II. HYDROMETEOROLOGY

OBSERVATIONS: Weather Snowpack SWSI Streamflow
FORECASTS: Runoff Volume Long Range Peaks Daily Streamflows

A. OBSERVATIONS

With the Pacific Northwest's highly diverse hydrologic conditions, both areally and seasonally, information on weather, snow packs, and streamflows played a pivotal role in the effective operation of the dams and reservoirs to meet the needs of the region's people, industry, and natural resources. This chapter summarizes these conditions, first generally in describing the overall conditions throughout the year and then some unique conditions that had a pronounced effect on the region. The chapter concludes with summaries of forecasts and peak streamflow conditions.

1. Weather

The Pacific Northwest has the most diverse weather conditions of any region of the nation, varying from the arid conditions in the shadows of the Olympic and Cascade Mountains to very wet rainforest along the Pacific coast to dry areas that are subject to occasional cold outbreaks of winter continental weather in the Rocky Mountains along the Continental Divide. The normal seasonal variations are just as dramatic with the coastal areas and Cascade Mountains receiving their maximum precipitation in the winter months while the eastern basins, with more steppe and continental climates, have their maximum precipitation in early summer. To best consider all these seasonal and areal variations, the following weather discussion will reference departures of temperatures and precipitation from normals rather than observed values. Monthly sub-basin precipitation is shown in Table 1 and Table 2, basin temperature in Table 3, and Figure 6 is a map of the annual precipitation in the Columbia drainage. Figure 6 shows accumulated precipitation across the Columbia Basin during the October 2004 through the September 2005 water year. Figure 7 denotes the monthly accumulation of the Columbia Basin snowpack for Water Year 2005 expressed as a percent of normal peak snowpack. Figure 8 denotes the accumulated precipitation in inches for the Water 2005 at primary Columbia River basins. Figure 9 is a map of the Pacific Northwest monthly temperature departures from normal for the month of December 2004.

A warm and dry June and July 2004 transitioned into a wetter and warmer than normal August due to low pressure troughs at the beginning and end of the month, and intermediate high pressure ridging. Wet conditions continued in September, raising hopes of a good start to the water year. An active jet stream within a broad area of low pressure supplied the region with 165 percent of normal precipitation at Columbia above Coulee, and 148 percent of normal at Columbia above The Dalles, and 124 percent of normal in the Snake Basin, above Ice Harbor, for September. This was on the heels of 195 percent, 204 percent, and 192 percent of normal precipitation in the usually dry month of August. August saw a greater temperature swing, from -0.8 °C to 4.1 °C (-1.4 °F to +7.3 °F), and September came in a little narrower, -1.6°C to 1°C (-2.8 °F to 1.8 °F). The active early autumn weather settled down some as October arrived.

A ridge of high pressure started out the month, and carried on toward mid month. In the middle of October, this regime resulted in record high temperatures at Pendleton, 30 °C (86 °F), and at Portland, 27.2 °C (81 °F), and the month's average temperature departed +0.7 °C (+1.2 °F). Then storms arrived via a jet stream incoming from the northwest. With a much cooler Gulf of Alaska airstream, temperature departures dropped off, and precipitation rose. Precipitation accumulated to 110 percent of normal at Columbia above Coulee, 123 percent of normal at Columbia above The Dalles, and 163 percent of normal at the Snake River above Ice Harbor. The

October precipitation boosted streamflows, but a change in course was due to occur in November, ultimately dropping these during the month. In November, the region saw a split develop in the jet stream. As a result, flows trailed off, and precipitation ended up at 72 percent of normal at Columbia above Coulee, 60 percent of normal at Columbia above The Dalles, and 50 percent of normal at the Snake River above Ice Harbor. Were it not for a tropically-fed frontal system about mid month, the precipitation percentages would have been lower. Temperatures were cooler than normal over Oregon and Idaho, and warmer than normal elsewhere during November, a regime typical of a split-flow pattern. Overall, regional temperatures departed +0.6 °C (+1.0 °F) from normal, with absolutes from -1.7 ° C to 3.8 ° C (-2.1 °F to +6.9 °F). The split in the flow continued into December.

Again, this time in the final month of 2004, the region received most of its precipitation from a frontal system that tapped tropical moisture. Overall, the split flow carried above normal precipitation into California and far north along the northern B.C. coast and into the Alaskan Peninsula. Only parts of southern Oregon and far south Idaho caught slightly above normal precipitation. As a result of this split, precipitation was 76 percent of normal at Columbia above Coulee, 75 percent of normal at Columbia above The Dalles, and 80 percent of normal at the Snake River above Ice Harbor. For the second month in a row, the tropical moisture tap offset the threat of abysmal precipitation totals, and also contributed to a large streamflow increase from the 5th through 15th. December was a very mild month, as well, so only higher elevation snow managed to sufficiently accumulate. On the cool side, departures bottomed out at +1°C (+1.8 °F) and topped out at 5.6 °C (+10.1 °F), bringing the average departure to 2.8 °C (+5.1 °F). Some much cooler weather ushered in 2005, as the split flow from November and December pulled a bit to the west, allowing Arctic air to briefly move into the Basin, during January, via a northerly flow.

Even with precipitation in this kind of a pattern, amounts are generally light. And that was the case until about mid month as the southern part of the split in the jet stream once again tapped tropical moisture. This was courtesy of a large Gulf of Alaska low pressure area that really managed to arc the northern part of the split flow in over the Basin. Combined with the delivered precipitation from the tropics, this warming air mass came with a very deep southerly flow. This sent temperatures to record levels in January. Portland, Seattle, Olympia, Bellingham, Quillayute, Medford, Hillsboro, and Corvallis all broke their record high temperatures, with most broken between the 12th and 21st. Basin-wide temperatures departed swung wide due to the extremes of the month: On the cold end, they met -2.2 °C (-4.0 °F), and at the other extreme, +3.3 °C (+5.9 °F). January averaged +0.7°C (+1.2 °F) from normal. January precipitation was 100 percent of normal at Columbia above Coulee, 78 percent of normal at Columbia above The Dalles, and 81 percent of normal at the Snake River above Ice Harbor. Streamflows responded with the precipitation and warming, with a large increase that peaked at the end of the month. So, a month of contrasts to open a new year gave way to a month of one-way extreme as February's weather pattern reverted to a more definitive split flow, and consequently much below normal precipitation.

The Basin realized most of its meager February amounts early on, and the accumulation resulted in 23 percent of normal at Columbia above Coulee, 30 percent of normal at Columbia above The Dalles, and 73 percent of normal at the Snake River above Ice Harbor. February 2005 regional temperatures continued above normal, averaging +0.6 °C (+1.0 °F) from normal, and containing a range from -1.9 °C to +3.4 °C (-3.5 °F to +6.2 °F). In February, we saw both high and low temperature records broken: Olympia reached 18.3 °C (65 °F) and Astoria 20°C (68 °F), while Olympia broke a low temperature record three times during the month. So, the split flow pattern had both temperature and precipitation repercussions, and these held into March. But, by the middle of that month, the weather pattern began to change, perhaps as a consequence of a large change in the pressure pattern across the Equatorial Pacific. As March wore on, precipitation increased due to a series of cold fronts crossed the region, with a notably strong weather system late in the month. Cumulatively, this resulted in a sharp rise in streamflows from the 27th onward, singularly from 115 percent of normal precipitation at Columbia above Coulee, 109 percent of normal at Columbia above The Dalles, and 108 percent of normal at the Snake River above Ice Harbor. With this increase in precipitation, we saw several daily records, including 3.0 cm (1.19") at Portland, 3.8 cm (1.51") at Seattle, 1.1 cm (0.45") at Lewiston, and 2.2 cm (0.88") at Spokane. Many high temperature records were broken, and these occurred early in the month, within the split flow pattern. Some of these included 19.4 °C (67 °F) at Seattle, 24.4 °C (76 °F) at Portland and Redmond, 19.4 °C (67 °F) at Astoria and Olympia, and 26.7°C (80 °F) at Medford. Ironically, Olympia broke its low temperature record on the same day that it broke its high: the capital city started out at -3.9 °C (25 °F) that day! Overall, March was warmer than normal, departing +1.4 °C (+2.5 °F), with mean departures ranging from -1.7 °C to +4.8 °C (-3.1 °F to +8.3 °F). March really began the back and forth temperature swing that would continue through most of the Summer! March's wet pattern continued into the first part of April.

More storms brought above normal precipitation region wide for the first half of the month, but a return of the split flow regime dried out northern areas, yet kept southern districts wetter than normal. As a result, April precipitation was 86 percent of normal at Columbia above Coulee, 101 percent of normal at Columbia above The Dalles, and 119 percent of normal at the Snake River above Ice Harbor. More precipitation records were broken in April. Astoria broke a daily record by measuring 4.9 cm (1.92"), and another with 2.2 cm (0.86"). Yakima, Redmond, and Pocatello broke daily records, accumulating 1.1-2.3 cm (0.45-0.90"). With temperature swings from -1.4 °C to + 2.8 °C (-2.5 °F to +5.1 °F), April averaged very close to normal, departing 0.4 °C (+0.8 °F). The largely wetter-than-normal Spring continued in May, even with a split in the jet stream. The northern arm of the split forced precipitation into the Canadian Upper Columbia and into the Canadian and U.S. Kootenay, while the southern part of the split brought above normal amounts across the southern tier basins. Above normal precipitation continued through May, as the Columbia above Coulee measured 109 percent of normal, the Columbia above The Dalles at 150 percent of normal, and the Snake River above Ice Harbor totaled a robust 194 percent of normal. Streamflows continued a steep rise, from April, and peaked late in May. Several more daily precipitation records were broken in May, including, Portland, at 1.5 cm (0.59") and Spokane at 2.2 cm (0.88"). May was warmer than normal, due mainly to milder than normal overnight temperatures, and high pressure ridging toward the latter part of the month. The month averaged +1 °C (+1.8 °F), with mean temperatures departures ranging from -0.7 °C to +4.0 °C (-1.2 to +7.2 °F). This warmth caused Medford to break a daily record at 35 °C (95 °F), as did Portland, with Seattle at 31.7 °C (89 °F). Warm temperatures turned much cooler as June arrived, but it remained wet due to a little more consolidation of the upper air flow.

Relative to what we expect for June, many regions of the Basin notched much above normal precipitation. A series of chilly storms, out of the ordinary for June, kept flows alive for the month, with only a small recession. Precipitation totaled 178 percent of normal at Columbia above Coulee, 141 percent of normal at Columbia above The Dalles, and 133 percent of normal at the Snake River above Ice Harbor. Again, several daily precipitation records fell: at Portland, Sand Point (Idaho), Idaho Falls and Kalispell. Western Montana was particularly hard hit with this weather pattern, thanks to a cool northwesterly flow, a by-product of the consolidation of the upper air flow. Regional temperatures departed -0.7 °C (-1.2 °F), and skewed chilly even on the range: -2.4 °C to only +0.9 °C (-4.4 °F to only +1.7 °F). Cooler than normal weather continued into July, as more cold fronts traversed the region. By mid to late in the month, higher pressure covered the U.S. part of the Basin, pretty much on time for the start of the Pacific Northwest's Summer. As such, the storm track ended up in Canada. July precipitation ended at 72 percent of normal at Columbia above Coulee, 65 percent of normal at Columbia above The Dalles, and 40 percent of normal at the Snake River above Ice Harbor. July ended warmer than normal, with daily temperature records set at Burns and Boise, at 37.8 °C and 40.6 °C (100 °F and 105 °F), respectively. The warm weather carried over into August, as an upper air high pressure area dominated for most of the month.

With the high in place, the storm track remained across the Canadian Upper Columbia, with even that area receiving below normal precipitation amounts. As such, and collectively, precipitation totaled 63 percent of normal at Columbia above Coulee, 58 percent of normal at Columbia above The Dalles, and 62 percent of normal at the Snake River above Ice Harbor. August's high pressure system largely sat over the western part of the Basin, and this allowed a cooler temperature pattern to maintain over eastern districts, like the Kootenay and Upper Snake. Late in August, a low pressure system managed to drop into the Basin from the northwest, and the resultant unstable air mass produced numerous, and occasionally heavy, regional showers. For example, Troutdale set a 24-hour precipitation record of 3.9 cm (1.55") on the 29th of the month. Although most of the Basin saw above normal temperatures for the month, areas on the eastern edge of the upper high were cooler than normal. Overall, regional temperatures departed +0.8 °C (+1.4 ° F). Cooler weather was on the way, though, as the Basin entered September.

And, although September managed to start quite mild, a springboard from August and thanks to a westerly flow and high pressure aloft, temperatures turned cool and stayed cool from about the 5th through the 25th. As such, the U.S. part of the Basin registered as the 53rd coolest September on record, based on the period, 1895-2004. Combined temperature departures of Spokane, Portland and Seattle came in at -0.8 °C (-1.5 °F). Because of the orientation of the high pressure, precipitation for most of the month was limited to the Canadian Upper Columbia, and over the far southeastern Idaho Upper Snake. The Canadian precipitation totaled slightly below to near normal until the final two days of the month when the weather pattern transitioned so that a potent weather system delivered abundant precipitation to many districts. To the 30th of the month, precipitation averaged 223 percent of normal at Columbia above Coulee, 153 percent of normal at Columbia above The Dalles, and 75 percent of normal at the Snake River above Ice Harbor. Suddenly, then, what could have one of the driest Septembers on record for many U.S. locales, ended up being slightly below to just at normal! In spite of this, and based on the long 1895-2004 period of record, this month ended as being the 23rd driest month on record.

2. **Snowpack**

Overall, the Columbia Basin snowpack above The Dalles has decreased from 64 percent of average last month to 58 percent on May 1. The percent of peak snowpack at The Dalleswas 55 percent of average. Except for the Pend Oreille River Basin, which increased from 61 percent last month to 62 percent this month, all sub-basin snowpacks within the Columbia Basin declined from the average value from one month ago. The Canadian snowpack decreased from 81 percent to 77 percent, the Kootenai from 62 percent to 48 percent, the Kettle from 73 percent to 52 percent, the Spokane from 45 percent to 41 percent. Looking at the Mid-Columbia region, the North Cascades declined from 42 percent to 31 percent, the Yakima from 32 percent to 21 percent, the John Day from 33 percent to 5 percent, the Deschutes from 51 percent to 47 percent. Changing to the Snake, the Upper Snake snowpack decreased from 79 percent last month to 73 percent this month, the Boise/Payette from 66 percent to 62 percent, Eastern Oregon from 50 percent to 47 percent, the Salmon River from 59 percent to 55 percent, and the Clearwater Basin from 55 percent to 54 percent.

Looking at the major Columbia River regions, the snowpack above Castlegar is at 65 percent of average, compared to 73 percent last month and 71 percent last year. The snowpack above Grand Coulee is at 63 percent of average, compared to 69 percent last month and 70 percent last year. The snowpack above Ice Harbor on the Snake is at 58 percent of average, compared to 61 percent last month and 60 percent last year.

Precipitation was hit 'n miss over the Columbia Basin. The Cascades received above average precipitation during March. Likewise, NE Washington, the Idaho panhandle, Boise, Clark Fork and Flathead basins received above average precipitation. On the other hand, central Oregon and Washington, lower Owyhee, upper Salmon, upper Snake, and Bitterroot basins received below average precipitation.

Temperatures over nearly all of the Columbia Basin were above average. Consequently, snowpacks throughout the region didn't increase as much as one might think. The Canadian snowpack is still the best in the Columbia Basin at 81% of average. It quickly goes downhill from there. The Kootenai and the Kettle snowpacks, most of which are in Canada, are at 62% and 73%, respectively. In the Columbia Basin below Grand Coolee, the North Cascades snowpack is at 42% of average; the Yakima - 32%; John Day/Umatilla - 33%; and the Deschutes - 51%. In the Snake River Basin, the snowpack above American Falls Reservoir is at 79% of average; south-central Snake - 66%; eastern Oregon - 50%; Salmon - 59%; and Clearwater - 55%.

The combined Columbia Basin snowpack above The Dalles is currently at 64% of average. On March 1, it was 59% of average. Last year at this time, the total Columbia Basin snowpack was 91% of average. It should also be noted that the total Columbia snowpack is at only 64% of its normal peak.

The Columbia Basin snowpack is currently at 75 percent of average for January. This compares to 98 percent of average last year. The overall snowpack is at 33 percent of the average peak accumulation. This compares to 43 percent last year.

The snowpack in the Columbia Basin above Castlegar is at 81 percent of average This compares to 90 percent last year. For the basin above Grand Coulee, the snowpack is at 79 percent of average, compared to 94 percent last year. The Snake River snowpack above Ice Harbor is at 73 percent of average, compared to 109 percent last year.

The Canadian snowpack is in the best shape this year at 88 percent of average. Over the rest of the Columbia Basin, the snowpack can be categorized as poor to almost nonexistent! Record low snowpack levels were measured at several snow courses in the Cascades, northeast Oregon, north central Idaho, and western Montana. Near record lows were measured at many more snow courses. Snow surveyors recorded only 35 percent of average snowpack over the entire Yakima Basin. Snowpacks in the North Cascades, Clearwater, John Day/Umatilla, and the Bitterroot basins are also in poor shape at this time.

There is plenty of time for the snowpacks to recover before the spring snowmelt. However, weather forecasters aren't helping out in this regard. They are forecasting dry, warm weather through March.

The composite Columbia Basin snowpack above The Dalles is currently at 68 percent of average for February. This is down from 75 percent on January 1. This compares to 101 percent at this time last year. The overall snowpack is at 45 percent of the average peak accumulation, compared to 67 percent last year. This is the lowest snowpack since the 2001 water year.

The snowpack above Castlegar is at 79 percent of average, compared to 81 percent on January 1 and 131 percent last year. The snowpack above Grand Coulee is at 74 percent, compared to 79 percent on January 1 and 129 percent last year. The Snake River snowpack above Ice Harbor is at 63 percent compared to 73 percent on January 1 and 122 percent last last year.

The Canadian snowpack is holding its' own this year, increasing to 92 percent of average, compared to 90 percent last month. The Upper Columbia in Canada was the only area that received an increase in snowpack percentage. It's difficult to find a decent snowpack anywhere in the U.S. portion of the Columbia Basin. Some of the worst are: Spokane (44%), North Cascades (45%), Yakima (23%), Eastern Oregon (53%), Salmon (62%), Clearwater (55%), and John Day (41%).

Forty-one (41) SNOTEL sites recorded new minimum swe values for February 1. Another 35 were recorded near record lows.

The combined Columbia Basin snowpack above The Dalles is currently at 59 percent of average for March. This is down from 68 percent on February 1. This compares to 91 percent at this time last year. The overall nowpack is at 50 percent of the average peak accumulation, compared to 78 percent last year. The snowpack is normally at 85 percent of its peak on March 1. For many snow measurement sites, this is the lowest year on record. Snow sites in the Columbia Basin where new record minimums were recorded are:

Roland Summit, ID (no snow)
Moscow Mountain, ID (no snow)
Copper Bottom, MT (no snow)
Emery Creek, MT
Intergaard, MT

Nez Perce Pass, MT
Lookout, ID
Kellogg Peak, ID
Canoe River, BC
Stampede Pass, WA
Olallie Meadows, WA
Molson Creek, BC

Near minimum measurements were recorded at several other snow sites.

The snowpack above Castlegar is at 69 percent of average, compared to 79 percent on February 1 and 84 percent last year. The snowpack above Grand Coulee is at 64 percent, compared to 74 percent on February 1 and 87 percent last year. The Snake River snowpack above Ice Harbor is at 56 percent compared to 63 percent on February 1 and 100 percent last last year.

The Columbia snowpack is in terrible shape. Much of the basin in the U.S. is snow free, except areas near the measured snow courses. Most of the snow courses are located in protected locations where snow tends to hold late into the season. Snow pack percentages by basin:

Upper Columbia River in Canada 78%
Kootenai River 56%
Pend Oreille River 53%
Kettle River 76%
Spokan River 38%
North Cascades 41%
Yakima River 23%
Snake River above American Falls 77%
Boise, Payette, Wood, Lost, Southside Snake ... 59%
Eastern Oregon Snake 48%
Salmon River 53%
Clearwater River 49%
John Day & Umatilla Rivers 40%
Deschutes River 55%

The February precipitation was much below average throughout the basin. Precipitation was between 20% to 30% in the South Cascades, 10% to 25% in the North Cascades, 20% to 30% in Eastern Oregon, 15% to 25% in the Boise Basin, 15% to 30% in the Salmon and Clearwater basins, 10% to 25% in the Upper Clark Fork, and 10% to 40% in the Flathead Basin. Measured precipitation at several SNOTEL sites was at record low values.

Expected streamflow runoff could rival (or exceed) the low levels observed during the very dry 1977 water year.

For information about snowpack measurements including that needed to develop the Oregon Surface Water Supply Index or SWSI for Table 4, see the NRCS National Water & Climate Center web site at http://www.or.nrcs.usda.gov/snow/watersupply/swsi.html .

3. Surface Water Supply Index – SWSI

Category-score numerical methods have been developed to indicate the status of the overall surface water supply. The Surface Water Supply Index (SWSI) was developed by the NRCS and has been applied, with slight variations, in portions of the Pacific Northwest. Thus far, the SWSI has only been applied to basins in Oregon, Idaho, and Montana; but only the Oregon values are computed monthly. These indices include consideration of the status of the surface waters and reservoir contents of the basin, along with precipitation, snow, temperature, and other parameters. The index has a range of +4.1 (very ample supply of water) through 0.0 (normal supply), to -4.1 (very inadequate supply).

For monthly information about the Oregon SWSI for the years 1997 to 2005, see the web site at: http://www.or.nrcs.usda.gov/snow/watersupply/swsi.html. For pertinent information about the Idaho SWSI for water year 2003, see the web site at: http://www.id.nrcs.usda.gov/snow/watersupply . (The Klamath, Lake County, and Harney areas do not contribute to the Columbia drainage or have flood control reservoirs and therefore are not germane to this report).

The effects of the water supply on the regulation of the specific reservoir projects are discussed in Chapter III, the effects on power generation, irrigation, recreation, fisheries, and other activities are discussed, by activity, in Chapter IV.

4. Streamflow

Streamflows in the Pacific Northwest were measured at approximately 900 gaging stations. To condense this information, data from 10 index gages on both uncontrolled and controlled streams were used to summarize the flows throughout the region. Data from all gages are reported with observed flows and are not adjusted for the amount of storage. Monthly mean discharges for each of these index stations, expressed as a percentage of their 1971–2000 normal discharges, are shown in Table 5 . Flood peaks will be discussed in Section 5.

The annual mean streamflows throughout the Columbia River Basin for WY 2005 were below normal for most of the index sites. The Snake River Basin index sites continued with the fifth straight year of below normal streamflow. The index station with the highest mean annual discharge, in percent of normal, was the Middle Fork Flathead River near West Glacier with 86%, and the lowest was the Snake River at Weiser, Idaho, with 55%. The 2005 water year started with all but one index site reporting at or above normal mean monthly flows. A dry winter impacted most of the Columbia River Basin, and by February 1, the snowpack in most of the basin was less than 60% of normal. By March, 9 out of 10 index gages in the Columbia River Basin were reporting below normal flows. The latter half of March and the rest of the spring was a stark contrast to the previous winter period. More than average precipitation helped provide a late boost to the meager snowpack. The cool wet period lasted to the end of June, with the remaining summer months dryer than normal resulting in streamflows trending below normal.

Tables 6, 7, 8, 9, and 10 show additional comparisons of WY 2005 observed streamflows and runoff with historical flows. The Snake River at Anatone had a record low November and December mean observed streamflow for the period of record.

B. FORECASTS

River forecasts are prepared primarily by the Northwest River Forecast Center (NWRFC) under an agreement between the NWRFC, the Corps, and Bonneville and are fully coordinated with the Bureau of Reclamation. Under this Columbia River Forecasting Service (CRFS) agreement all major projects are assumed to be operated based on coordinated forecasts. This minimizes unanticipated project operations due to the use of different flow forecasts. This agreement sets three main goals: (1) pool certain resources of the three participating agencies within the region; (2) avoid duplication of forecasts; and (3) increase the overall efficiency of operation. These forecasts are released monthly about the tenth of each month between January and June and are based on the basin hydrologic conditions on the first of each month plus normal weather assumed throughout the remainder of the forecast period.

In addition to these CRFS forecasts, the NWRFC also prepared forecasts that are distributed through the state NWS offices for public warning, for rivers in areas that were not affected by project regulations.

For forecast points located below flood control projects, outflow schedules are provided by the operating agency before the downstream flood warning is issued. The forecast area includes all of Oregon, Washington, Idaho, western Montana, western Wyoming, and the Columbia Basin portion of British Columbia. Distribution of all these forecasts was through CROHMS, by the Columbia Basin Telecommunications system (CBT), and the National Weather Service (NWS) web page (http://www.nws.noaa.gov/forecasts.html). The NWS AFOS system is used to transmit the forecasts to the state hydrologist offices in Seattle, Portland, Medford, Boise, Missoula, Pendleton, Pocatello, and Spokane for public release.

1. Runoff Volumes

For information about water supply streamflow products posted by NRCS, National Water & Climate Center, see the NRCS web site at http://www.wcc.nrcs.usda.gov/water/w_qnty.html. Products for this web site include streamflow color graphics maps and forecast probability charts.

2. Long-Range Peaks

Spring peak flow forecasts, expressed as a range of stages or flows, are a product of volume forecasts with model simulation of daily forecasts that provide adjustments to these long-range predictions. The forecast peak stage or flow are expressed so there was a probability that 16% of peak drainage may occur above the higher limit and a 16% probability of the peak occurring below the lower limit.

3. Daily Streamflows

The forecasts of operational streamflow were prepared by the NWRFC. The three operating agencies, Bureau of Reclamation, Bonneville Power Administration, and the Corps, used these streamflow forecasts in their day-to-day reservoir project operation and energy production. Close and constant coordination was required between these agencies and the NWRFC because project operations were dependent upon forecasts and the forecasts must take into consideration the project operation. The results of water resource uses of these forecasts are described in the following two chapters of this report.