week in July. Releases started to decline by mid July and were decreased to 7100 cfs by the end of July and to 5100 cfs by the end of September. Palisades Reservoir maximum elevation was 5580.89 feet on May 2. Maximum reservoir content was 663,034 acre-feet.

Maximum combined content of the two reservoirs was 1,407 kaf on May 21. After the below average runoff in 2000, contents in Jackson Lake and Palisades reservoirs were 898 kaf on October 1, 2000. Storage increased slightly through the winter until releases began to meet irrigation demand. Snow accumulation on the watershed above Palisades Dam was 55% of normal on April 1. April through July runoff was 44% of the 30-year average. September 30 content was 231 kaf, 987 kaf below the 30-year average content on September 30.

17. Ririe Project

Ririe Reservoir is a Section 7 project that is operated by the Bureau of Reclamation for the joint uses of irrigation, flood control, recreation, and fish and wildlife. The active capacity is 90,500 acre-feet including exclusive flood control space of 10,000 acre-feet. This year's operation is graphically shown on [Chart 35](#).

The October through June runoff into the reservoir was 24,260 acre-feet, 27 percent of average. The peak daily inflow was 207 cfs on April 20. No flood control releases were made. The maximum release was 402 cfs on August 18 during the drawdown during the irrigation season. The maximum content was 54,446 acre-feet on October 1, 2000 while evacuating storage to meet the minimum winter space requirement. Storage at the end of the water year was 24,331 acre-feet, 19,515 acre-feet below the average.

18. American Falls Project

American Falls Dam is a Section 7 project that has an active capacity of 1,673,000 acre-feet and is operated primarily for irrigation, power, and flood control. During the irrigation season American Falls Reservoir is operated to meet irrigation needs in the Snake River downstream from American Falls Dam. The Snake River near Shelley gage is approximately 73 miles upstream of American Falls Dam and is the control point for flood regulation in American Falls Reservoir. The Snake River near Blackfoot gage, approximately 46 miles upstream of American Falls Dam, is the control point for irrigation releases from upstream reservoirs. This year's operation is graphically shown on [Chart 36](#), [Chart 37](#), [Chart 38](#), and [Chart 71](#).

American Falls releases were reduced to 350 cfs in late October due to dry conditions and remained there until late March. During late March flows were increased to 2,000 cfs to fill Lake Walcott. During April, May and June releases were gradually increased to 12,200 cfs driven by irrigation demands. Starting the third week in July releases were steadily reduced to about 5,300 cfs by the end of September due to diminishing irrigation demands. Maximum storage during the year was 1,683,050 acre-feet on April 17. Reservoir content on September 30 was 43,160 acre-feet, 471,690 acre-feet below the 30 year average.

18. Little Wood Project

Little Wood Reservoir has an active capacity of 30,000 acre-feet. Although it was originally constructed by Little Wood Irrigation District for exclusive irrigation use, it has been designated as a Section 7 project since enlargement by the Bureau of Reclamation and is now operated for flood control. The Little Wood River at Carey, Idaho, gage, approximately 3 miles downstream from the dam, is the control point for reservoir operations. This year's operation is graphically shown on [Chart 39](#).

The October through July runoff into the reservoir was 48,550 acre-feet, 40 percent of the average. Maximum daily inflow was 244 cfs on March 26 and peak daily discharge at the Carey gage was 317 cfs on May 16.

Little Wood Reservoir was allowed to fill starting in mid October with no flood control space being evacuated during the winter or spring. The discharge was shut off November 1. The first of May the release was increased to about 150 cfs to regulate the fill. During May and June releases averaged about 240 cfs. Starting in early July the release steadily declined with irrigation demands and reached 25 cfs by the end of August at which time the release matched inflow until the end of September.

The reservoir reached its maximum contents May 2 and remained full until about May 5. Maximum reservoir content was 29,309 acre-feet on May 2. The storage at the end of September was 1,050 acre-feet, 5,300 acre-feet below the average.

20. Owyhee Project

Although constructed by the US Bureau of Reclamation as a single-purpose irrigation reservoir, Owyhee Reservoir has an active storage capacity of 715 kaf and can provide significant incidental flood protection along the lower Owyhee River and further downstream along the Snake River from Nyssa, Oregon to Weiser, Idaho. Most of the largest floods from this basin result from winter rain on snowpack over frozen ground. This year's operation is graphically shown on [Chart 40](#).

21. Boise Project

The Boise Project, Arrowrock Division, is a three-reservoir system including Anderson Ranch, Arrowrock, and Lucky Peak reservoirs with a combined total active storage capacity of 974 kaf. US Bureau of Reclamation operates Section 7 projects Anderson Ranch and Arrowrock, while Lucky Peak is a Corps project that is regulated in close cooperation with the two upstream projects. Seattle City Light retrofitted a powerhouse for Lucky Peak. This system is operated as a multipurpose unit for flood control, fish and wildlife, power production, recreation, and irrigation. The Boise River at Glenwood Bridge gage is the control point for the flood control operation of the system. This year's operation is graphically shown on [Chart 41](#) and [Chart 72](#).

22. Malheur Project

Beulah (Agency Valley Dam) and Warm Springs Reservoirs were originally constructed and operated as single-purpose irrigation reservoirs. Since the construction of Bully Creek Reservoir in 1962, all three of these Section 7 reservoirs are operated for multipurpose benefits and have a combined active capacity of 281 kaf. The Malheur River is similar to the Owyhee River in that the major floods are usually caused by rain on frozen and snow-covered ground. The Malheur River at Vale gage is the control point for flood control operation of the reservoirs, with the primary goal of limiting flows to 8000 cfs. This year's operation is graphically shown on [Chart 43](#), [Chart 44](#), and [Chart 45](#).

23. Payette Project

The Payette River reservoir storage system includes Cascade and Deadwood reservoirs that have a combined total active storage capacity of 815 kaf. These reservoirs were originally constructed by US Bureau of Reclamation for irrigation and power purposes, but now are also operated informally for incidental flood control. The control point for flood control operation of these projects is the Payette River near Horseshoe Bend streamgage at river mile 60.8. A second key streamgage is the Payette River near Emmett at river mile 38.4. Approximately 65% of the drainage basin above Horseshoe Bend is unregulated. This year's operation is shown on [Chart 42](#) and [Chart 73](#).

24. Snake River at Weiser

Snake River at Weiser flows are highly regulated by upstream irrigation diversions and reservoir storage operations previously discussed in this chapter. These operations normally result in a fairly smooth hydrograph at Weiser. This year's operation is graphically shown on [Chart 46](#) and [Chart 74](#).

25. Powder Project

Phillips Lake is formed by Mason Dam on the Powder River in eastern Oregon, is owned by US Bureau of Reclamation, and is operated by the Baker Valley Irrigation District as a multipurpose project with 17 kaf for exclusive flood control, 21 kaf for joint use, and 52.5 kaf for active conservation use, for a total active capacity of 90.5 kaf. The control point for flood control regulation is the Powder River at Baker City streamgage, which should be controlled to 500 cfs, if possible. This year's operation is graphically shown on [Chart 88](#).

26. Brownlee-Hells Canyon Projects

The Brownlee, Oxbow, and Hells Canyon Dams are owned and operated by Idaho Power Company (IPC). These tandem projects are operated in accordance with a single license issued by the Federal Energy Regulatory Commission, which requires operation for flood control and navigation, in addition to power. Specifically, this license requires that Brownlee, the only one of the three projects with significant storage, provide a minimum of 500 kaf of flood control space by February 1 of each year. By March 31 the reservoir is to provide an additional 500,000 acre-ft if necessary to help control flooding in the Lower Columbia, as determined by the Corps of Engineers. The license does, however, have a provision for a partial waiver of this requirement in dry years or for increased space in wet years. The Corps of Engineers examined the Brownlee flood control operations in 1987 and again in 1998. The 1998 procedure is currently being used. The FERC license also requires adequate navigation depths be maintained below Hells Canyon Dam. Spring refill of Brownlee is coordinated with the Corps of Engineers Reservoir Control Center for flood control. This year's operation is graphically shown on [Chart 15](#) and [Chart 75](#).

At the beginning of Water Year 2001, Brownlee was at elevation 2039.7 ft. The lake was drafted to elevation 2033.5 ft by October 7 to create space in the reservoir so a portion of the inflow could be stored while discharge from Hells Canyon could be maintained about 9.5 kcfs to encourage fall chinook salmon to spawn at a low elevation in the downstream channel during the October through December 3 time frame. The goal was to fill the lake near the end of the spawning operation. The lake was filled to 2067.4 ft on 3 Dec and continued to fill to 2073.7 ft on January 14 (2077 ft is full). The Hells Canyon discharges were then maintained above 9 kcfs until fry emergence in the spring.

In November 1998, the Corps sent IPC a new procedure for determining the annual draft of Brownlee for flood control that delivers the same level of flood control and provides a smoother real-time operation than the current procedure. In December 1998 IPC sent the Corps a letter approving the new procedure. This new procedure was submitted in the PNCA Data Submittal for use in WY 2000.

The February water supply forecast for Brownlee for the April-July period was 49 percent of the 1961-90 average. Based on this forecast and the forecast of 59% of the 1961-90 average at The Dalles the Corps notified IPC that there was no flood requirement this year at Brownlee. The April final volume forecast decreased to 32.6% of the 1961-90 average for the April-July period so there was still no flood control requirement. The project reached full (2077 ft) on May 16. Idaho Power. The project was at 2075.5 ft on June 30. In July and August Idaho Power coordinated with National Marine Fisheries Service to release least 100 kaf of storage each month for power and fish needs. By the end of August the project had drafted to 2053.91 ft. Brownlee delivered about 107 kaf in July and 168 kaf in August.

The regulated peak inflow was 15,900 cfs on May 19 and the unregulated peak inflow was 46,366 cfs on May 22, 2001. Maximum daily outflow was 19,700 cfs on May 18. The April-July observed Brownlee inflow was 2395 kaf, or 41 percent of the 1961-90 average.

27. Dworshak Lake and Dam

Dworshak Lake and Dam are located on the North Fork Clearwater River in west central Idaho. This project was constructed and is operated by the Corps of Engineers for power, flood control, fishery, navigation and recreation. This year's operation is graphically shown on [Charts 16](#) and [76](#).

Dworshak was drafted to 1520.07 by the end of August 2000 for salmon flow augmentation. Starting 1 September, flows were reduced to between 1.5 and 1.7 kcfs, which is the minimum flow from the project that produces total dissolved gas at less than 110 percent. Reflecting low inflows, the project continued to draft, reaching an elevation of 1518.85 ft on September 29, 2000. The project continued at the minimum constrained flows through October, November and into December. The project was at minimum flow for the entire month of December except for December 10 – 12 when the project was ramped up to full load in response to the declaration of a Regional Power Emergency Warning of Potential Alert 2. The end of December elevation was 1517 ft. Average November and December project inflows were respectively 53 percent and 36 percent of normal.

Dworshak average outflows in January were 2.9 kcfs. The project was at minimum flow between 1 – 21 January. In response to a declaration of a power emergency by BPA, outflows were increased to about 6 kcfs for the rest of January. Outflows were reduced to 1.3 kcfs on 3 February and remained at that level until 13 February when BPA again declared a power emergency. Outflows were increased through 19 February until the emergency was cancelled, and then went back to minimum. The end of January elevation was 1507.9 ft, 29.2 ft below the required flood control elevation. Dworshak inflows in January were 1.04 kcfs, 31 percent of normal and in February inflows averaged 1.29 kcfs or 28 percent of normal.

The project remained at or near minimum flows, with adjustment made to keep the TDG below 110 percent for the remainder of the winter and the spring refill season. Even at minimum flows Dworshak was unable to refill, and reached its highest pool elevation, 1587.8 ft, on July 01, 2001. Dworshak inflows for the period January through June 2001 averaged 46 percent of normal. The Salmon Managers submitted a SOR requesting Dworshak begin flow augmentation on July 2 by gradually increasing flows so that by July 7 the project was at full load (9.7 kcfs). The justification was to try to keep the Lower Granite forebay temperatures below 68 degrees for as long as possible to benefit juvenile migrating subyearling Chinook salmon. The state of Idaho and Nez Perce Tribe elevated the SOR to the Implementation Team. Idaho and the Nez Perce desired to wait until July 8 (after the 4th of July weekend) to start increasing flows to benefit recreation. They also desired to wait to increase flows to keep the water warmer for premature Clearwater Chinook and save cool water for resident fish in September. The Implementation Team adopted the SOR as submitted and flows were increased starting July 2.

Dworshak outflows averaged 8.8 kcfs during July and 9.4 kcfs during August. Beginning on 28 August, the project began ramping down from full load to minimum flow as it neared the BiOp Interim Draft Point of 1520 ft. Dworshak reached minimum outflow on 30 August. The end of August elevation was 1520.5 ft. In September flows were at the minimum flow, facilitating refill and producing total dissolved gas at less than 110 percent. The project continued at minimum flow as it was targeting its end of December Upper Rule Curve elevation of 1558 ft.

The peak daily inflow was 18.6 kcfs on May 14, 2001, while outflow at the time was 1.6 kcfs. The peak daily outflow was full powerhouse at 10.8 kcfs, on August 26, 2001. The January-July runoff volume was 1930 kaf, 52 percent of normal, while the April-July runoff was 1580 kaf, or 55 percent of average.

28. Clearwater River at Spalding

The stream gage on the Clearwater River at Spalding measures the portion of the Lower Granite Dam inflow originating in the Clearwater River Basin. It is also used as a flood control point in the operation of Dworshak Dam. This year's operation is graphically shown on [Chart 77](#).

The observed peak regulated flow at Spalding this year was 38,500 cfs on May 16. Dworshak was releasing 1,600 cfs on this date. The unregulated peak flow during the freshet was 58,029 cfs on May 15, 2001, well above the flow at flood stage of 111,600 cfs.

29. Lower Snake Projects

Lower Granite, Little Goose, Lower Monumental, and Ice Harbor are run-of-river projects on the lower portion of the Snake River in southeastern Washington. Lower Granite and Little Goose have 5-foot forebay operating ranges, and Lower Monumental and Ice Harbor have 3-foot ranges. All four projects are operated by the Corps of Engineers for navigation, hydropower, fishery, and recreation. This year's operation is graphically shown on [Chart 78](#) and [Chart 90](#).

During the summer of 2000 the projects had been operating at Minimum Operating Pool (MOP) to improve conditions for juvenile fish migration. The theory of the MOP operation is to lower the pools to increase the water velocity and facilitate faster downstream juvenile fish passage.

Lower Monumental, Little Goose and Lower Granite projects were authorized to return to their normal pool operations on 8 September. The Salmon Managers typically request Ice Harbor, Little Goose and Lower Monumental projects refill about 1 September to submerge fish ladder entrances at upstream projects and to facilitate adult fish passage. Lower Granite filled above minimum operating pool on September 14. There is no project immediately upstream of Lower Granite and therefore no fish ladder entrance to submerge. The emphasis at the project is juvenile fish passage. On September 22, the Walla Walla Corps office requested the Lewiston gage at the confluence of the Clearwater and Snake Rivers be held below 735 ft. The Lewiston levee has had seepage since 1992 when Lower Granite was drawn down for fish. Seepage had been steadily increasing and the Walla Walla District contracted out for repair, with an expected completion date in March 2001. The operational request was to maintain Lewiston below 735 ft with the exception of flooding or a power emergency.

In December during the Power Emergency Warning Alert 2, Walla Walla District Chief of Operations authorized 0.5-foot exceedances at Ice Harbor, Lower Monumental and Little Goose projects. The exceedance was granted 8 December – 12 December. Lower Granite continued to operate to maintain the Lewiston gage no higher than 735 ft because of the Lewiston levee problem.

Walla Walla District was not able to dredge in the Lower Snake, and surveys showed a 734 foot or higher elevation was needed at Lewiston to achieve a 14-foot channel. Walla Walla District requested Lower Granite be operated so Lewiston was maintained at 734 ft. In February, a CBT message was issued to operate Lewiston 733.5 ft to 735.0 ft. BPA declared a power emergency April 3, based on the Northwest Power Planning Council's estimates of power system reliability problems for spring and summer of 2001 and the impact of spill for fish passage under the Biological Opinion on west coast prices and reliability. The Federal Executives made a joint decision to not initiate Snake River spill on April 3 per the 2000 Biological Opinion because of the power emergency. At TMT on April 11, the Salmon Managers requested MOP and MOP + 1 operations starting April 10. Lower Granite and Ice Harbor were operated MOP + 1 to MOP + 2 to provide a 14 foot channel depth, as Walla Walla District had not accomplished dredging. In early May it was decided to increase the operating range at Lower Granite by half a foot and the project was then operating at MOP + 1 ft to MOP + 2.5 ft. Outflows had been low at night; few fish had showed up at the Lewiston trap and the salmon managers wanted to keep flows up at night to help fish.

In September, due to low Snake inflows there were several occasions that required operation of Lower Granite below 734 ft for short periods of time, and operation of the Snake projects out of the 1 percent efficiency range, as required by the Fish Passage Plan. MOP and MOP + operations were cancelled for Little Goose, Lower Monumental and Ice Harbor on September 06, and a similar operation at Granite was cancelled on September 20. Low inflows also required authorizing projects to go to zero nighttime flows at Lower Granite, Little Goose and Lower Monumental.

The April-July unregulated runoff to Lower Granite was 10,298 kaf, or 48 percent of normal. The regulated peak flow into Lower Granite was 89,200 cfs on May 17, 2001 and the unregulated peak was 127,972 cfs on May 17, 2001.

30. Mill Creek Project

Mill Creek Dam is a Corps of project on Mill Creek, east of Walla Walla, Washington. This is an off-stream project into which high flows are diverted for flood control and recreation. The reservoir (Bennington Lake) has 8,200 acre-ft of active storage capacity. It is used for both flood control and recreation. There were no flood control operations at Mill Creek this year. Its annual operation is graphically shown on [Chart 47](#).

Bennington Lake began refilling for recreation on February 22, 2001 and reached its conservation pool elevation of 1205 ft on March 15, 2001. Bennington Lake's elevation remained near 1205 ft until June 8. From June 8 through September 30, 2001 seepage and evaporation losses caused drawdown of Bennington Lake to elevation 1194 ft.

31. Willow Creek Project

Willow Creek Dam at river mile 52.4, together with the City of Heppner Flood Warning System, constitutes the Corps of Engineers flood protection provided for the urban reach of Willow Creek through the city and immediately north of Heppner in north-central Oregon. The dam is a 154 ft high roller-compacted concrete structure with an ungated spillway. The 14,091 acre-ft of storage space below the ungated spillway crest, 2113.5 ft, is allocated to flood control, irrigation, and minimum flow maintenance. The lake is held at 2063.0 ft in the winter and 2076.5 ft in the summer to provide for flood control. This year's operation is graphically shown on [Chart 48](#).

32. Lake Umatilla, John Day Dam

Lake Umatilla was formed by the construction of John Day Dam on the Columbia River. The project, which straddles the Oregon-Washington border, is operated by the Corps -- primarily for power, flood control, and navigation. The lake has approximately 500 kaf of active storage in its full operating range, 257-268 ft. Historically, the Corps generally operated the lake in the elevation range 260-265 ft from November through the spring runoff. Following the spring runoff, and continuing until mid-October, the lake was normally operated in its top 3 ft, 265-268 ft. However, in recent years the lake has been operated at lower levels in accordance with the Endangered Species Act in an attempt to improve juvenile spring/Chinook salmon passage through the reservoir. From approximately mid-April through the end of September there is a 1.5-foot operating range. The normal operating range during this period is from 262.5 ft to 264 ft. The lower elevation limit is adjusted to meet irrigation needs. Between September 30 and mid April there is a 2.5-foot operating range from 262.5 ft to 265 ft. In addition, at any time during the year the lake can be operated from 257 ft to 268 ft for flood control. This year's operation is graphically shown on [Chart 17](#).

While there were no flood control operations at John Day in Water Year 2001, there were special operations set up for several different parties. There were special operations for goose hunting (7 October – 21 January) and goose nesting (March 21 – June 2). The requested operation for hunting was to operate in the top foot of the operating range on Wednesdays, weekends and holidays. The requested operation for nesting was to operate in the top foot of the range at least once every four days for 6 to 8 daylight hours. Due to low flow levels, the John Day pool was authorized to operate as low as 261.5 ft from February 20 to February 28. This operation was needed to add flexibility to the lower river while flow at Bonneville was maintained at the appropriate levels for Chum salmon. There were also special operations set up involving tailwater ranges for fish-related research. Contractors also requested special operations to hold the forebay low to facilitate work in the pool. Additionally, one special low flow operation was set up to retrieve a truck in the river, and a forebay restriction operation was set up to free a grounded barge.

Spill for juvenile fish passage occurred at John Day only during the spring, from 25 May through 15 June. Due to a low water supply volume year and low river flows, spill levels were limited and were initiated through executive action and special coordination between the Fish and Action agencies. See Section G., Fishery Operations for additional information.

33. Upper Deschutes River Project

This multiple reservoir system is composed of Prineville and Ochoco Reservoirs on the Crooked River, both Section 7 projects, and Crane Prairie, Wickiup, Crescent Lake, and Haystack Reservoirs on the Deschutes River. Including Haystack, which is an off stream reregulating reservoir, there is a combined total active storage capacity of 559 kaf. This year's operation is graphically shown on [Chart 49](#) and [Chart 50](#).

Crescent Lake storage at the beginning of the water year was 63 kaf. Storage peaked for the season on April 12 at 72.5 kaf, which was 83% full. Carryover storage at the end of the year was 44 kaf. The maximum combined Wickiup and Crane Prairie storage of 249 kaf was reached on April 2. Combined storage at the end of the year was 75 kaf.

Prineville Reservoir entered the water year with a carryover of 85.8 kaf (89% of average.) Winter flows ranged from 55 to 65 cfs from mid October to late March. Flows were increased in late March in response to irrigation demand. Peak storage of 116.6 kaf, 78 percent of active capacity was reached on May 4. The maximum inflow was approximately 1208 cfs on March 25; maximum release was 258 cfs on July 13. The reservoir had a storage of 53.3 kaf (60% of average) at the end of September ([Chart 49](#)).

Ochoco Reservoir entered the water year with a carryover of 18.0 kaf. The outlets were turned off during the winter months and all inflow was stored until mid April. Irrigation draft began in early May. The peak inflow for the year was 140 cfs on April 28, and outflow peaked at 29 cfs on May 27. The reservoir reached a maximum content of 23.5 kaf (53% of capacity) on May 7. Irrigation demand drafted the reservoir during the summer to 8.4 kaf by the end of September.

This multiple-reservoir system is composed of six reservoirs: Prineville and Ochoco reservoirs (both Section 7 projects) on the Crooked River (a mid Deschutes Basin tributary) and Crane Prairie, Wickiup, Crescent Lake, and Haystack reservoirs on the upper Deschutes River. Including Haystack, which is an offstream re-regulating reservoir, the combined total active storage capacity is 559 kaf. This year's operation is graphically shown on [Chart 49](#) and [Chart 50](#).

Prineville Lake was operated in accordance with the project's Section 7 authorization, and complied with the Project flood control requirements ([Chart 49](#)). From October through February, the reservoir was held close to elevation 3207.0 ft, some 4 ft below Minimum Flood Control Pool. The reservoir was then filled to a maximum elevation of 3,222.6 ft, some 12 ft below Maximum Conservation Pool, and held there during May 3 through May 10. The reservoir was then drafted to El 3,190.0 ft by 30 September. The evacuation rate varied between 400 and 500 acre-ft per day. Except for a few very small and very brief rises, inflows generally remained in the range of 50 to 70 cfs during the period of October through early March. Small peak inflows occurred on March 25 and April 28, with mean daily inflow values of 1,200 cfs and 460 cfs, respectively. Inflows during June through September dropped back down and remained low, in the range of 10 to 50 cfs. Releases from the Project remained in the range of 60 to 120 cfs from October through April. They were then held up at around 220 cfs during May through mid-September, with the maximum annual release of 260 cfs during July 12 through July 23.

Ochoco Lake was operated in accordance with the project's Section 7 authorization, and complied with Corps of Engineers flood control requirements ([Chart 50](#)). Ochoco Reservoir began the Water Year at elevation 3100.3 ft, some 13.6 ft below Minimum Flood Control Pool, and remained close to this elevation until mid-March. The reservoir then slowly refilled to its maximum annual elevation of 3,107.8 ft on May 8. The pool was then drafted slowly through diversion for irrigation, and reached elevation 3083.0 ft, some 40 ft below Minimum Flood Control Pool, on September 30. Regional drought conditions were reflected in Project inflows which generally remained in the range of 0 cfs to 20 cfs during the period of October through February, and 20 to 50 cfs during March and the first half of April. The annual peak inflow of 123 cfs occurred on April 28, with the statistical 2-year recurrence interval inflow around 950 cfs. By early May inflows again dropped back down and remained in the range of 50 cfs to 0 cfs. Releases from the Dam into Ochoco Creek generally ranged between 3 and 5 cfs in October and November, 1 to 2 cfs during December through March, 2 to 10 cfs in April. The highest releases into Ochoco Creek occurred during May 22-31, at 29 cfs. Diversion canal releases for irrigation ranged from 40 to 90 cfs during May through July, and 20 to 30 cfs during August and September, as typical of previous years.

34. Chief Joseph, McNary, The Dalles, and Bonneville Projects

The Corps operates these run-of-river projects for hydropower, navigation, irrigation, recreation, and fisheries. Chief Joseph is located on mid-Columbia River in central Washington. McNary, The Dalles, and Bonneville are on the lower Columbia River, straddling the Oregon-Washington border. Several special operations occur each year at these projects to meet special requirements for power production, navigation, recreation, fishery, and construction activities. This year's operation is shown on [Chart 80](#) and [Chart 91](#).

McNary Dam had Biological Opinion flow requirements that varied throughout the spring and summer (see Section G., Fishery Operations). Fish were bypassed during the spring. Fish barging started on April 24, 2001 and ended August 11 when the transportation mode was switched back to trucking. Trucking continued until November 29, 2001. The fish bypass remained in operation through November 30, 2001. Also continuing at McNary this year was the offloading and burying of four decommissioned, de-fueled, submarine reactor compartments and two decommissioned, de-fueled, cruiser reactor compartments at the Hanford Reservation. The four submarine shipments were made on four consecutive weekends, with offloading between September 30 and October 21, 2000. The two cruiser reactor compartment shipments were made on two consecutive weekends during March 2001. Cruiser reactor compartments differ from submarine

reactor compartments because they have a different configuration and are slightly larger. Because the cruiser compartments are bigger, they require a longer offloading period than the submarine compartments. These offloading operations required special operation of the water level behind McNary Dam and Chief Joseph and Priest Rapids Dam discharges to allow barge docking and nuclear reactor compartment unloading at the Port of Benton slip. The duration of the special operations was about 192 hours for a submarine compartment and 104 hours for the cruiser compartments. There were also special forebay operations at McNary for national level competitive boat races, a wakeboard tour, construction work, waterfowl nesting, waterfowl hunting, and irrigation of a habitat management area. At times, these requests conflicted with each other, requiring special coordination.

Special operations at Bonneville included high forebay for Treaty gill net fishing, low forebay for construction work, high forebay for cross-channel swim, and spill to assist Spring Creek Hatchery fish released in passing Bonneville Dam. A minimum flow or minimum tailwater restriction was also enforce from 27 November, 2000 to 13 March, 2001, to protect Chum redds below the project in vicinity of Ives Island. Due to effects from a low water year, the operation was particularly demanding at times, and required various adjustments throughout the protection period. A high forebay was also needed July – November 2000 to help keep The Dalles tailwater high due to a navigation hazard.

Special tailwater operations at The Dalles were required through September 2000 to facilitate cleanup of a toxic spill at Fifteen Mile. A high tailwater was also needed through November 2000 until a high spot downstream of the entrance to the navigation lock was dredged. A forebay operating range restriction was also in place during May through August of 2001 for a special fishery operation.

Due to a low water supply volume year and low river flows, spill levels were limited and were initiated through executive action and special coordination between the Fish and Action agencies. See Section G., Fishery Operations for additional information.

The observed peak flow at The Dalles was 169,400 cfs on May 17, 2001. The Dalles unregulated freshet peak flow was 326,930 cfs on May 30, 2001. The unregulated January-July runoff at The Dalles was 58.19 Maf, or 55 percent of normal. The April - August unregulated runoff was 52.79 Maf, or 57 percent of average.

35. Columbia River at Vancouver

The Columbia River Basin reservoir system did not need to be operated for flood control during the winter of 2000 - 2001. The observed peak stage at Vancouver Washington was 5.54 ft, 10.46 ft below flood stage, on June 01, 2001. Flood stage at Vancouver is 16 ft and a major flood is considered to be at a stage of 26 ft. This year's operation is graphically shown on [Chart 79](#).

As a comparison, in 1964, the flood crest was 27.7 ft and in February 1996, 27.2 ft was reached. The all time record is 31 ft in 1948.

36. Willamette Basin Projects

There are 25 dams in the Willamette Valley of western Oregon, eleven of which are single-purpose, hydroelectric plants operated by public and private utilities and are not the focus of this report. Of the remaining projects, the Corps of Engineers (COE) operates eleven storage

and two re-regulating reservoirs. The US Bureau of Reclamation (USBR) operates one storage project, Scoggins Dam, which is a Section 7 project. The Federal projects are:

Hydroelectric		Non-power
Storage	Re-regulation	Storage only
Hills Creek	Big Cliff	Fall Creek
Lookout Point	Dexter	Cottage Grove
Cougar		Dorena
Green Peter		Blue River
Foster		Fern Ridge
Detroit		Scoggins

These projects are operated for flood control, hydropower (where applicable), irrigation, fishery habitat, and recreation. Since these federal projects are operated as a system to control the flow of the Willamette River, their operation will be discussed as a unit. This year's operation is graphically shown on [Charts 18-28](#), [Charts 81-84](#), and [Chart 92](#).

a. COE Projects

The summer augmentation plan was drafted and sent to interested State and Federal agencies in May. A meeting was held and the plan was presented to the agencies. The augmentation plan called for releases from the projects to be increased to meet downstream minimum flow requirements and target flows recommended by the Oregon Department of Fish and Wildlife. The following target minimum flows, in cfs, for the mainstem Willamette were adopted:

<u>Location</u>	<u>May</u>	<u>June</u>	<u>July</u>	<u>August</u>	<u>September</u>
Albany	6,000	4,500	4,500	5,000	5,000
Salem	15,000	12,500/8,500	6,000	6,000/6,500	7,000

The target minimum flows were met or exceeded in the May through September period. Fall drawdown at the projects was initiated after Labor Day.

b. USBR Tualatin Project

a. Tualatin Project

Henry Hagg Lake is formed by Scoggins Dam on Scoggins Creek, tributary to the Tualatin River near Forest Grove, Oregon. The reservoir has an active capacity of 53.64 kaf and is operated for flood control, irrigation, municipal supply, fish and wildlife, recreation, and water quality. The runoff occurs mostly from winter rainstorms. The year's operation was generally according to flood control regulations and is graphically shown on [Chart 85](#).

Henry Hagg Lake storage at the beginning of the water year was 21.3 kaf, 40 percent of capacity and 83 percent of average. The reservoir was drafted during the fall to meet late season irrigation demand and provide water quality flows downstream on the Tualatin River, reaching its low for the year of 11.5 kaf on November 26. Storage began to accumulate when discharges were reduced to minimum flows the first week of December. The 2001 runoff in the Tualatin

basin was the second lowest on record at 10.7 kaf, 27 percent of average. Outflows remained at minimum levels through mid May when irrigation draft began. Storage remained below the flood control rule curve through the season. The maximum inflow was 115 cfs on May 14. Storage at the end of the water year was 7.8 kaf.

37. Western Washington Projects

a. Howard A. Hanson Dam

Howard Hanson Dam, at mile 64.5 on the Green River, is a flood control and conservation storage project that provides fall and winter flood protection primarily for the lower Green-Duwamish River valley between the cities of Auburn and Seattle. In the spring, over 24 kaf are stored to augment late summer and fall low flows for fishery purposes. The City of Tacoma diverts an average daily discharge of 84 cfs for municipal and industrial water supply at its diversion dam and pipeline, 4.1 miles downstream from Hanson Dam. The year's operation is graphically shown on [Chart 51](#).

b. Mud Mountain Dam

Mud Mountain Dam, at mile 29.7 on the White River, is a single-purpose, flood control project that is normally empty except during flood control operation, project maintenance, and occasional special regulation for downstream needs. The year's operation is graphically shown on [Chart 52](#).

c. Wynoochee Dam

Wynoochee Dam, at river mile 51.8 on the Wynoochee River, provides flood control for the Wynoochee Valley, water supply for the City of Aberdeen's diversion at river mile 8.1, fishery enhancement, recreation, and irrigation benefits. On July 26, 1995, the project was transferred from the City of Aberdeen to the City of Tacoma. However, the Corps' role in the flood control operation of the project remains unchanged while Tacoma is responsible for all non-flood reservoir regulation duties. The year's operation was generally according to flood control regulations and is graphically shown on [Chart 53](#).

d. Ross Project

Ross Dam, at mile 105.2 on the Skagit River, is owned and operated by the City of Seattle, Department of Lighting (Seattle City Light). The FERC license for the dam states that evacuation of flood control storage must begin by October 1 and be completed by December 1 to provide storage of 120 kaf above 1592.1 ft. The storage space must remain available until at least March 15 of the following calendar year. The FERC license also gives the Corps limited authority to specify project regulation during a flood emergency. During a flood event, when the unregulated or natural flow in the Skagit River near the town of Concrete is forecast to exceed the major damage level of 90.0 kcfs, the Corps can specify operation of the project. Under this flood control operation, Seattle City Light is permitted to release full powerhouse capacity from Ross Dam provided the flow is regulated by the two downstream projects, Diablo and Gorge, to a maximum outflow of 5,000 cfs. The year's operation was generally according to flood control regulations and is graphically shown on [Chart 54](#).

e. Upper Baker Project

Upper Baker Dam is located at mile 9.3 on the Baker River, a tributary of the Skagit River. The FERC license for this two dam hydroelectric project, owned and operated by Puget Sound Energy (PSE), requires Upper Baker Dam to provide 16 kaf of flood control storage space by November 1 for replacement of natural valley storage eliminated by the project. An additional 58 kaf of flood control storage must be provided by November 15 in accordance with congressional legislation and an agreement between PSE and the Federal Government for reimbursement of power losses due to operation of the additional storage for flood control. When necessary, flood control storage is managed by the Corps from November 1 through March 1 each year. As with Ross Dam, the Corps can specify operation of Upper Baker Dam when the unregulated or natural flow in the Skagit River near the town of Concrete is forecast to exceed 90.0 kcfs. Under flood control operation, PSE is required to maintain a release of 5.0 kcfs from Upper Baker Dam. The year's operation was generally according to flood control regulations and is graphically shown on [Chart 55](#).

f. Mossyrock and Mayfield Dams

Mossyrock and Mayfield dams are cooperative regulation and re-regulation projects on the Cowlitz River that are owned and operated by Tacoma City Light, and provide mutually beneficial hydroelectric power generation and authorized Section (7) flood control. Their FERC license gives the Corps the corresponding authority to specify project regulation during major flood events. The flood control plan for Mossyrock is to provide a maximum of 360 kaf of flood control storage between elevations 745.5 and 778.5 ft during the months of December and January. The originally authorized water control diagram requires a gradual drawdown to minimum flood control pool between October 1 and November 30, and allows a gradual refilling to full pool between February 1 and June 1. The year's operation was generally according to flood control regulations and is graphically shown on [Chart 56](#).

The project was operated well within the requirements of the authorized water control diagram. Mossyrock Reservoir elevations were greatly influenced by the persistent regional drought conditions, along with the demand for hydropower. The Reservoir elevation fell slowly from the elevation of 743.9 ft at the start of the Water Year to a minimum elevation of 645.22 ft on March 7, with Minimum Power Pool at elevation 600.0 ft. The reservoir slowly refilled during the period of March through June, and reached a maximum elevation of 740.60 ft on July 10, which was some 37.9 ft below Maximum Conservation Pool elevation 778.5 ft. The Project then began drafting on July 17, and drafted uniformly to elevation 726.1 ft on September 30.

Minor flood control operations occurred during May 2, May 16, and May 25, with peak inflows of 9,100 cfs, 10,120 cfs, and 10,150 cfs, respectively. During these times, and throughout the entire period of March through September as well, outflows from Mayfield were held essentially constant at 2,600 cfs. During the preceding period of October through February, outflows generally ranged between 4,200 cfs and 7,500 cfs, with brief Project releases 8,300 cfs on November 13 through 15, and 10,100 cfs on December 12 and 13.

g. Sediment Retention Structure

The Sediment Retention Structure (SRS) is a Corps project on the North Fork Toutle River in southwestern Washington designed to trap Mount St. Helens volcanic sediment by slowing the river flow. The dam was designed with six rows of outlet pipes that allow the water to pass

through the SRS and into the outlet channel. The rows of outlets are successively blocked and closed as the sediment deposited in the pool continues to increase.

The uppermost and final tier of outlet conduits, designed to pass inflow as the pool filled with sediment, were closed on April 21, 1998. In its nine years of operation nearly 70 million cubic yards (mcy) of volcanic sediment accumulated behind the Structure. Toutle River now flows over the spillway as sediment continues to accumulate, to a maximum of 284 mcy, behind the 184-ft high structure. Other conduit-tiers were closed in 1991, 1993, 1994, 1995, and 1997.

38. Oregon Coastal Projects

Out of the 11 dams in the Rogue River Basin of southwestern Oregon, two are operated by the Corps, seven by US Bureau of Reclamation, and two by a private utility. Only the Corps projects, one of the US Bureau of Reclamation projects, and a county owned project are operated for flood control. The Corps reservoirs, Lost Creek and Applegate, with a combined active storage of 390 kaf, are operated for flood control, irrigation, fish and wildlife enhancement, municipal and industrial water supply, water quality, recreation and power (at Lost Creek only). Elk Creek Dam is a partially completed Corps project on Elk Creek, a tributary to the Rogue, five miles below Lost Creek. US Bureau of Reclamation's Emigrant Lake has 39 kaf of storage and is operated for flood control, irrigation, and recreation. Douglas County owns Galesville Dam. The latter two projects are operated under Corps direction, when needed, for flood control.

a. William L. Jess Dam and Intake (Lost Creek Lake and Dam)

The year's operation was generally according to flood control regulations and is graphically shown on [Chart 29](#).

b. Applegate Dam

The year's operation was generally according to flood control regulations and is graphically shown on [Chart 30](#).

c. Elk Creek Dam

The storage area behind the partially completed Elk Creek Dam is dry except for involuntary storage during high water periods.

d. Galesville Dam

Galesville reservoir operations were in compliance with Corps of Engineers flood control regulations, and provided flood control space in exceedance of the requirements for its Section 7 Authorization. The year's operation is graphically shown on [Chart 86](#).

Galesville Lake conditions were seriously impacted by the extreme drought conditions that prevailed throughout the Region. The project began the Water Year at elevation 1850.1 ft, some 31 ft below its Maximum Conservation Pool Elevation of 1881.5 ft. The reservoir was slowly drafted to Minimum Flood Control elevation of 1842.5 ft by November 10. Due to the persistence of the drought conditions, the reservoir dropped to an elevation of 1821.8 ft on 30 September 2001, some 21 ft below Minimum Flood Control Elevation. The maximum lake elevation reached was 1850.1 ft, which corresponded to the Lake's elevation at the start of the Water Year on 1 October 2000. Inflows typically remained in the range of 10 to 30 cfs during the

months of October through January. During February and March, inflows varied between 30 and 55 cfs. The maximum inflow occurred on April 12, with a peak inflow of 91 cfs, which was around 4 percent of the maximum inflow for the preceding Water Year. During this peak, the reservoir stayed around 9.0 ft below the normal Minimum Flood Control Elevation of 1842.5 ft, with the project outflow at 68 cfs. During the months of October through January, outflows typically ranged between 30 and 70 cfs. During the months of February through April, outflows typically ranged between 40 and 65 cfs, and were generally below the project minimum release of 60 cfs for November through April.

The lake was operated according to its rule curve and its operations were in compliance with flood control regulations.

e. Emigrant Lake and Dam.

The lake was operated in accordance with the authorized water control diagram and authorized flood control requirements. The US Bureau of Reclamation operated the lake in accordance with the authorized rule curve as graphically shown on [Chart 87](#).

As with other water resource projects, Emigrant Lake elevations were greatly impacted by the extreme drought conditions that prevailed throughout the Region. Emigrant project began the Water Year at elevation 2,170.2 ft, some 39 ft below its Minimum Flood Control Elevation of 2,209.5 ft. The maximum pool elevation of 2,228.6 ft was reached on May 1, with Maximum Conservation Pool at elevation 2,241.0 ft. The reservoir reached a minimum elevation of 2,149.3 ft on September 18. The Water Year closed out with the project at elevation 2,153.4 ft, some 39 ft below Minimum Flood Control Pool. Maximum inflows occurred on February 6 and March 29, at 136 cfs and 124 cfs, respectively. Other than these small peaks, reservoir inflows remained in the range of 10 cfs to 90 cfs: representing releases from small upstream storage and power plant projects. Lake releases into the Emigrant Creek channel downstream ranged from 0 to 70 cfs during the entire Water Year. Releases through the diversion canal were made during April through September, and averaged 115 cfs, which is typical of releases during the conservation release seasons for previous years.