

Washington Water Supply Outlook Report May 1, 2016



Mt. Blum Aerial Marker, Baker River, May 4, 2016, Puget Sound Energy

Reminder: We are soliciting field work photos from our snow surveyors again this year. Each month we pick one to grace the cover of this report. The photographer will be given proper credit of course. Please include all specific information when submitting photos. Scott.pattee@wa.usda.gov

Water Supply Outlook Reports and Federal - State – Private Cooperative Snow Surveys

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How forecasts are made

Most of the annual streamflow in the western United States originates as snowfall that has accumulated in the mountains during the winter and early spring. As the snowpack accumulates, hydrologists estimate the runoff that will occur when it melts. Measurements of snow water equivalent at selected manual snow courses and automated SNOTEL sites, along with precipitation, antecedent streamflow, and indices of the El Niño / Southern Oscillation are used in computerized statistical and simulation models to prepare runoff forecasts. These forecasts are coordinated between hydrologists in the Natural Resources Conservation Service and the National Weather Service. Unless otherwise specified, all forecasts are for flows that would occur naturally without any upstream influences.

Forecasts of any kind, of course, are not perfect. Streamflow forecast uncertainty arises from three primary sources: (1) uncertain knowledge of future weather conditions, (2) uncertainty in the forecasting procedure, and (3) errors in the data. The forecast, therefore, must be interpreted not as a single value but rather as a range of values with specific probabilities of occurrence. The middle of the range is expressed by the 50% exceedance probability forecast, for which there is a 50% chance that the actual flow will be above, and a 50% chance that the actual flow will be below, this value. To describe the expected range around this 50% value, four other forecasts are provided, two smaller values (90% and 70% exceedance probability) and two larger values (30%, and 10% exceedance probability). For example, there is a 90% chance that the actual flow will be more than the 90% exceedance probability forecast. The others can be interpreted similarly.

The wider the spread among these values, the more uncertain the forecast. As the season progresses, forecasts become more accurate, primarily because a greater portion of the future weather conditions become known; this is reflected by a narrowing of the range around the 50% exceedance probability forecast. Users should take this uncertainty into consideration when making operational decisions by selecting forecasts corresponding to the level of risk they are willing to assume about the amount of water to be expected. If users anticipate receiving a lesser supply of water, or if they wish to increase their chances of having an adequate supply of water for their operations, they may want to base their decisions on the 90% or 70% exceedance probability forecasts, or something in between. On the other hand, if users are concerned about receiving too much water (for example, threat of flooding), they may want to base their decisions on the 30% or 10% exceedance probability forecasts, or something in between. Regardless of the forecast value users choose for operations, they should be prepared to deal with either more or less water. (Users should remember that even if the 90% exceedance probability forecast is used, there is still a 10% chance of receiving less than this amount.) By using the exceedance probability information, users can easily determine the chances of receiving more or less water.

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Washington Water Supply Outlook

May 2016

General Outlook

Record high temperatures rocked not only Washington but the whole Pacific Northwest. With snowpack already teetering on the verge of melt the blistering heat served as the proverbial “straw that broke the camel’s back”. Over 80% of all SNOTEL sites with at least 15 years of data set all new melt rate records for April and the rest came in 2nd. During 2 separate high pressure weather systems in April SNOTEL experienced minimum daily temperatures exceeding 20 degrees above normal. Due to the rapid snow melt runoff was above normal however our rivers and streams were able to contain it without flooding. The latest NWS short term forecasts are calling for warmer than normal with some chance of seasonal precipitation. Long range forecasts for the early summer continue to be warmer than normal with equal chances of precipitation. Suffice it say that normal rain fall during this period is only about 13% of the annual total. The leading climate factor this summer will be temperature.
<http://www.cpc.ncep.noaa.gov/>

Snowpack

The May 1 statewide SNOTEL readings were 87% of normal. The Tolt River Basin reported the lowest readings at 44% of the 30-year median among those with remaining snow. Potato Hill SNOTEL near Mt. Adams had the highest percentage with 121%. Most basins reported considerable decreases from last month. Most areas reached peak snowpack by April 1 or before which is 2-3 weeks early. Westside medians from SNOTEL, and May 1 snow surveys, included the North Puget Sound river basins with 83% of normal, the Central and South Puget river basins with 60% and 78% respectively, and the Lower Columbia basins with 93% of normal. Snowpack along the east slopes of the Cascade Mountains included the Yakima area with 72% and the Wenatchee area with 74%. Snowpack in the Spokane River Basin was mostly melted out and the Walla Walla River Basin had 76% remaining.

BASIN	PERCENT OF MEDIAN	LAST YEAR PERCENT MEDIAN
Spokane	51	23
Newman Lake	0	0
Pend Oreille	70	61
Okanogan	92	79
Methow	100	79
Conconully Lake	0	0
Central Columbia	74	29
Upper Yakima	65	2
Lower Yakima	80	20
Ahtanum Creek	55	1
Walla Walla	76	0
Lower Snake	74	32
Cowlitz	96	25
Lewis	89	1
White	87	37
Green	55	0
Puyallup	79	33
Cedar	72	0
Snoqualmie	58	1
Skykomish	59	1
Tolt	44	0
Skagit	93	58
Nooksack	55	14
Olympic Peninsula	75	0

Precipitation

The state received much below normal precipitation for the month of April however year to date statewide SNOTEL averages remain above normal at 124%. The Pend Oreille, which includes parts of Idaho and Montana, recorded the highest percentages in the state at 71%. Sheep Canyon SNOTEL near Mt. St. Helens received the most rain last month with a total of 4.9 inches or 46% of normal.

RIVER BASIN	MAY PERCENT OF AVERAGE	WATER YEAR PERCENT OF AVERAGE
Spokane	51	103
Pend Oreille	71	99
Upper Columbia	45	116
Central Columbia	43	126
Upper Yakima	27	123
Lower Yakima	37	128
Walla Walla	37	104
Lower Snake	73	104
Lower Columbia	36	125
South Puget Sound	49	126
Central Puget Sound	46	123
North Puget Sound	40	119
Olympic Peninsula	55	134

Reservoir

Seasonal reservoir levels in Washington can vary greatly due to specific watershed management practices required in preparation for irrigation season, fisheries management, power generation, municipal demands and flood control. May 1 Reservoir storage in the Yakima Basin was 777,000-acre feet, 128% of average for the Upper Reaches and 222,000-acre feet or 124% of average for Rimrock and Bumping Lakes. The power generation reservoirs included the following: Coeur d'Alene Lake, 206,000 acre feet, 90% of average and 86% of capacity; and the Skagit River reservoirs at 93% of average and 50% of capacity. Recent climate impacts and management procedures may affect these numbers on a daily or weekly basis.

BASIN	PERCENT OF CAPACITY	CURRENT STORAGE AS PERCENT OF AVERAGE
Spokane	86	90
Pend Oreille	62	101
Upper Columbia	95	136
Central Columbia	80	181
Upper Yakima	93	128
Lower Yakima	96	124
Lower Snake	84	110
North Puget Sound	50	93

For more information contact your local Natural Resources Conservation Service office.

Streamflow

Above normal temperatures and below normal April precipitation contributed to a statewide decrease in streamflow forecasts for this summer. May-September forecasts for some Western Washington streams include the Cedar River near Cedar Falls, 96%; White River, 90%; and Skagit River, 99%. Some Eastern Washington streams include the Yakima River near Parker 75%, Wenatchee River at Plain 87%; and Spokane River near Post Falls 78%. Volumetric forecasts are developed using current, historic and average snowpack, precipitation and streamflow data collected and coordinated by organizations cooperating with NRCS.

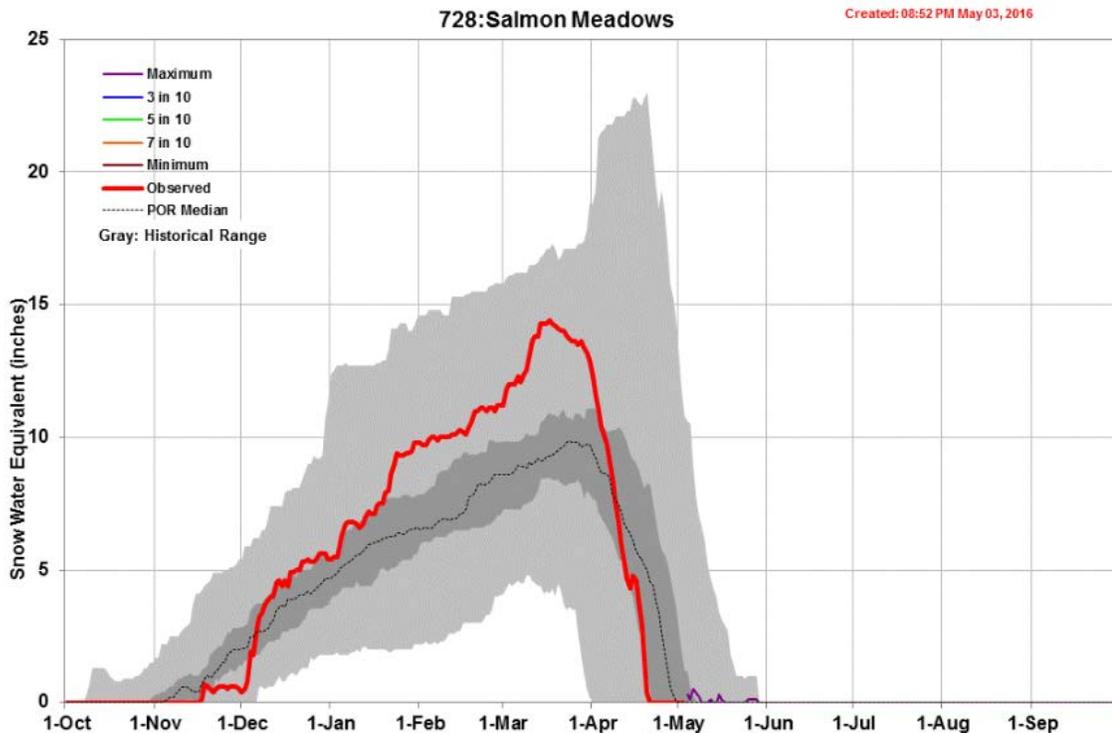
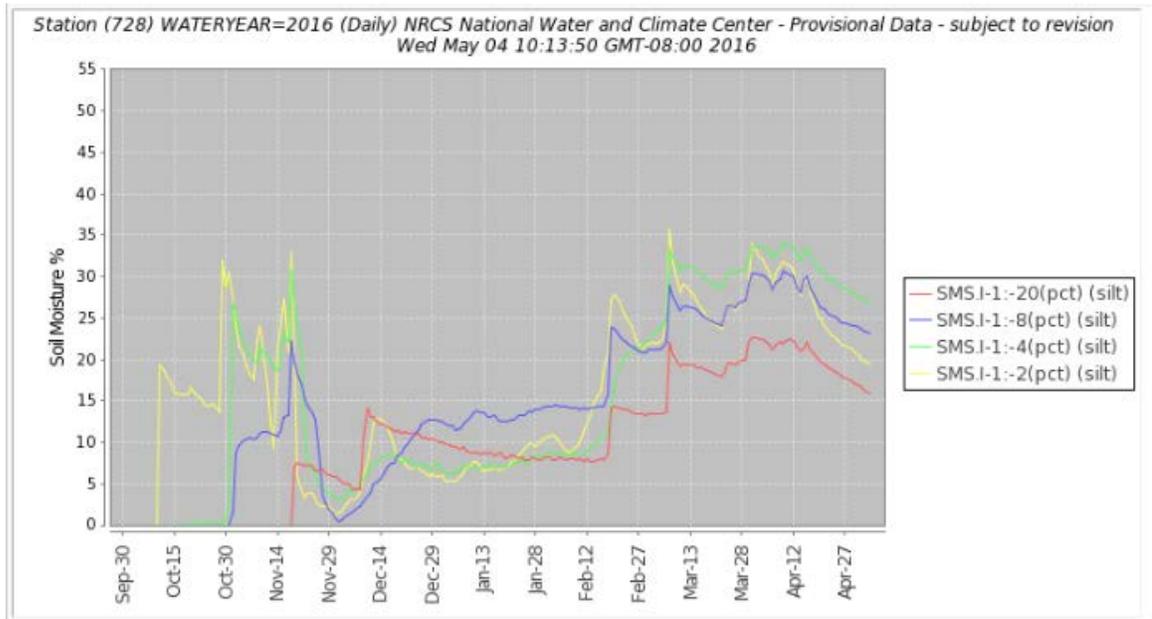
BASIN	PERCENT OF AVERAGE (50 PERCENT CHANCE OF EXCEEDENCE)
Spokane	78-98
Pend Oreille	85-86
Upper Columbia	86-101
Central Columbia	87-103
Upper Yakima	67-74
Lower Yakima	72-94
Walla Walla	94-98
Lower Snake	75-93
Lower Columbia	89-99
South Puget Sound	74-90
Central Puget Sound	87-98
North Puget Sound	98-99
Olympic Peninsula	73-75

STREAM	PERCENT OF AVERAGE MAY STREAMFLOWS
Pend Oreille at Albeni Fall Dam	145
Kettle at Laurier	245
Columbia at Birchbank	210
Spokane at Spokane	104
Similkameen at Nighthawk	353
Okanogan at Tonasket	328
Methow at Pateros	443
Chelan at Chelan	272
Wenatchee at Pashastin	223
Cle Elum near Roslyn	189
Yakima at Parker	177
Naches at Naches	207
Grande Ronde at Troy	97
Snake below Lower Granite Dam	120
Columbia River at The Dalles	157
Lewis at Merwin Dam	77
Cowlitz below Mayfield Dam	109
Skagit at Concrete	159
Dungeness near Sequim	170

Soil Moisture

Current soil moisture data is available from a limited number of SNOTEL sites scattered throughout each basin. As the effort continues to install additional sensors and more years of data are acquired this information will become invaluable to the streamflow forecasting community.

The following graph shows a very typical spring soil moisture profile at Salmon Meadows SNOTEL site near Omak, WA. Notice the profile recharge when fall rains began, a decline after, followed by a steady recharge throughout the winter with a steady decline after snow melt out. Soil saturation occurred at melt out in mid-April. The second graph is snowpack projection for the same site which shows a normal peak around April 15 and subsequent rapid melt curve. Notice how this site melted out about 2 weeks early.



This is an automated product based on SNOTEL data, provisional data are subject to change. This product combines the historical period of record data (gray background) with the recent daily data (heavy red, left) to project into the future (colored lines, right). This product does not consider climate information such as El Nino or short range weather forecasts and therefore should only be used as a seasonal planning tool. Contact Jim.Marron@por.usda.gov 503 414 3047



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Helpful Internet Addresses

NRCS Snow Survey and Climate Services Homepages

Washington:

<http://www.nrcs.usda.gov/wps/portal/nrcs/main/wa/snow/>

Oregon:

<http://www.nrcs.usda.gov/wps/portal/nrcs/main/or/snow/>

Idaho:

<http://www.nrcs.usda.gov/wps/portal/nrcs/main/id/snow/>

National Water and Climate Center (NWCC):

<http://www.wcc.nrcs.usda.gov>

USDA-NRCS Agency Homepages

Washington:

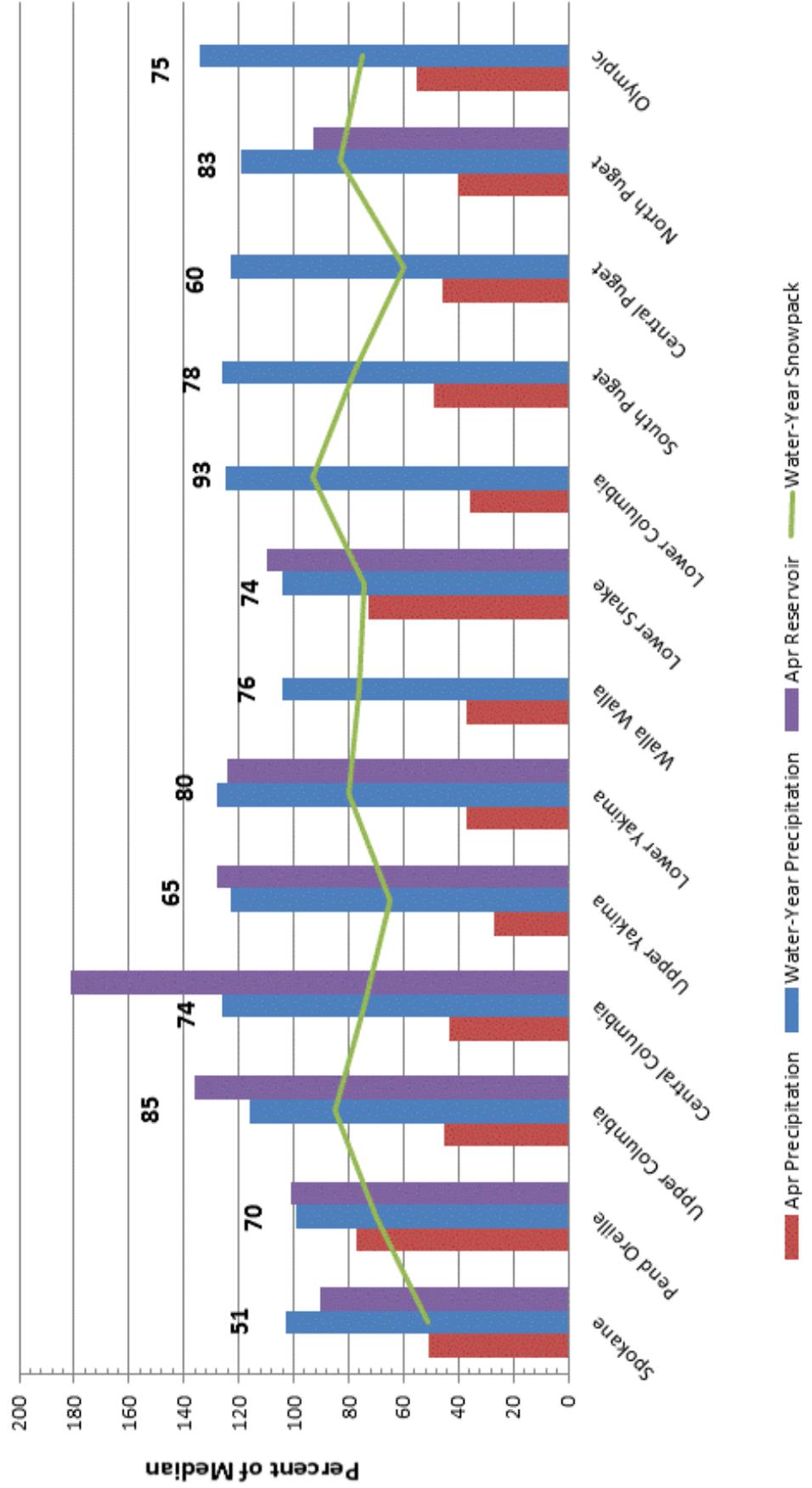
<http://www.nrcs.usda.gov/wps/portal/nrcs/site/wa/home/>

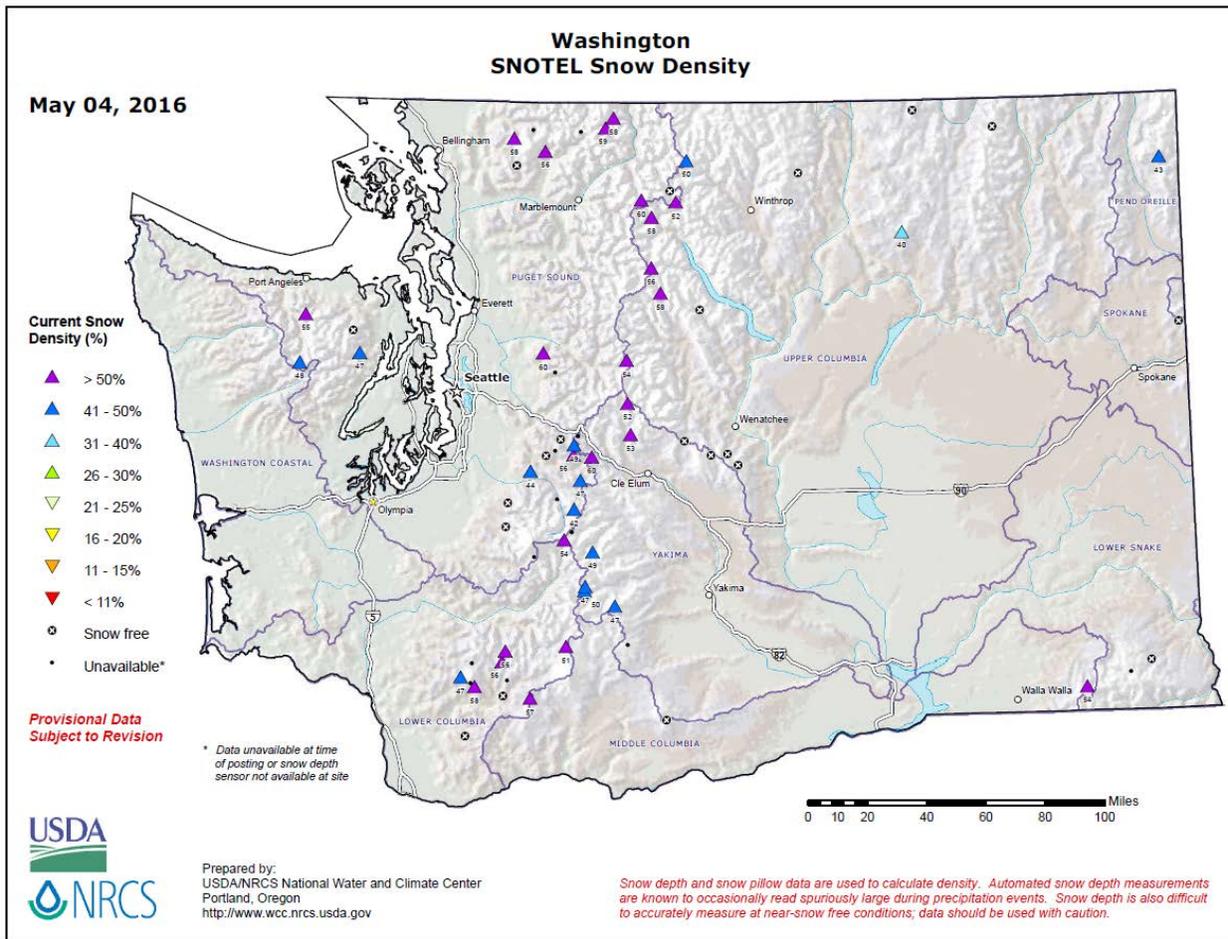
NRCS National:

<http://www.nrcs.usda.gov/wps/portal/nrcs/site/national/home/>

May 1, 2016 - Snowpack, Precipitation and Reservoir Conditions at a Glance

(Water Year = October 1, 2015 - Current Date)



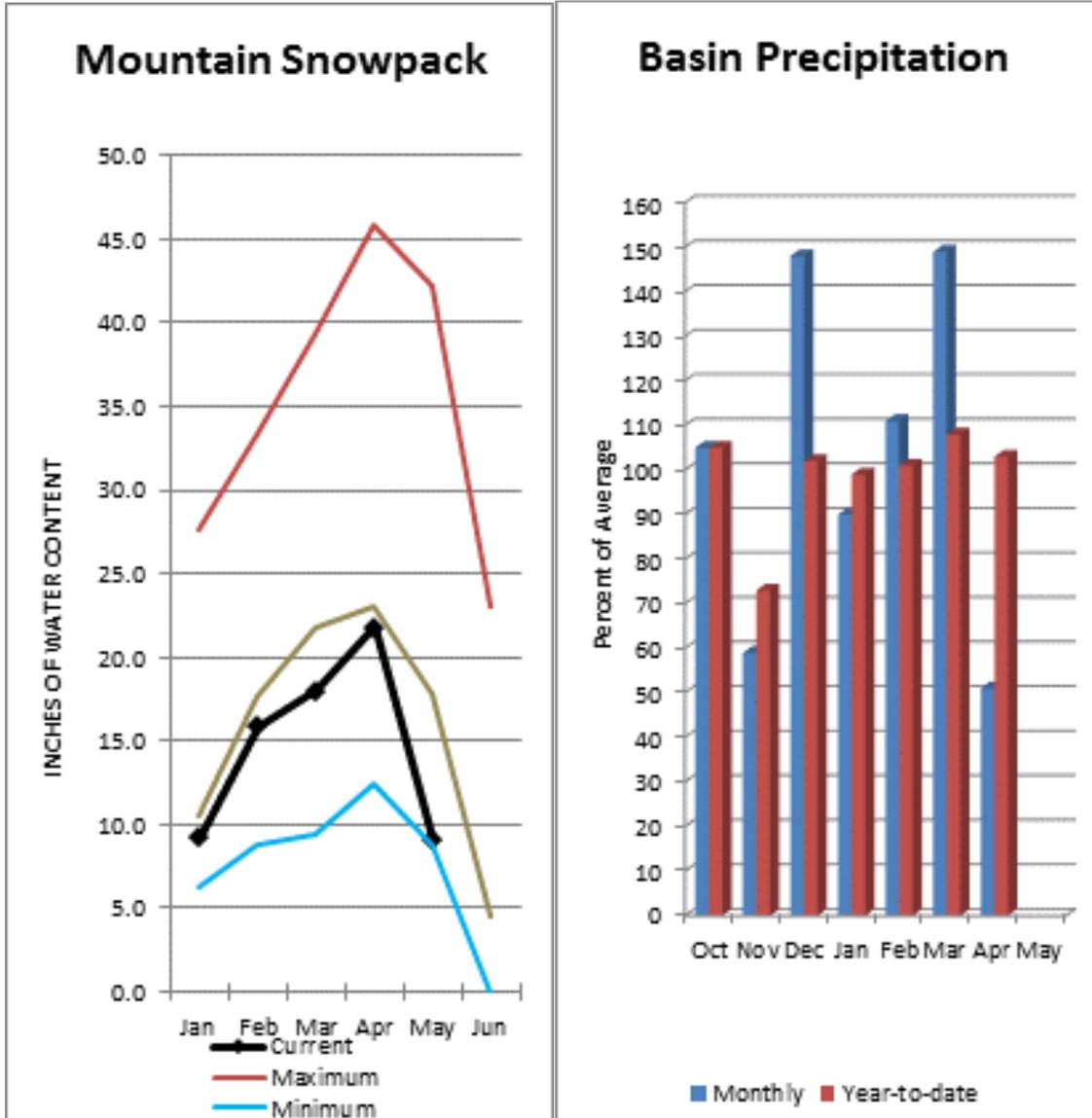


Western Snow Conference

A very successful conference was held in Seattle, WA, April 18-21, 2016. We look forward to the 2017 Western Snow Conference and joint meeting with the Weather Modification Association April 17-20, 2017 in Boise, ID.

Additional information about the conference can be found on the WSC web page at: <http://www.westernsnowconference.org/>

Spokane River Basin



The May 1 forecasts for summer runoff within the Spokane River Basin are 78% of average near Post Falls and 82% at Long Lake. The Chamokane River near Long Lake forecasted to have 98% of average flows for the May-August period. The forecast is based on a basin snowpack that is 51% of normal and precipitation that is 103% of average for the water year. Precipitation for April was below normal at 51% of average. Streamflow on the Spokane River at Spokane was 104% of average for April. May 1 storage in Coeur d'Alene Lake was 206,000 acre feet, 90% of average and 86% of capacity. Snowpack at Quartz Peak SNOTEL site had melted out by May 1 however it should have had 14.4 inches of water content. Average temperatures in the Spokane basin were 4-6 degrees above normal for April and 2-4 degrees above for the water year.

For more information contact your local Natural Resources Conservation Service office.

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Spokane Streamflow Forecasts - May 1, 2016

Spokane	Forecast Period	Forecast Exceedance Probabilities for Risk Assessment Chance that actual volume will exceed forecast						30yr Avg (KAF)
		90% (KAF)	70% (KAF)	50% (KAF)	% Avg	30% (KAF)	10% (KAF)	
Spokane R nr Post Falls ²	MAY-JUL	740	1010	1200	78%	1380	1650	1530
	MAY-SEP	775	1070	1270	78%	1470	1770	1620
Spokane R at Long Lake ²	MAY-JUL	865	1190	1410	82%	1630	1960	1710
	MAY-SEP	1020	1370	1600	82%	1840	2190	1950
Chamokane Ck nr Long Lake	MAY-AUG	4.5	7.2	9.1	98%	10.9	13.6	9.3

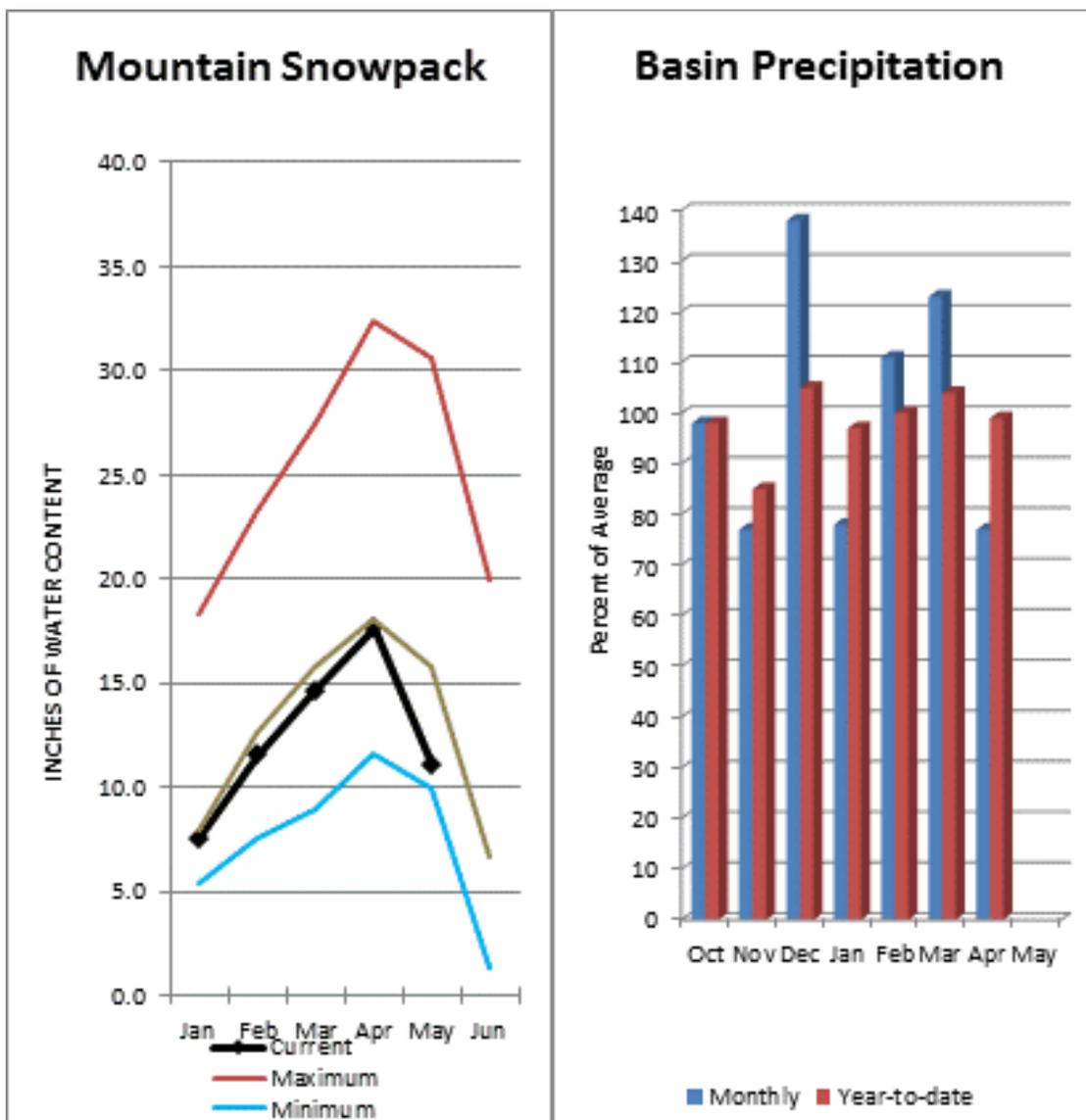
1) 90% and 10% exceedance probabilities are actually 95% and 5%

2) Forecasts are for unimpaired flows. Actual flow will be dependent on management of upstream reservoirs and diversions

3) Median value used in place of average

Reservoir Storage End of April, 2016	Current (KAF)	Last Year (KAF)	Average (KAF)	Capacity (KAF)
Lake Coeur d' Alene	205.7	209.1	228.0	238.5
Basin-wide Total	205.7	209.1	228.0	238.5
# of reservoirs	1	1	1	1

Watershed Snowpack Analysis May 1, 2016	# of Sites	% Median	Last Year % Median
Spokane	11	51%	23%
Newman Lake	1	0%	0%



The May – September average forecast for the Priest River near the town of Priest River is 86% and the Pend Orielle below Box Canyon is 86%. April streamflow was 145% of average on the Pend Oreille River and 210% on the Columbia at Birchbank. May 1 snow cover was 70% of normal in the Pend Oreille Basin River Basin. Bunchgrass Meadows SNOTEL site had 18.2 inches of snow water on the snow pillow. Normally Bunchgrass would have 23.6 inches on May 1. Precipitation during April was 71% of average, dropping the year-to-date precipitation at 99% of average. Reservoir storage in the basin, including Lake Pend Oreille and Priest Lake was 101% of normal. Average temperatures were 4-6 degrees above normal for April and 2-4 degrees above for the water year.

For more information contact your local Natural Resources Conservation Service office.

Pend Oreille River Basins

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Pend Oreille Basins Streamflow Forecasts - May 1, 2016

Forecast Exceedance Probabilities for Risk Assessment Chance that actual volume will exceed forecast

Pend Oreille Basins	Forecast Period	90% (KAF)	70% (KAF)	50% (KAF)	% Avg	30% (KAF)	10% (KAF)	30yr Avg (KAF)
Pend Oreille Lake Inflow ²	MAY-JUL	6630	7580	8230	85%	8880	9830	9690
	MAY-SEP	7340	8430	9180	86%	9920	11000	10700
Priest R nr Priest River ²	MAY-JUL	390	455	500	86%	545	610	580
	MAY-SEP	415	490	540	86%	590	665	630
Pend Oreille R bl Box Canyon ²	MAY-JUL	6700	7650	8300	85%	8950	9900	9750
	MAY-SEP	7420	8520	9260	86%	10000	11100	10800

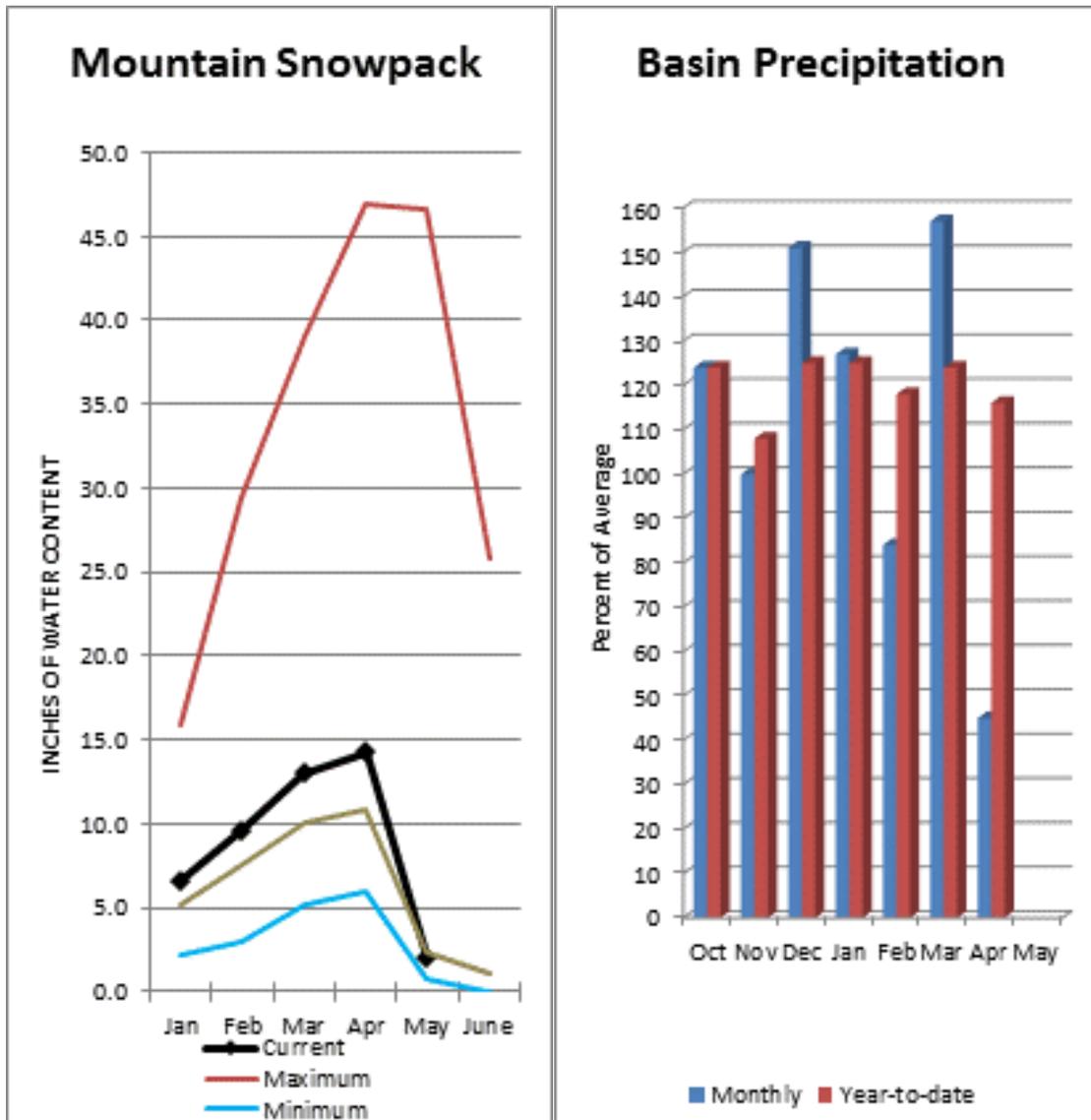
1) 90% and 10% exceedance probabilities are actually 95% and 5%

2) Forecasts are for unimpaired flows. Actual flow will be dependent on management of upstream reservoirs and diversions

3) Median value used in place of average

Reservoir Storage End of April, 2016	Current (KAF)	Last Year (KAF)	Average (KAF)	Capacity (KAF)
Lake Pend Oreille	920.1	851.9	931.7	1561.3
Priest Lake	127.3	81.9	101.9	119.3
Basin-wide Total	1047.4	933.8	1033.6	1680.6
# of reservoirs	2	2	2	2

Watershed Snowpack Analysis May 1, 2016	# of Sites	% Median	Last Year % Median
Pend Oreille Basins	65	70%	61%
Colville River	0		
Kettle River	4	52%	44%



Summer runoff average forecast for the Okanogan River is 91%, Similkameen River is 94%, and Methow River is 101%. May 1 snow cover on the Okanogan was 92% of normal, Omak Creek was 46% and the Methow was 100%. April precipitation in the Upper Columbia was 47% of average, with precipitation for the water year at 116% of average. April streamflow for the Methow River was 443% of average, 328% for the Okanogan River and 353% for the Similkameen. Salmon Meadows SNOTEL was void of snow by May 1. Combined storage in the Conconully Reservoirs was 22,400 acre-feet or 136% of normal. Temperatures were 4-6 degrees above normal for April and for the water year.

Upper Columbia River Basins

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Upper Columbia Basins Streamflow Forecasts - May 1, 2016

Forecast Exceedance Probabilities for Risk Assessment
Chance that actual volume will exceed forecast

Upper Columbia Basins	Forecast Period	90% (KAF)	70% (KAF)	50% (KAF)	% Avg	30% (KAF)	10% (KAF)	30yr Avg (KAF)
Kettle R nr Laurier	MAY-JUL	1220	1370	1480	102%	1590	1740	1450
	MAY-SEP	1250	1430	1550	101%	1670	1850	1530
Colville R at Kettle Falls	MAY-JUL	30	53	69	96%	85	108	72
	MAY-SEP	34	61	79	94%	98	125	84
Columbia R at Grand Coulee ^{1,2}	MAY-SEP	43600	46600	47900	90%	49200	52200	52970
Similkameen R nr Nighthawk ¹	MAY-JUL	750	920	995	94%	1070	1240	1060
	MAY-SEP	795	985	1070	94%	1160	1340	1140
Okanogan R nr Tonasket ¹	MAY-JUL	675	985	1120	86%	1260	1570	1300
	MAY-SEP	755	1110	1270	86%	1430	1780	1470
Okanogan R at Malott ¹	MAY-JUL	685	1010	1160	91%	1300	1620	1270
	MAY-SEP	775	1140	1310	91%	1470	1840	1440
Methow R nr Pateros	MAY-JUL	610	680	730	100%	780	855	730
	MAY-SEP	660	740	795	101%	845	925	790
Columbia R at Birchbank ^{1,2}	MAY-SEP	30100	34000	35800	93%	37600	41500	38390

1) 90% and 10% exceedance probabilities are actually 95% and 5%

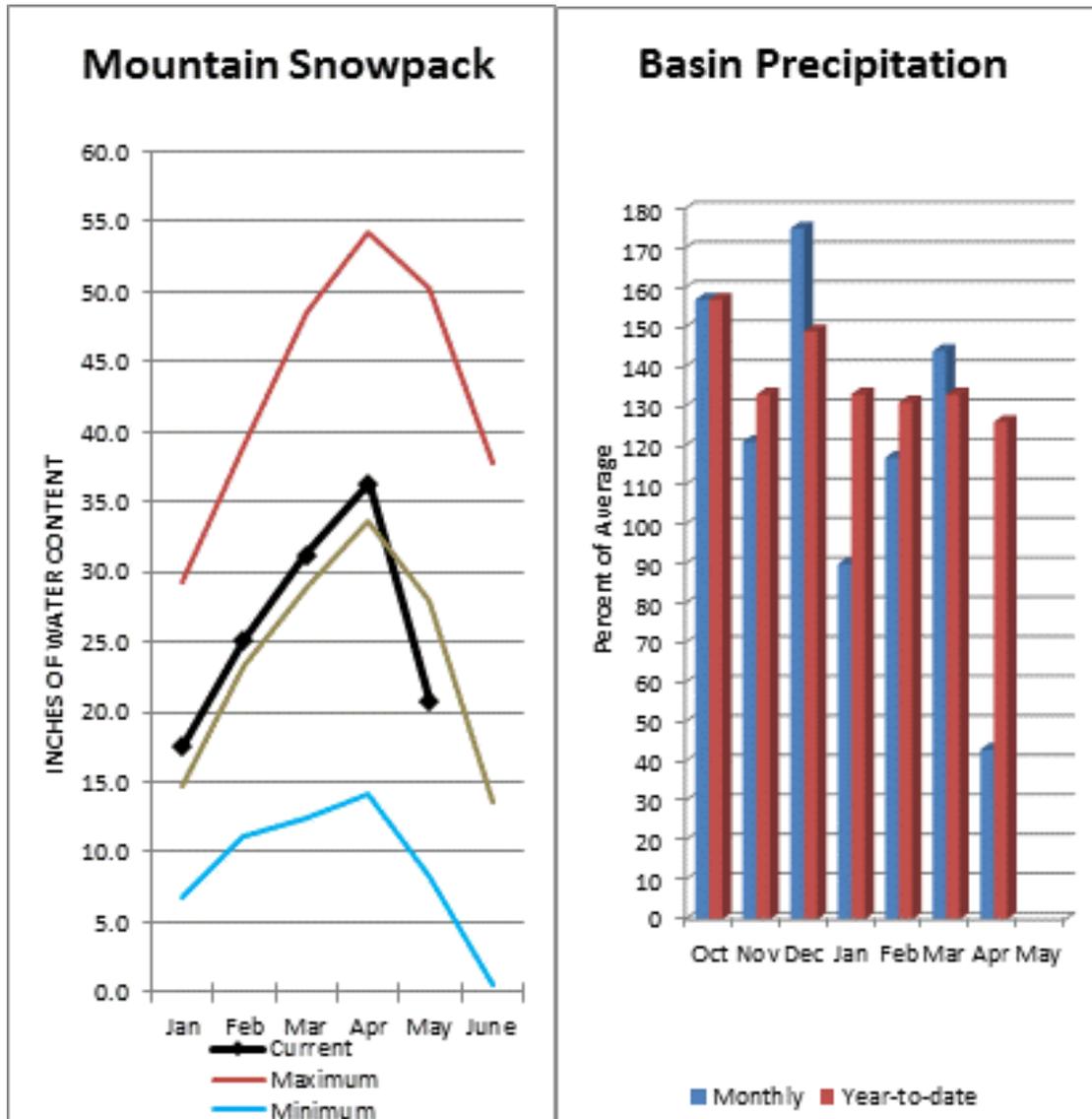
2) Forecasts are for unimpaired flows. Actual flow will be dependent on management of upstream reservoirs and diversions

3) Median value used in place of average

Reservoir Storage End of April, 2016	Current (KAF)	Last Year (KAF)	Average (KAF)	Capacity (KAF)
Conconully Lake (Salmon Lake Dam)	9.4	9.0	7.6	10.5
Conconully Reservoir	13.0	12.5	8.9	13.0
Basin-wide Total	22.4	21.5	16.5	23.5
# of reservoirs	2	2	2	2

Watershed Snowpack Analysis May 1, 2016	# of Sites	% Median	Last Year % Median
Upper Columbia Basins	13	85%	71%
Okanogan River	8	92%	79%
Omak Creek	1	46%	0%
Sanpoil River	0		
Similkameen River	5	56%	63%
Toats Coulee Creek	0		
Conconully Lake	1		
Methow River	4	100%	79%

Central Columbia River Basins



Precipitation during April was 44% of average in the basin and 126% for the year-to-date. Runoff for Entiat River is forecast to be 87% of average for the summer. The May-September average forecast for Chelan River is 97%, Wenatchee River at Plain is 87%, Stehekin River is 103% and Icicle Creek is 96%. April average streamflow on the Chelan River was 272% and on the Wenatchee River 223%. May 1 snowpack in the Wenatchee River Basin was 74% of normal; the Chelan, 97%; the Entiat, Stemilt Creek, and Colockum Creek were all melted out by May 1. Reservoir storage in Lake Chelan was 181% of average and 80% of capacity. Lyman Lake SNOTEL had the most snow water with 60.7 inches of water. This site would normally have 61.2 inches on May 1. Temperatures were 4-6 degrees above normal for April and 2-4 degrees above for the water year.

For more information contact your local Natural Resources Conservation Service office.

Central Columbia River Basins

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Central Columbia Basins Streamflow Forecasts - May 1, 2016

Forecast Exceedance Probabilities for Risk Assessment
Chance that actual volume will exceed forecast

Central Columbia Basins	Forecast Period	90% (KAF)	70% (KAF)	50% (KAF)	% Avg	30% (KAF)	10% (KAF)	30yr Avg (KAF)
Stehekin R at Stehekin	MAY-JUL	500	565	610	103%	655	720	595
	MAY-SEP	625	685	725	103%	770	830	705
Chelan R at Chelan	MAY-JUL	735	790	825	96%	860	910	860
	MAY-SEP	855	905	945	97%	980	1030	975
Entiat R nr Ardenvoir	MAY-JUL	132	146	156	88%	166	180	178
	MAY-SEP	146	161	171	87%	181	196	196
Wenatchee R at Plain	MAY-JUL	620	685	725	88%	770	835	825
	MAY-SEP	685	755	800	87%	845	915	920
Icicle Ck nr Leavenworth	MAY-JUL	188	210	225	96%	240	265	235
	MAY-SEP	205	230	250	96%	265	295	260
Wenatchee R at Peshastin	MAY-JUL	875	955	1010	89%	1070	1150	1140
	MAY-SEP	965	1050	1110	88%	1180	1270	1260
Columbia R bl Rock Island Dam ²	MAY-SEP	46600	50200	52600	92%	55000	58600	57360

1) 90% and 10% exceedance probabilities are actually 95% and 5%

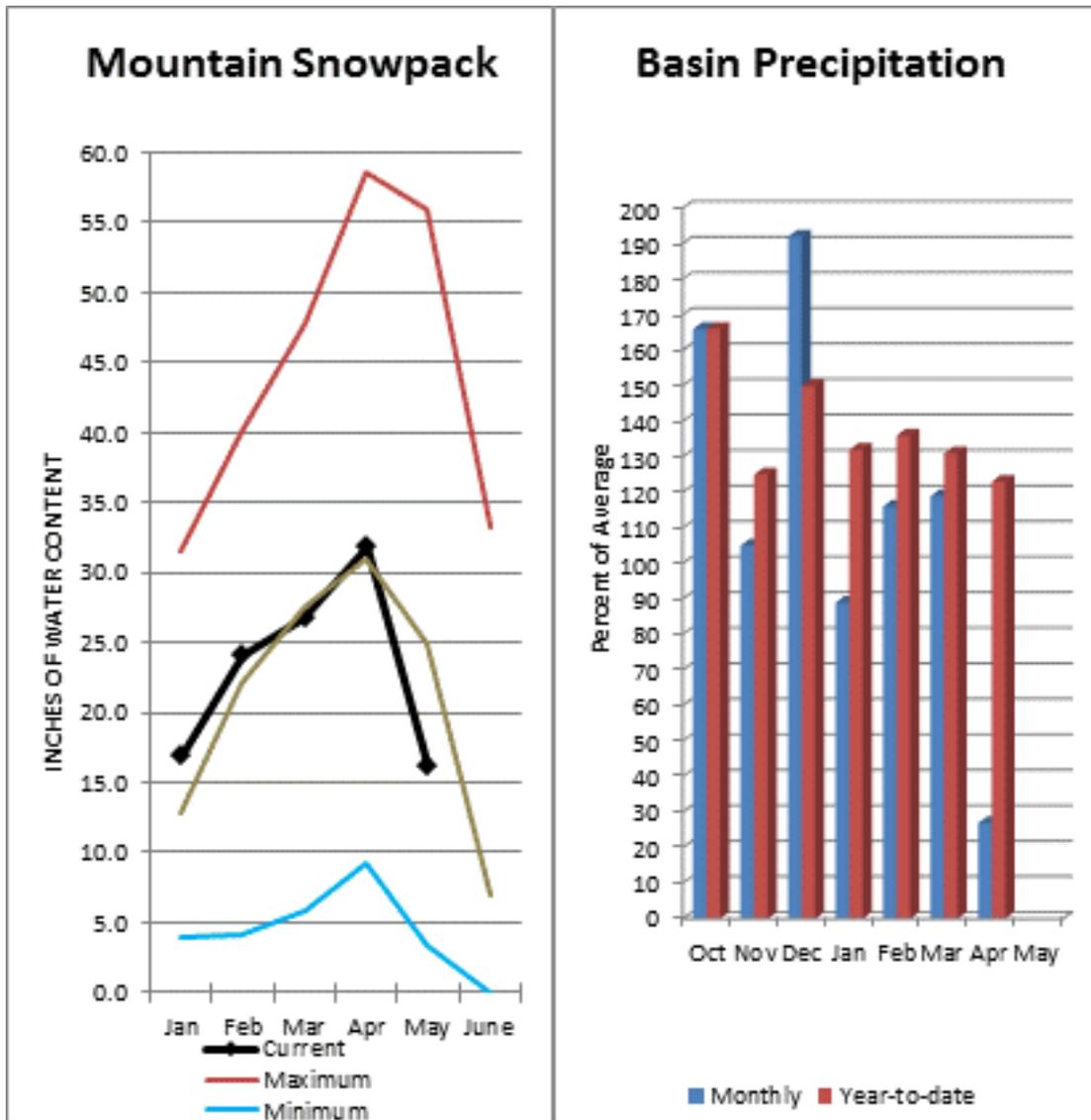
2) Forecasts are for unimpaired flows. Actual flow will be dependent on management of upstream reservoirs and diversions

3) Median value used in place of average

Reservoir Storage End of April, 2016	Current (KAF)	Last Year (KAF)	Average (KAF)	Capacity (KAF)
Lake Chelan	543.3	425.6	300.7	676.1
Basin-wide Total	543.3	425.6	300.7	676.1
# of reservoirs	1	1	1	1

Watershed Snowpack Analysis May 1, 2016	# of Sites	% Median	Last Year % Median
Central Columbia Basins	3	97%	53%
Chelan Lake Basin	3	97%	53%
Entiat River	1	0%	0%
Wenatchee River	7	74%	29%
Stemilt Creek	1	0%	0%
Colockum Creek	1	0%	0%

Upper Yakima River Basin



May 1 reservoir storage for the Upper Yakima reservoirs was 777,000-acre feet, 128% of average. Forecasts for the Yakima River at Cle Elum are 71% of average and the Teanaway River near Cle Elum is at 67%. Lake inflows are all forecasted to be in that same range this summer as well. April streamflow's within the basin were Cle Elum River near Roslyn at 189%. May 1 snowpack was 65% based upon 8 snow course and SNOTEL readings within the Upper Yakima Basin. Precipitation was 26% of average for April and 123% for the water-year. Volume forecasts for the Yakima Basin are for natural flow. As such, they may differ from the U.S. Bureau of Reclamation's forecast for the total water supply available, which includes irrigation return flow.

For more information contact your local Natural Resources Conservation Service office.

Upper Yakima River Basin

Data Current as of: 5/5/2016 3:17:29 PM

Upper Yakima River Streamflow Forecasts - May 1, 2016

Forecast Exceedance Probabilities for Risk Assessment
Chance that actual volume will exceed forecast

Upper Yakima River	Forecast Period	90% (KAF)	70% (KAF)	50% (KAF)	% Avg	30% (KAF)	10% (KAF)	30yr Avg (KAF)
Keechelus Reservoir Inflow ²	MAY-JUL	47	55	60	71%	65	73	85
	MAY-SEP	52	61	68	71%	75	84	96
Kachess Reservoir Inflow ²	MAY-JUL	42	47	51	67%	55	60	76
	MAY-SEP	46	52	57	68%	62	68	84
Cle Elum Lake Inflow ²	MAY-JUL	197	215	225	74%	235	255	305
	MAY-SEP	215	235	250	74%	265	285	340
Yakima R at Cle Elum ²	MAY-JUL	320	360	390	68%	420	460	570
	MAY-SEP	355	415	455	71%	495	555	645
Teanaway R bl Forks nr Cle Elum	MAY-JUL	28	43	53	67%	63	78	79
	MAY-SEP	30	45	55	67%	65	80	82

1) 90% and 10% exceedance probabilities are actually 95% and 5%

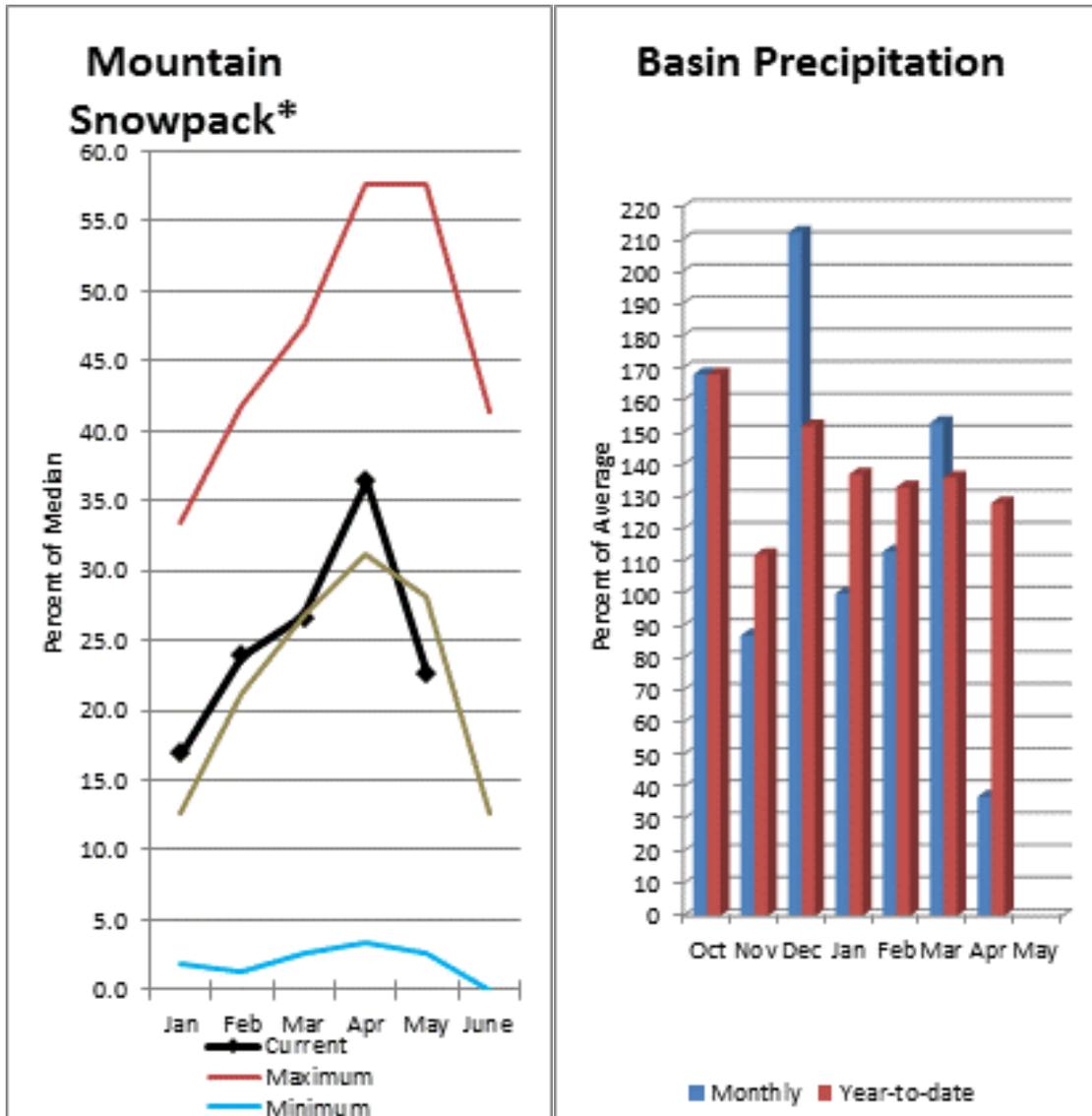
2) Forecasts are for unimpaired flows. Actual flow will be dependent on management of upstream reservoirs and diversions

3) Median value used in place of average

Reservoir Storage End of April, 2016	Current (KAF)	Last Year (KAF)	Average (KAF)	Capacity (KAF)
Keechelus	153.1	142.1	122.1	157.8
Kachess	215.6	237.3	183.7	239.0
Cle Elum	408.6	425.5	302.6	436.9
Basin-wide Total	777.3	804.8	608.4	833.7
# of reservoirs	3	3	3	3

Watershed Snowpack Analysis May 1, 2016	# of Sites	% Median	Last Year % Median
Upper Yakima River	8	65%	2%

Lower Yakima River Basin



April average streamflow's within the basin were: Yakima River near Parker, 177% and the Naches River near Naches, 207%. May 1 reservoir storage for Bumping and Rimrock reservoirs was 222,000-acre feet, 124% of average. Forecast averages for Yakima River near Parker are 75%; American River near Nile, 76%; Ahtanum Creek, 72%; and Klickitat River near Glenwood, 91%. May 1 snowpack was 80% based upon 6 snow course and SNOTEL readings within the Lower Yakima Basin and Ahtanum Creek reported in at 55% of normal. Precipitation was 37% of average for April and 128% for the water-year. Temperatures were 2-6 degrees above normal for April and for the water year. Volume forecasts for Yakima Basin are for natural flow. As such, they may differ from the U.S. Bureau of Reclamation's forecast for the total water supply available, which includes irrigation return flow.

For more information contact your local Natural Resources Conservation Service office.

Lower Yakima River Basin

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Lower Yakima River Streamflow Forecasts - May 1, 2016

Forecast Exceedance Probabilities for Risk Assessment
Chance that actual volume will exceed forecast

Lower Yakima River	Forecast Period	90% (KAF)	70% (KAF)	50% (KAF)	% Avg	30% (KAF)	10% (KAF)	30yr Avg (KAF)
Bumping Lake Inflow ²	MAY-JUL	69	75	80	86%	84	91	93
	MAY-SEP	75	83	88	85%	93	101	103
American R nr Nile	MAY-JUL	52	59	64	76%	69	76	84
	MAY-SEP	56	65	70	76%	76	84	92
Rimrock Lake Inflow ²	MAY-JUL	116	126	133	88%	139	149	151
	MAY-SEP	140	154	163	88%	172	186	185
Naches R nr Naches	MAY-JUL	320	385	430	80%	475	540	540
	MAY-SEP	355	430	480	80%	530	605	600
Ahtanum Ck at Union Gap	MAY-JUL	7.6	11.4	14.3	74%	17.6	23	19.3
	MAY-SEP	8.4	12.1	15.1	72%	18.4	24	21
Yakima R nr Parker ²	MAY-JUL	745	850	920	75%	990	1090	1230
	MAY-SEP	850	960	1040	75%	1120	1230	1390
Klickitat R nr Glenwood	MAY-JUL	72	82	88	91%	94	104	97
	MAY-SEP	82	93	100	91%	107	118	110
Klickitat R nr Pitt	MAY-JUL	245	275	295	97%	315	345	305
	MAY-SEP	325	360	385	97%	410	445	395

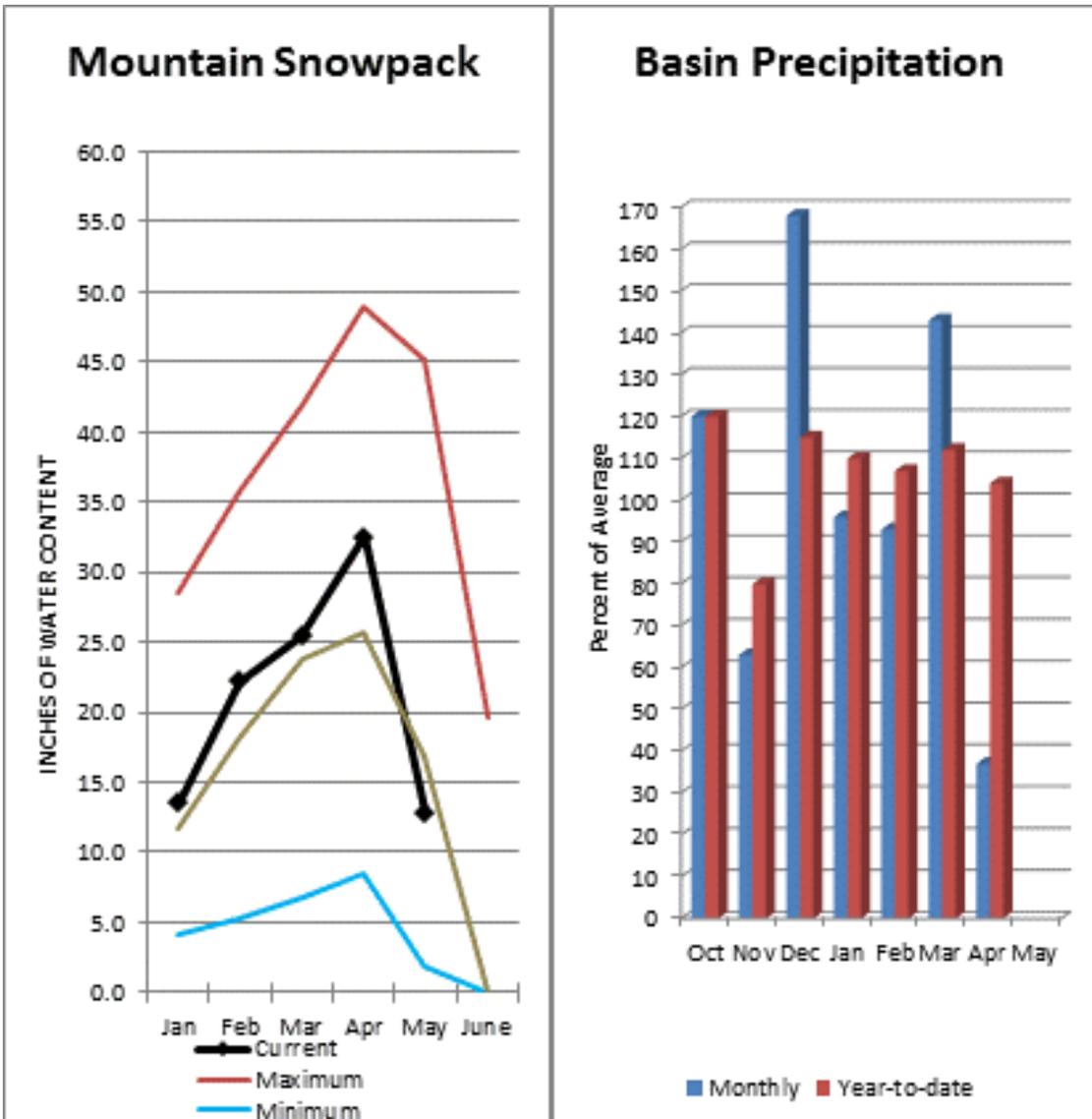
1) 90% and 10% exceedance probabilities are actually 95% and 5%

2) Forecasts are for unimpaired flows. Actual flow will be dependent on management of upstream reservoirs and diversions

3) Median value used in place of average

Reservoir Storage End of April, 2016	Current (KAF)	Last Year (KAF)	Average (KAF)	Capacity (KAF)
Bumping Lake	30.3	33.6	21.7	33.7
Rimrock	191.6	191.2	156.9	198.0
Basin-wide Total	221.9	224.8	178.6	231.7
# of reservoirs	2	2	2	2

Watershed Snowpack Analysis May 1, 2016	# of Sites	% Median	Last Year % Median
Lower Yakima River	6	80%	20%
Ahtanum Creek	2	55%	1%



April precipitation was 37% of average, maintaining the year-to-date precipitation at 104% of average. Snowpack in the basin was 76% of normal. Streamflow forecasts are 94% of average for Mill Creek and 98% for the SF Walla Walla near Milton-Freewater. Average temperatures were 4-6 degrees above normal for April and 2-4 degrees above for the water year.

For more information contact your local Natural Resources Conservation Service office.

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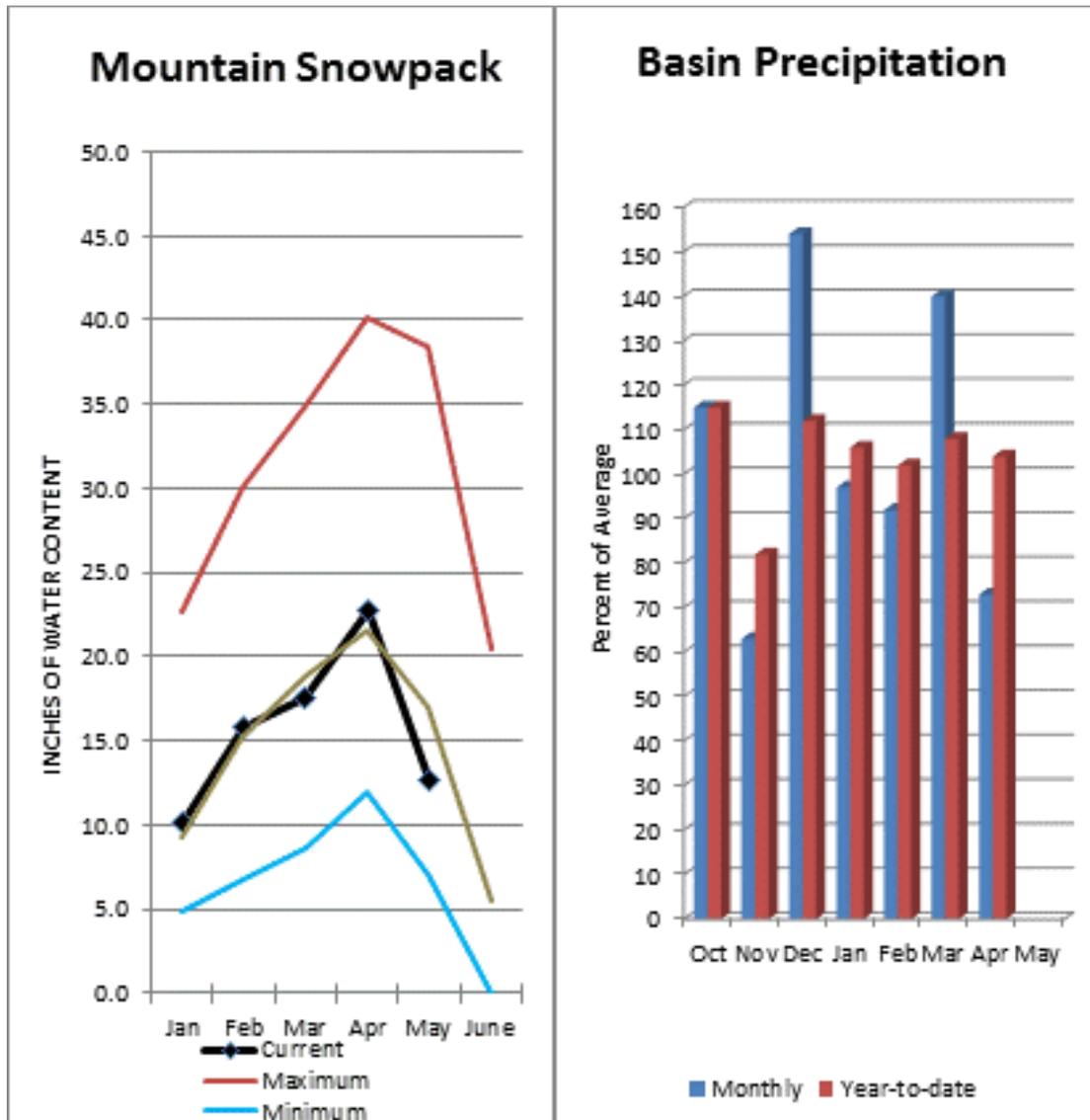
Walla Walla River Streamflow Forecasts - May 1, 2016

Forecast Exceedance Probabilities for Risk Assessment
Chance that actual volume will exceed forecast

Walla Walla River	Forecast Period	90% (KAF)	70% (KAF)	50% (KAF)	% Avg	30% (KAF)	10% (KAF)	30yr Avg (KAF)
SF Walla Wall R nr Milton-Freewater	MAY-JUL	27	33	36	97%	39	45	37
	MAY-SEP	38	44	48	98%	52	58	49
Mill Ck nr Walla Walla	MAY-JUL	9.1	11.3	12.9	93%	14.4	16.7	13.9
	MAY-SEP	12.2	14.7	16.3	94%	18	20	17.3

- 1) 90% and 10% exceedance probabilities are actually 95% and 5%
- 2) Forecasts are for unimpaired flows. Actual flow will be dependent on management of upstream reservoirs and diversions
- 3) Median value used in place of average

Watershed Snowpack Analysis May 1, 2016	# of Sites	% Median	Last Year % Median
Walla Walla River	2	76%	0%



The Grande Ronde River can expect summer flows to be about 93% of normal. The forecast for Asotin Creek at Asotin predicts 73% of average flows for the May – July runoff period. April precipitation was 73% of average, bringing the year-to-date precipitation to 104% of average. May 1 snowpack readings averaged 74% of normal. April streamflow was 120% of average for Snake River below Lower Granite Dam and 97% for Grande Ronde River near Troy. Dworshak Reservoir storage was 110% of average. Average temperatures were 4-6 degrees above normal for April and 2-4 degrees above for the water year.

For more information contact your local Natural Resources Conservation Service office.

Lower Snake River Basin

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Lower Snake, Grande Ronde, Clearwater Basins Streamflow Forecasts - May 1, 2016

Forecast Exceedance Probabilities for Risk Assessment Chance that actual volume will exceed forecast

Lower Snake, Grande Ronde, Clearwater Basins	Forecast Period	90% (KAF)	70% (KAF)	50% (KAF)	% Avg	30% (KAF)	10% (KAF)	30yr Avg (KAF)
Grande Ronde R at Troy	MAY-JUL	560	705	800	93%	895	1040	860
	MAY-SEP	640	780	880	93%	980	1120	945
Asotin Ck at Asotin	MAY-JUL	9	14.1	17.6	73%	21	26	24
Clearwater R at Spalding ²	MAY-JUL	3030	3570	3930	75%	4290	4830	5260
	MAY-SEP	3290	3860	4250	75%	4640	5210	5640
Snake R bl Lower Granite Dam ¹²	MAY-JUL	9030	11300	12300	80%	13300	15600	15280
	MAY-SEP	11000	13600	14800	84%	16000	18600	17715

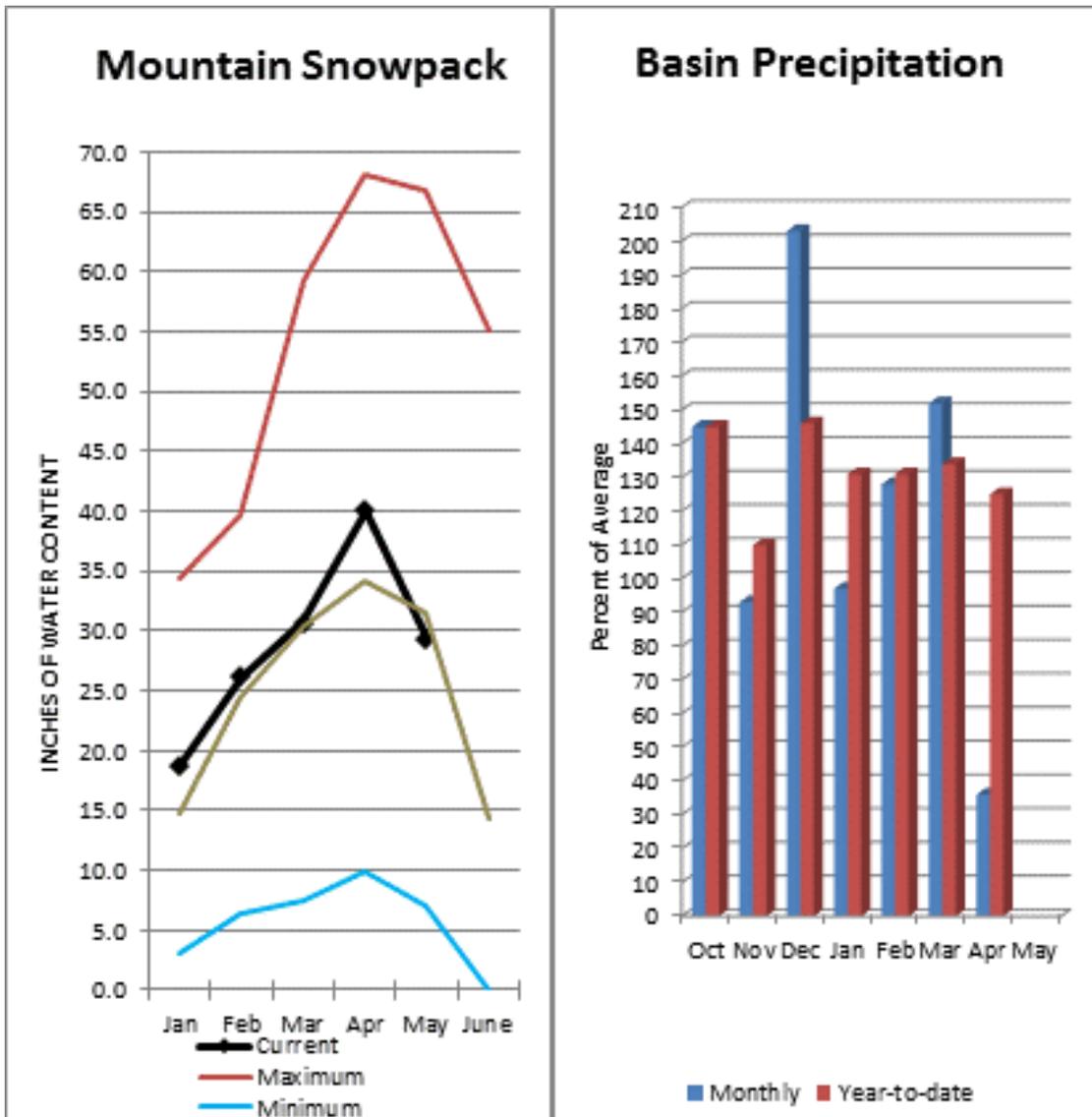
1) 90% and 10% exceedance probabilities are actually 95% and 5%

2) Forecasts are for unimpaired flows. Actual flow will be dependent on management of upstream reservoirs and diversions

3) Median value used in place of average

Reservoir Storage End of April, 2016	Current (KAF)	Last Year (KAF)	Average (KAF)	Capacity (KAF)
Dworshak Reservoir	2897.8	3218.2	2646.0	3468.0
Basin-wide Total	2897.8	3218.2	2646.0	3468.0
# of reservoirs	1	1	1	1

Watershed Snowpack Analysis May 1, 2016	# of Sites	% Median	Last Year % Median
Lower Snake, Grande Ronde, Clearwater Basins	14	74%	32%



Forecasts for May – September streamflow’s within the basin are Lewis River at Ariel, 90% and Cowlitz River at Castle Rock, 99% of average. The Columbia at The Dalles is forecasted to have 89% of average flows this summer according to the River Forecast Center. April average streamflow for Cowlitz River was 109%. The Columbia River at The Dalles was 157% of average. April precipitation was 37% of average and the water-year average was 126%. May 1 snow cover for Cowlitz River was 96%, and Lewis River was 89% of normal. Temperatures were 4-6 degrees above normal during April and 2-4 degrees above for the water year.

Lower Columbia River Basins

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Lower Columbia Basins Streamflow Forecasts - May 1, 2016

Forecast Exceedance Probabilities for Risk Assessment
Chance that actual volume will exceed forecast

Lower Columbia Basins	Forecast Period	90% (KAF)	70% (KAF)	50% (KAF)	% Avg	30% (KAF)	10% (KAF)	30yr Avg (KAF)
Columbia R at The Dalles ²	MAY-SEP	62100	67100	70500	89%	73900	78900	78900
Klickitat R nr Glenwood	MAY-JUL	72	82	88	91%	94	104	97
	MAY-SEP	82	93	100	91%	107	118	110
Klickitat R nr Pitt	MAY-JUL	245	275	295	97%	315	345	305
	MAY-SEP	325	360	385	97%	410	445	395
Lewis R at Ariel ²	MAY-JUL	425	515	575	93%	630	720	615
	MAY-SEP	535	630	695	90%	760	855	770
Cowlitz R bl Mayfield ²	MAY-JUL	775	950	1070	91%	1190	1360	1180
	MAY-SEP	890	1120	1280	92%	1440	1670	1390
Cowlitz R at Castle Rock ²	MAY-JUL	1210	1410	1540	96%	1680	1870	1600
	MAY-SEP	1510	1730	1870	99%	2020	2230	1890

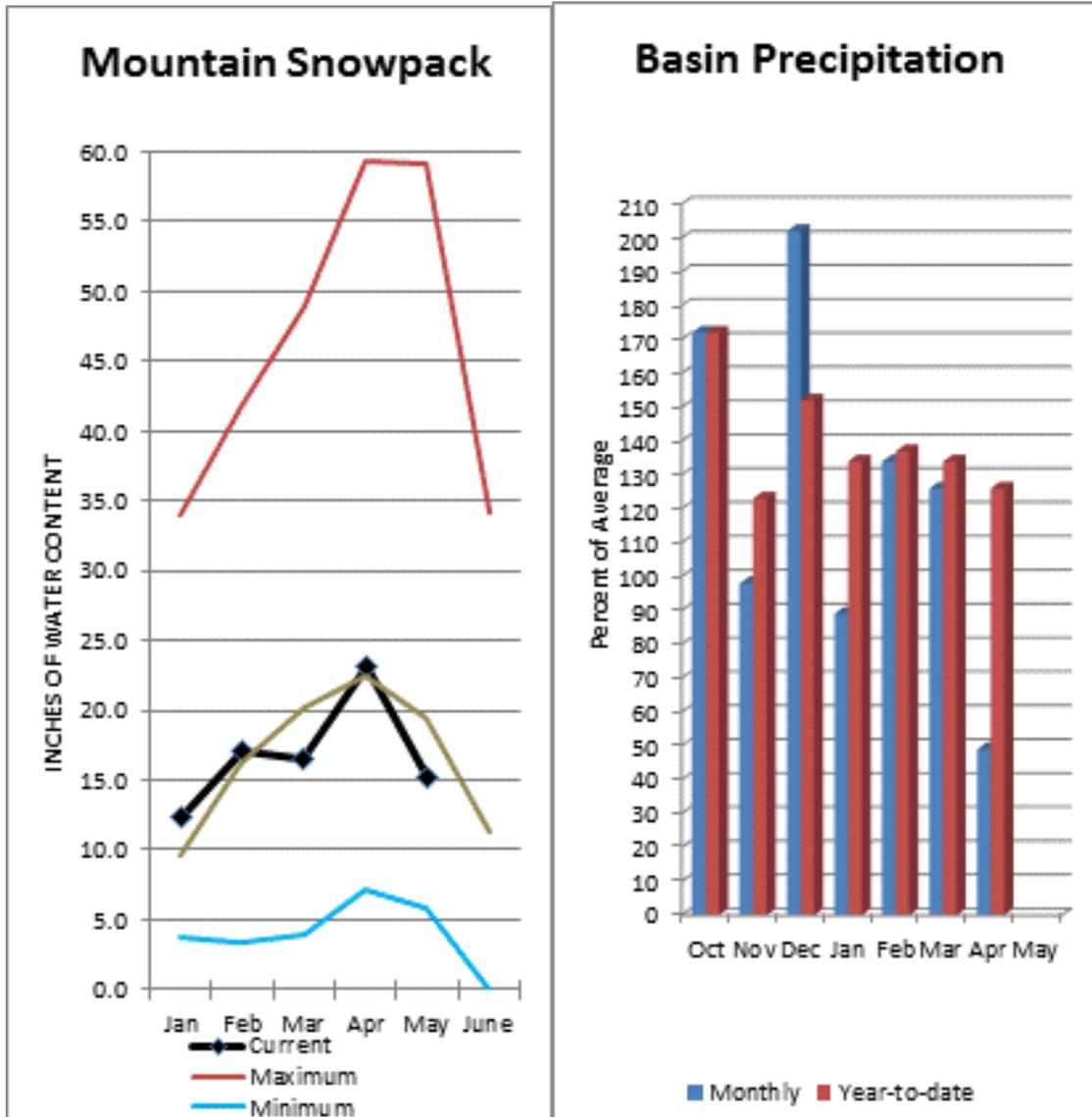
1) 90% and 10% exceedance probabilities are actually 95% and 5%

2) Forecasts are for unimpaired flows. Actual flow will be dependent on management of upstream reservoirs and diversions

3) Median value used in place of average

Watershed Snowpack Analysis May 1, 2016	# of Sites	% Median	Last Year % Median
Lower Columbia Basins	11	93%	13%
Lewis River	5	89%	1%
Cowlitz River	6	96%	25%

South Puget Sound River Basins



Summer runoff is forecast to be 74% of normal for the Green River below Howard Hanson Dam and 90% for the White River near Buckley. May 1 snowpack was 87% of average for the White River, 79% for Puyallup River and 55% in the Green River Basin. April precipitation was 48% of average, bringing the water year-to-date to 126% of average for the basins. Average temperatures in the area were 4-6 degrees above normal for April and 2-4 degrees above for the water-year.

For more information contact your local Natural Resources Conservation Service office.

South Puget Sound River Basins

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South Puget Sound Basins Streamflow Forecasts - May 1, 2016

Forecast Exceedance Probabilities for Risk Assessment Chance that actual volume will exceed forecast

South Puget Sound Basins	Forecast Period	90% (KAF)	70% (KAF)	50% (KAF)	% Avg	30% (KAF)	10% (KAF)	30yr Avg (KAF)
White R nr Buckley ^{1,2}	MAY-JUL	198	265	295	89%	325	390	330
	MAY-SEP	265	345	380	90%	415	495	420
Green R bl Howard A Hanson Dam ^{1,2}	MAY-JUL	56	90	106	70%	122	157	152
	MAY-SEP	73	112	130	74%	148	188	175

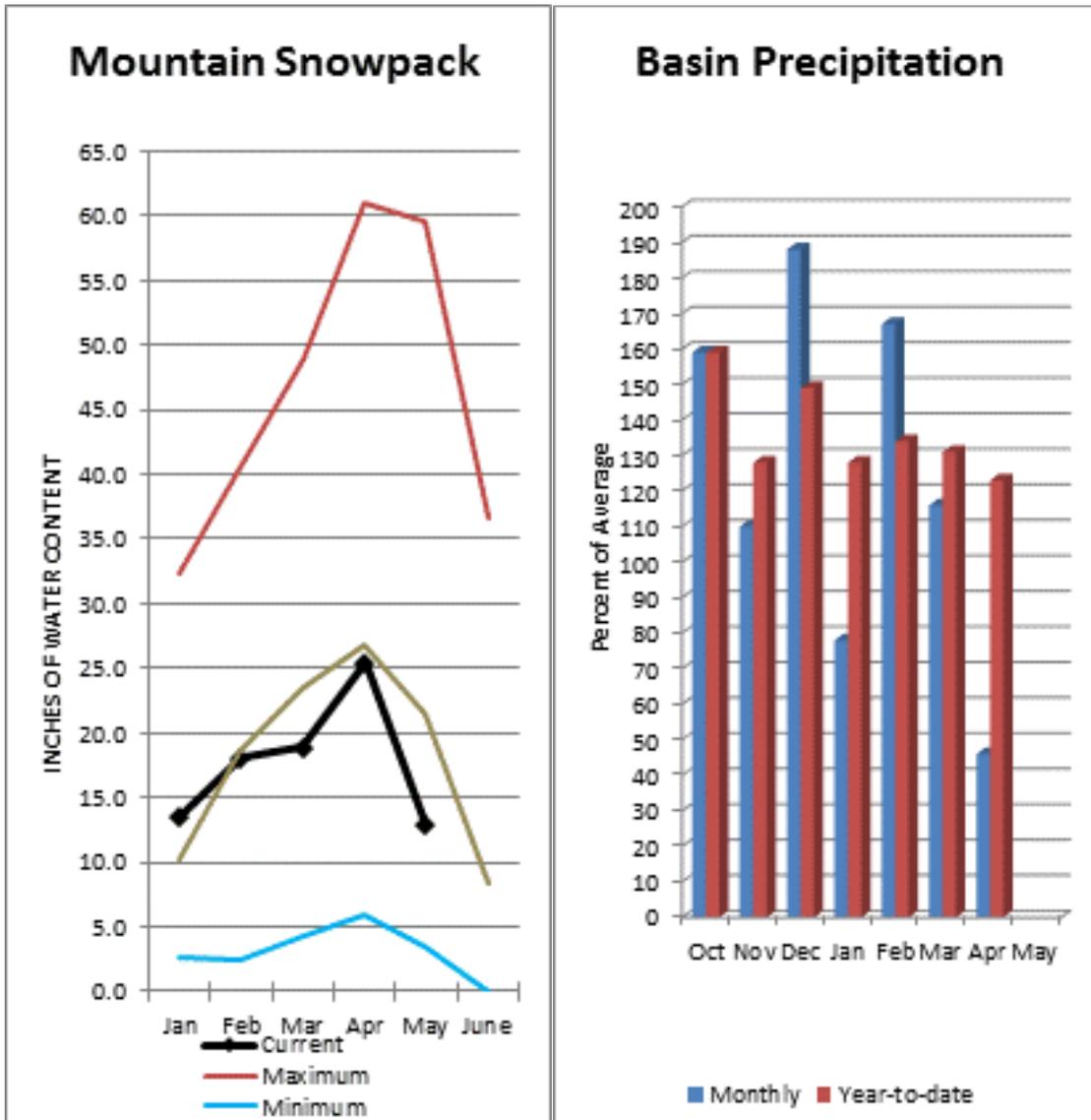
1) 90% and 10% exceedance probabilities are actually 95% and 5%

2) Forecasts are for unimpaired flows. Actual flow will be dependent on management of upstream reservoirs and diversions

3) Median value used in place of average

Watershed Snowpack Analysis May 1, 2016	# of Sites	% Median	Last Year % Median
South Puget Sound Basins	10	78%	28%
White River	3	87%	37%
Green River	2	55%	0%

Central Puget Sound River Basins



Forecast for spring and summer flows are: 96% for Cedar River near Cedar Falls; 93% for Rex River; 98% for South Fork of the Tolt River; and 98% for Taylor Creek near Selleck. Basin-wide precipitation for April was 50% of average, bringing water-year-to-date to 124% of average. May 1 median snow cover in Cedar River Basin was 72%, Tolt River Basin was 44%, Snoqualmie River Basin was 58%, and Skykomish River Basin was 59%. Temperatures were 4-6 degrees above normal for April and 2-4 degrees above for the water-year.

For more information contact your local Natural Resources Conservation Service office.

Central Puget Sound River Basins

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Central Puget Sound Basins Streamflow Forecasts - May 1, 2016

Forecast Exceedance Probabilities for Risk Assessment
Chance that actual volume will exceed forecast

Central Puget Sound Basins	Forecast Period	90% (KAF)	70% (KAF)	50% (KAF)	% Avg	30% (KAF)	10% (KAF)	30yr Avg (KAF)
Cedar R nr Cedar Falls	MAY-JUL	38	44	48	98%	52	58	49
	MAY-SEP	42	49	54	96%	59	66	56
Rex R nr Cedar Falls	MAY-JUL	10.5	13.2	15.1	93%	16.9	19.6	16.2
	MAY-SEP	11.8	15	17.2	93%	19.4	23	18.5
Taylor Ck nr Selleck	MAY-JUL	10.7	12.1	13.1	98%	14.1	15.5	13.3
	MAY-SEP	13.5	15.4	16.6	98%	17.9	19.7	16.9
SF Tolt R nr Index	MAY-JUL	5.6	7.6	9	87%	10.4	12.4	10.4
	MAY-SEP	6.3	8.9	10.7	87%	12.5	15.2	12.3

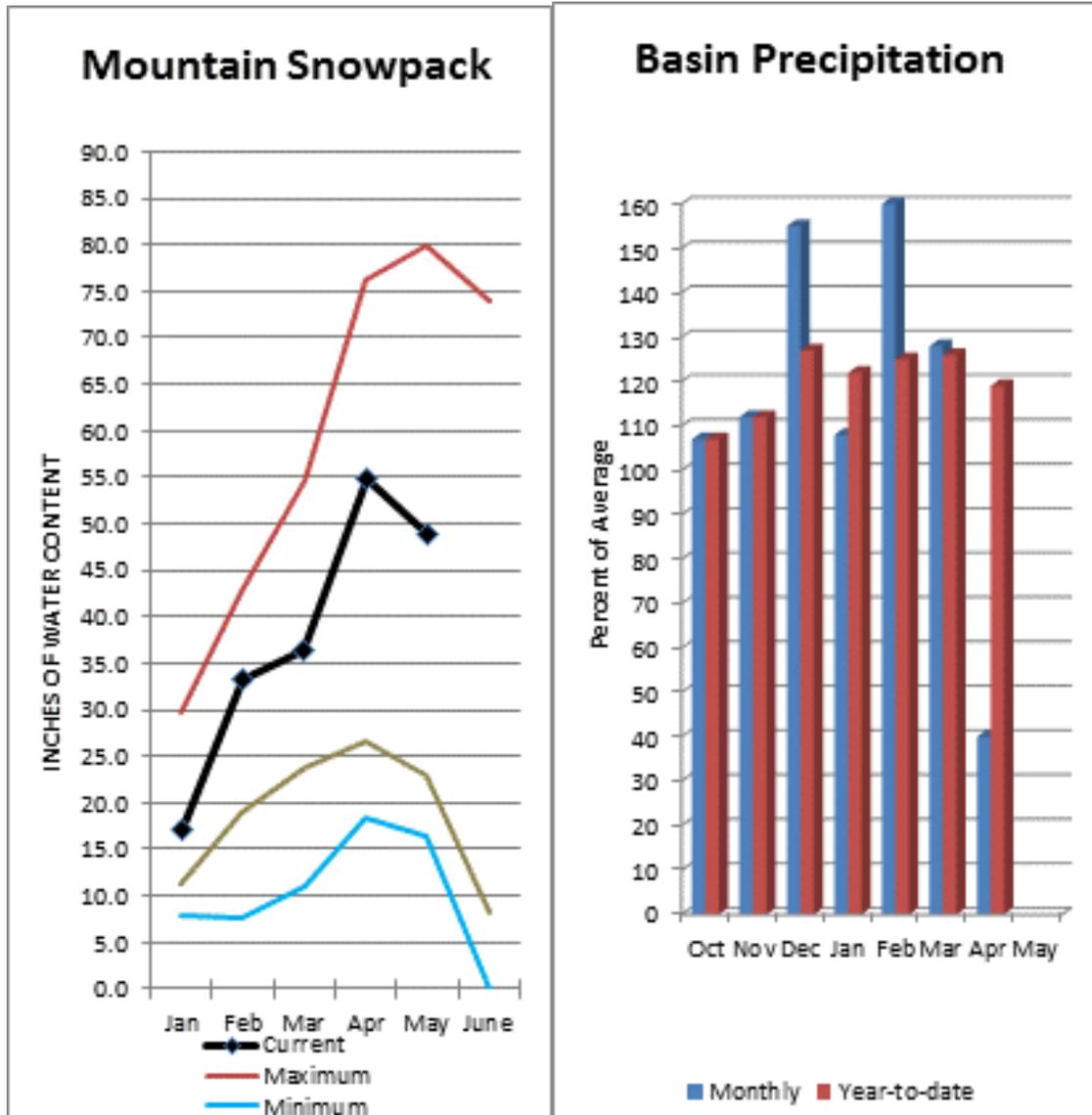
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2) Forecasts are for unimpaired flows. Actual flow will be dependent on management of upstream reservoirs and diversions

3) Median value used in place of average

Watershed Snowpack Analysis May 1, 2016	# of Sites	% Median	Last Year % Median
Central Puget Sound Basins	12	60%	1%
Puyallup River	5	79%	33%
Cedar River	4	72%	0%
Tolt River	2	44%	0%
Snoqualmie River	4	58%	1%
Skykomish River	2	59%	1%

North Puget Sound River Basins



Forecast for Skagit River streamflow at Newhalem is 99% of average for the spring and summer period. April streamflow in Skagit River was 159% of average. Other forecast points included Baker River at 98% and Thunder Creek at 98% of average. Basin-wide precipitation for April was 41% of average, bringing water-year-to-date to 119% of average. May 1 average snow cover in Skagit River Basin was 93%, Nooksack River Basin was 55% and Baker River Basin was 63% of normal. May 1 Skagit River reservoir storage was 93% of average and 50% of capacity. Average temperatures were 4-6 degrees above normal for April and 2-4 degrees above for the water year.

For more information contact your local Natural Resources Conservation Service office.

North Puget Sound River Basins

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North Puget Sound Basins Streamflow Forecasts - May 1, 2016

Forecast Exceedance Probabilities for Risk Assessment
Chance that actual volume will exceed forecast

North Puget Sound Basins	Forecast Period	90% (KAF)	70% (KAF)	50% (KAF)	% Avg	30% (KAF)	10% (KAF)	30yr Avg (KAF)
Thunder Ck nr Newhalem	MAY-JUL	174	192	205	98%	220	235	210
	MAY-SEP	265	285	300	98%	315	335	305
Skagit R at Newhalem ²	MAY-JUL	1240	1340	1410	99%	1480	1580	1420
	MAY-SEP	1560	1680	1760	99%	1840	1970	1770
Baker R at Concrete	MAY-JUL	500	570	620	98%	670	740	635
	MAY-SEP	625	740	820	98%	900	1020	835

1) 90% and 10% exceedance probabilities are actually 95% and 5%

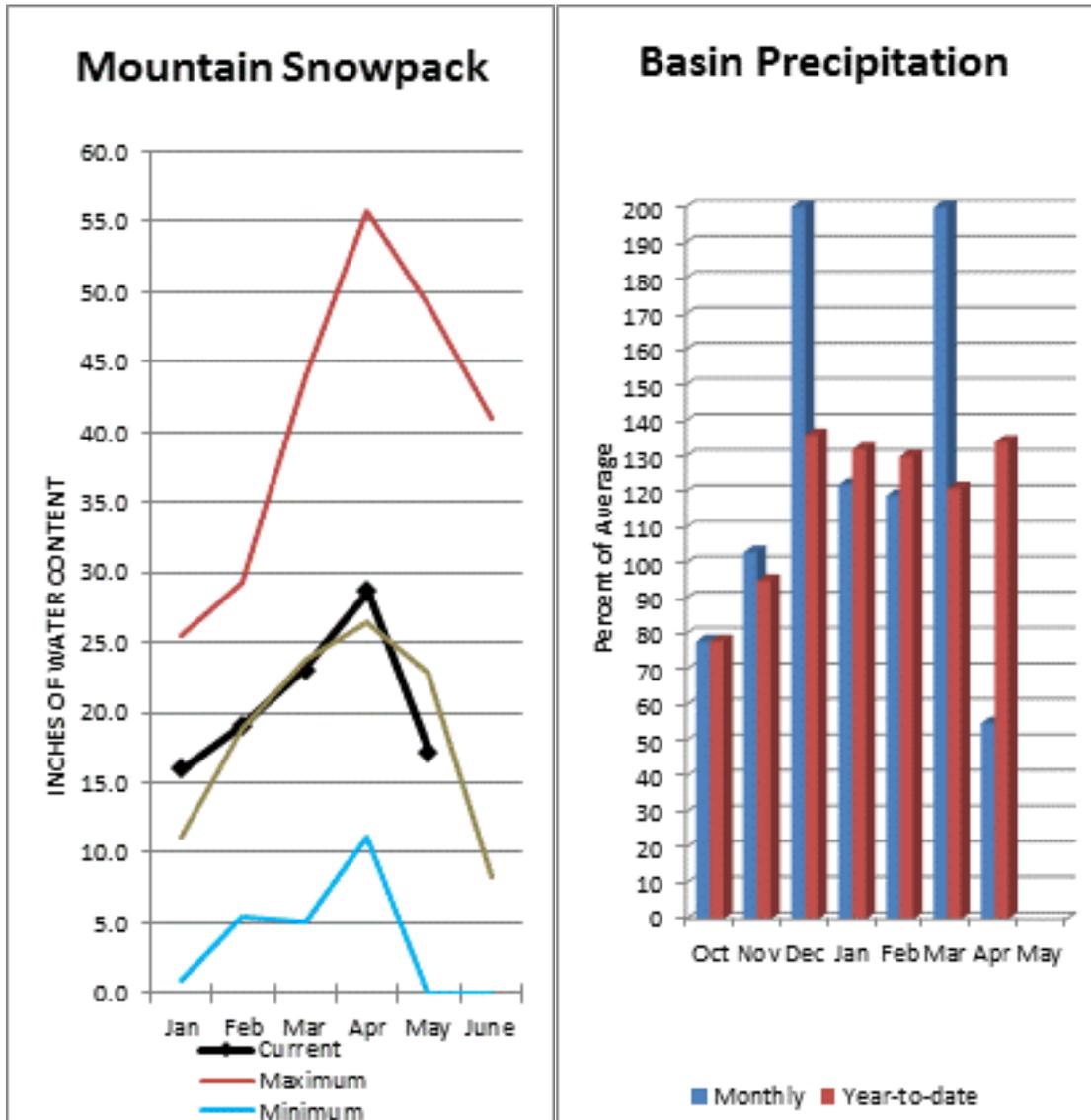
2) Forecasts are for unimpaired flows. Actual flow will be dependent on management of upstream reservoirs and diversions

3) Median value used in place of average

Reservoir Storage End of April, 2016	Current (KAF)	Last Year (KAF)	Average (KAF)	Capacity (KAF)
Ross	700.0	710.1	754.4	1404.1
Diablo Reservoir			85.9	90.6
Basin-wide Total	700.0	710.1	754.4	1404.1
# of reservoirs	1	1	1	1

Watershed Snowpack Analysis May 1, 2016	# of Sites	% Median	Last Year % Median
North Puget Sound Basins	23	73%	31%
Skagit River	14	93%	58%
Baker River	6	63%	15%
Nooksack River	3	55%	14%

Olympic Peninsula River Basins



Forecasted average runoff for streamflow for the Dungeness River is 75% and Elwha River is 73% April runoff in the Dungeness River was 170% of normal. Big Quilcene and Wynoochee rivers may expect near average runoff this summer as well. April precipitation was 56% of average. Precipitation has accumulated at 134% of average for the water year. April precipitation at Quillayute was only 29% of normal. Olympic Peninsula snowpack averaged 75% of normal on May 1. Temperatures were 4-6 degrees above average and 2-4 degrees above normal for the water year.

For more information contact your local Natural Resources Conservation Service office.

Olympic Peninsula River Basins

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Olympic Peninsula Streamflow Forecasts - May 1, 2016

Forecast Exceedance Probabilities for Risk Assessment Chance that actual volume will exceed forecast

Olympic Peninsula	Forecast Period	90% (KAF)	70% (KAF)	50% (KAF)	% Avg	30% (KAF)	10% (KAF)	30yr Avg (KAF)
Dungeness R nr Sequim	MAY-JUL	58	69	76	75%	83	94	101
	MAY-SEP	72	85	94	75%	103	116	125
Elwha R at McDonald Bridge nr Port Angeles	MAY-JUL	184	210	230	72%	250	275	320
	MAY-SEP	225	260	285	73%	310	345	390

1) 90% and 10% exceedance probabilities are actually 95% and 5%

2) Forecasts are for unimpaired flows. Actual flow will be dependent on management of upstream reservoirs and diversions

3) Median value used in place of average

Watershed Snowpack Analysis May 1, 2016	# of Sites	% Median	Last Year % Median
Olympic Peninsula	6	75%	0%

Issued by

Jason Weller
Chief
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U.S. Department of Agriculture

Released by

Roylene Rides At The Door
State Conservationist
Natural Resources Conservation Service
Spokane, Washington

The Following Organizations Cooperate with the Natural Resources Conservation Service in Snow Survey Work*:

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State	Washington State Department of Ecology Washington State Department of Natural Resources
Federal	Department of the Army Corps of Engineers U.S. Department of Agriculture Forest Service U.S. Department of Commerce NOAA, National Weather Service U.S. Department of Interior Bonneville Power Administration Bureau of Reclamation Geological Survey National Park Service Bureau of Indian Affairs Recourse Conservation & Development Councils
Local	City of Tacoma City of Seattle Chelan County P.U.D. Pacific Power and Light Company Puget Sound Energy Washington Water Power Company Snohomish County P.U.D. Colville Confederated Tribes Spokane County Yakama Indian Nation Whatcom County Pierce County Kalispel Tribe of Indians Spokane Indian Tribe Jamestown S'klallum Tribe
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*Other organizations and individuals furnish valuable information for the snow survey reports. Their cooperation is gratefully acknowledged.



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Washington Water Supply Outlook Report

Natural Resources Conservation Service
Spokane, WA

