

Washington Water Supply Outlook Report April 1, 2016



Pahto (Mt. Adams), Scott Ladd, Yakama Tribal Hydrologist

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

April 2016

General Outlook

All basins reported a notable increase in snowpack last month. This, on the heels of a winter that tended to be warm and rainy, was just what we needed to bolster spring and summer runoff. There is still concern that the existing snowpack is further advanced than normal and could begin to melt more rapidly than hoped for. As the weather warms and the snow begins to melt in earnest be aware that streams and rivers will still be very cold and swift. The latest NWS short term forecasts are calling for warmer than normal with some chance of seasonal precipitation. Long range forecasts for the spring continue to be warmer and dryer than normal.
<http://www.cpc.ncep.noaa.gov/>

Snowpack

The April 1 statewide SNOTEL readings were 110% of normal. The Tolt River Basin reported the lowest readings at 77% of the 30-year median for April 1 and Trough SNOTEL near Wenatchee had the highest percentage with 205%. Most basins reported steady or a slight increase from last month with new snow particularly in the north Cascades. Westside medians from SNOTEL, and April 1 snow surveys, included the North Puget Sound river basins with 105% of normal, the Central and South Puget river basins with 95% and 103% respectively, and the Lower Columbia basins with 117% of normal. Snowpack along the east slopes of the Cascade Mountains included the Yakima area with 110% and the Wenatchee area with 108%. Snowpack in the Spokane River Basin was at 95% and the Walla Walla River Basin had 127% of the long term median.

BASIN	PERCENT OF MEDIAN	LAST YEAR PERCENT MEDIAN
Spokane	95	31
Newman Lake	120	1
Pend Oreille	98	69
Okanogan	141	66
Methow	135	78
Conconully Lake	144	11
Central Columbia	108	33
Upper Yakima	103	11
Lower Yakima	117	24
Ahtanum Creek	122	19
Walla Walla	127	27
Lower Snake	105	54
Cowlitz	115	29
Lewis	118	4
White	109	41
Green	87	0
Puyallup	106	35
Cedar	112	2
Snoqualmie	88	3
Skykomish	80	6
Skagit	114	58
Nooksack	91	13
Olympic Peninsula	108	2
Baker	103	21

Precipitation

For the most part the state received above normal precipitation for the month of March keeping year to date statewide SNOTEL averages above normal at 132%. The central and north east areas of the state recorded the highest percentages in the state. Swift Creek SNOTEL near Mt. St. Helens received nearly 1 inch per day for a total of 29.1 inches and precipitation for the month of March.

RIVER BASIN	APRIL PERCENT OF AVERAGE	WATER YEAR PERCENT OF AVERAGE
Spokane	149	108
Pend Oreille	124	104
Upper Columbia	157	124
Central Columbia	141	133
Upper Yakima	119	131
Lower Yakima	153	136
Walla Walla	143	112
Lower Snake	140	108
Lower Columbia	152	134
South Puget Sound	126	134
Central Puget Sound	116	131
North Puget Sound	128	126
Olympic Peninsula	204	141

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. April 1 Reservoir storage in the Yakima Basin was 664,000-acre feet, 130% of average for the Upper Reaches and 196,000-acre feet or 130% of average for Rimrock and Bumping Lakes. The power generation reservoirs included the following: Coeur d'Alene Lake, 181,000 acre feet, 110% of average and 76% of capacity; and the Skagit River reservoirs at 64% of average and 33% 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	76	100
Pend Oreille	41	82
Upper Columbia	66	103
Central Columbia	42	111
Upper Yakima	80	130
Lower Yakima	85	130
Lower Snake	84	121
North Puget Sound	33	64

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

Streamflow

Above normal temperatures continue to drive greater than normal daily runoff throughout the state. However a strong snowpack and precipitation accumulation are helping to keep streamflow forecasts near to above normal. April-September forecasts for some Western Washington streams include the Cedar River near Cedar Falls, 116%; White River, 114%; and Skagit River, 116%. Some Eastern Washington streams include the Yakima River near Parker 117%, Wenatchee River at Plain 105%; and Spokane River near Post Falls 98%. 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	98-118
Pend Oreille	98-113
Upper Columbia	96-130
Central Columbia	104-116
Upper Yakima	99-105
Lower Yakima	111-166
Walla Walla	106-111
Lower Snake	102-112
Lower Columbia	103-128
South Puget Sound	90-114
Central Puget Sound	108-116
North Puget Sound	106-116
Olympic Peninsula	99-101

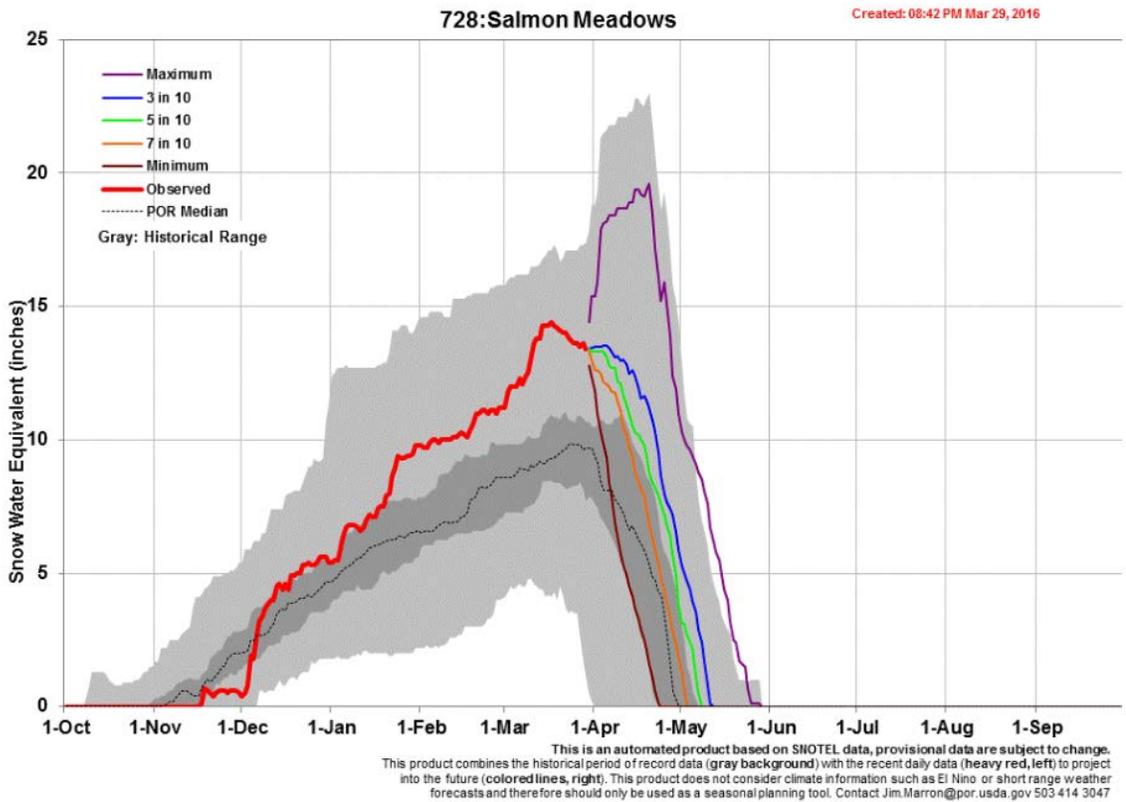
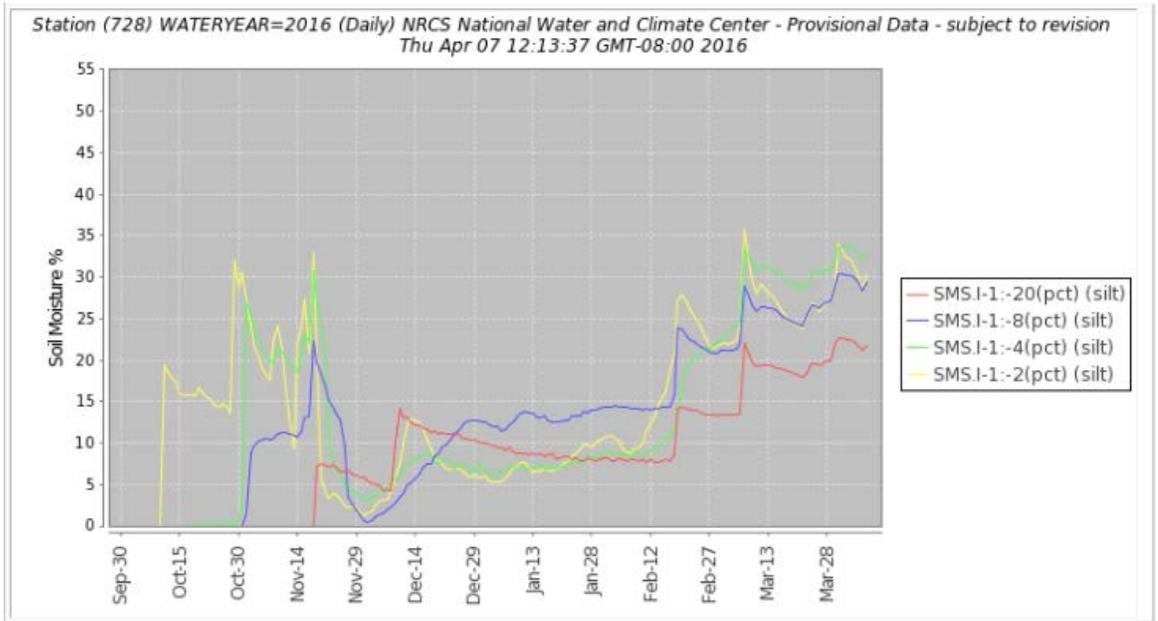
STREAM	PERCENT OF AVERAGE APRIL STREAMFLOWS
Pend Oreille at Albeni Fall Dam	135
Kettle at Laurier	250
Columbia at Birchbank	132
Spokane at Spokane	155
Similkameen at Nighthawk	169
Okanogan at Tonasket	150
Methow at Pateros	230
Chelan at Chelan	175
Wenatchee at Pashastin	163
Cle Elum near Roslyn	130
Yakima at Parker	177
Naches at Naches	199
Grande Ronde at Troy	118
Snake below Lower Granite Dam	109
Columbia River at The Dalles	111
Lewis at Merwin Dam	144
Cowlitz below Mayfield Dam	163
Skagit at Concrete	143
Dungeness near Sequim	176

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

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 winter 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. The second graph is snowpack projection for the same site which shows a normal peak around March 15 and subsequent melt curve. Lining up the dates of noticeable storms will correlate with the spikes in soil moisture. Air temperature and melt rate will determine date of melt out. Best odds appear to be later than normal this year.





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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>

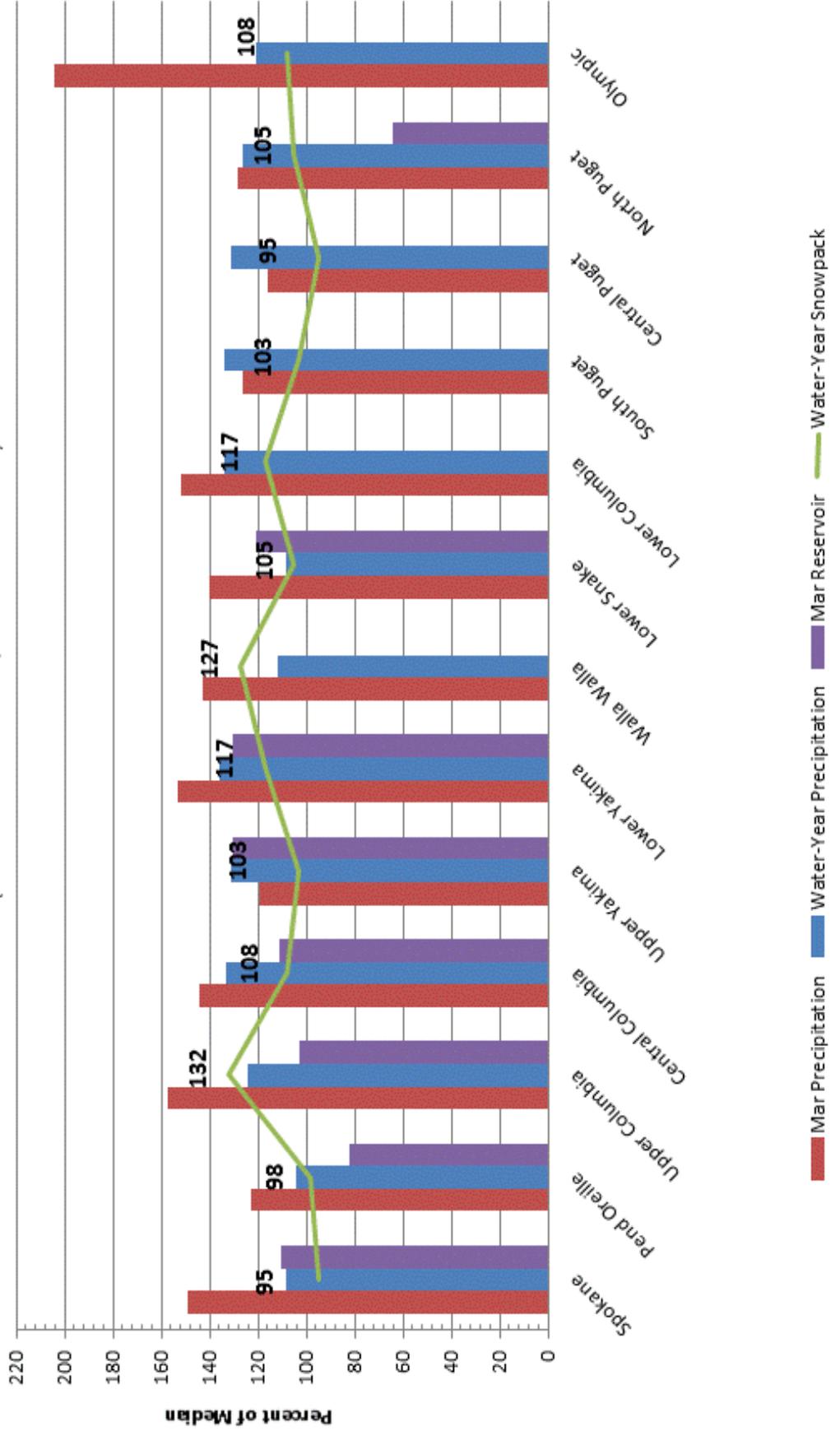
USDA-NRCS Agency Homepages

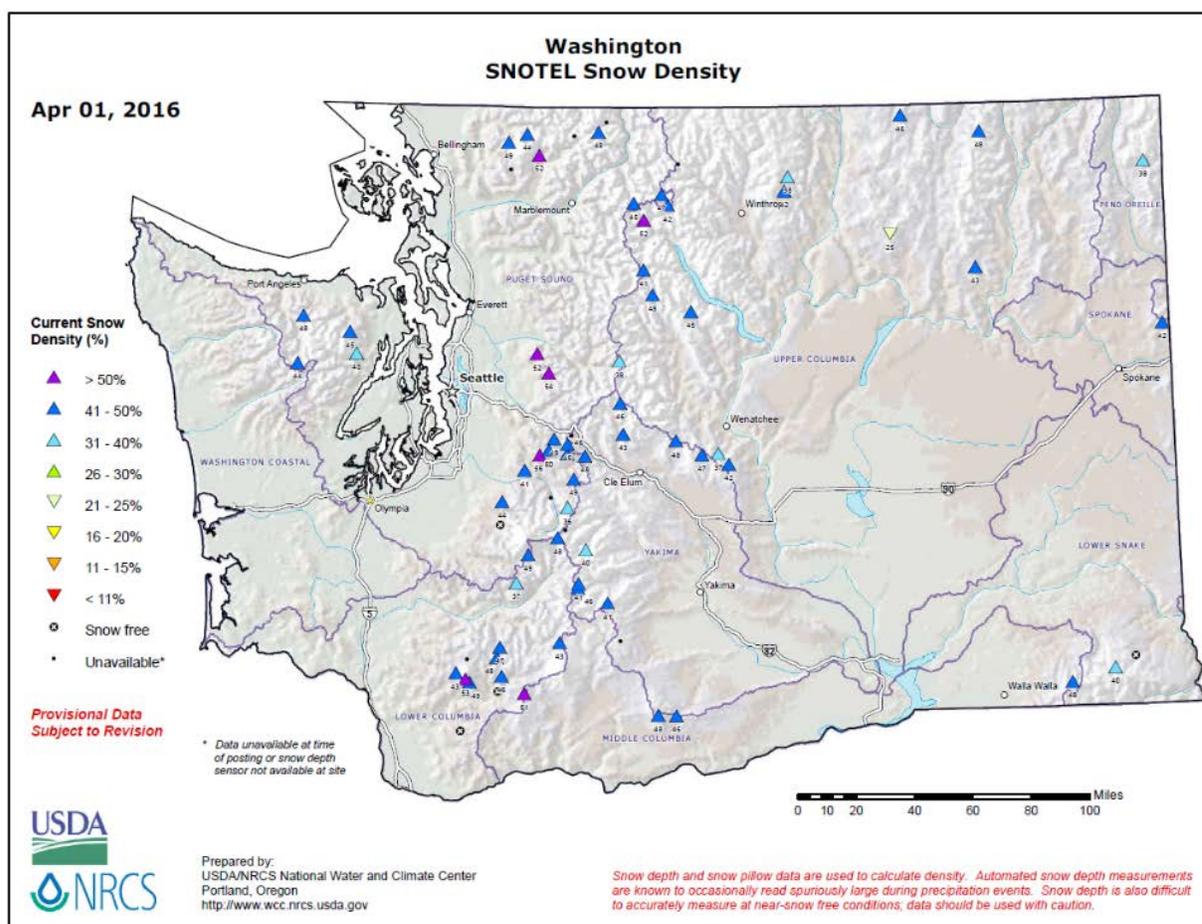
Washington:
<http://www.nrcs.usda.gov/wps/portal/nrcs/site/wa/home/>

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

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

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





Western Snow Conference

The Western Snow Conference is an annual tradition which started in 1932 as an international forum for individuals and organizations to share scientific, management and socio-political information on snow and runoff. The principal aim of the Western Snow Conference is to advance snow and hydrological sciences. The North Pacific Area Committee is making plans for the 84th Annual Western Snow Conference in 2016.

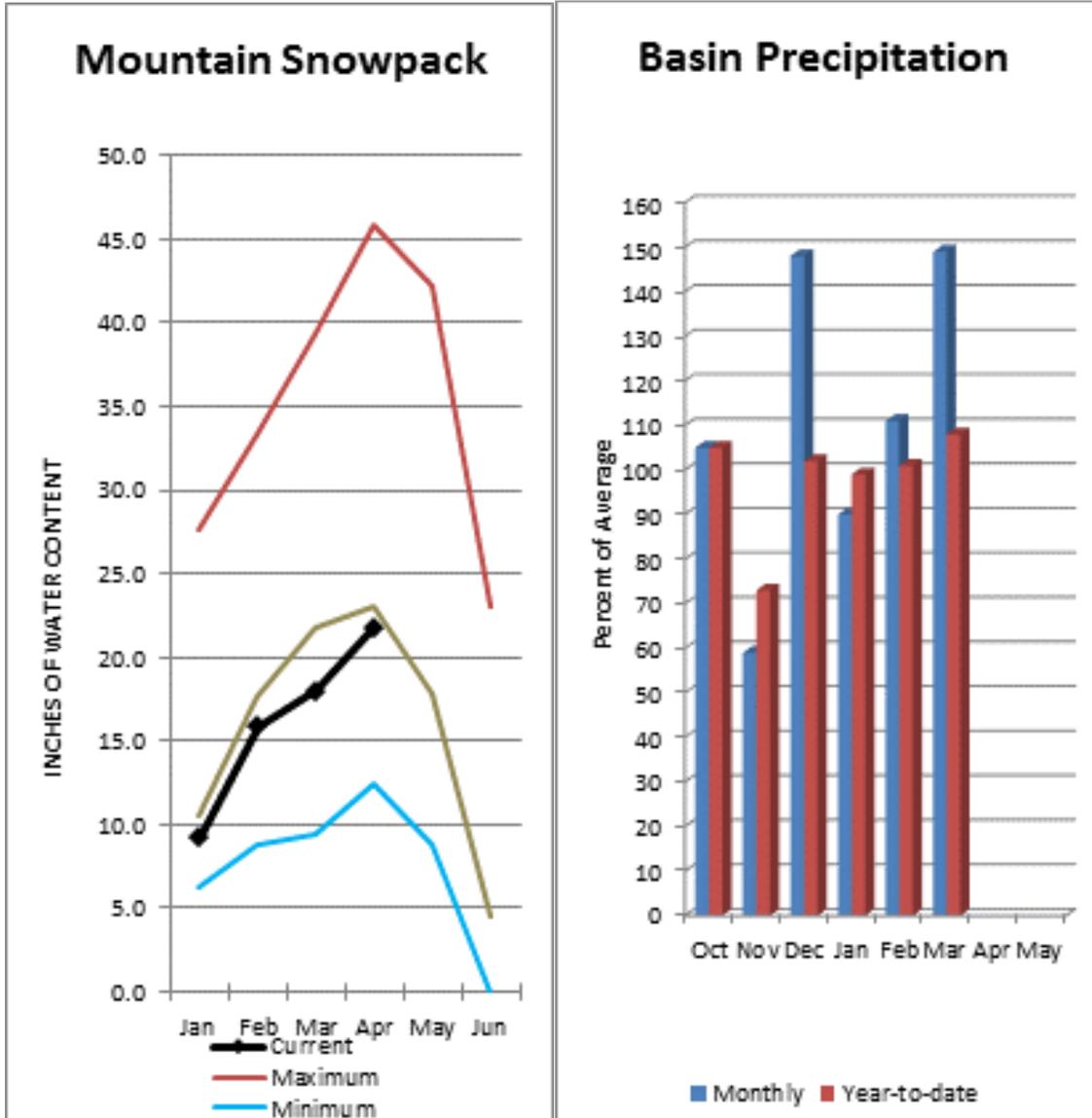
Dates: April 18-21, 2016

Location: Seattle, Washington

The Conference will begin Monday, April 18th with a short course and panel discussion on "Validation of the rain/snow Global Precipitation Measurements (GPM) satellite data in the Olympic Mountains: University of Washington and NASA" with several invited experts in the field. Tuesday and Wednesday will include formal paper and poster presentations on a variety of topics, including snow drought, climatology of drought, forecasting in drought conditions, dichotomy of precipitation and snow conditions, impacts and mitigation of low snow packs and record events in the snow environment. Thursday will include a technical of northwest geology and hydropower complexes in the North Cascade Mountains.

Additional information about the conference and the Call for Papers will be posted on the WSC web page at <http://www.westernsnowconference.org/>

Spokane River Basin



The April 1 forecasts for summer runoff within the Spokane River Basin are 98% of average near Post Falls and 98% at Long Lake. The Chamokane River near Long Lake forecasted to have 118% of average flows for the May-August period. The forecast is based on a basin snowpack that is 95% of normal and precipitation that is 108% of average for the water year. Precipitation for March was above normal at 149% of average. Streamflow on the Spokane River at Spokane was 147% of average for March. April 1 storage in Coeur d'Alene Lake was 181,000 acre feet, 110% of average and 76% of capacity. Snowpack at Quartz Peak SNOTEL site was 120% of average with 22.7 inches of water content. Average temperatures in the Spokane basin were 1-2 degrees above normal for March and 3-4 degrees above for the water year.

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

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Spokane Streamflow Forecasts - April 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	APR-JUL	1770	2100	2330	97%	2560	2890	2390
	APR-SEP	1840	2190	2420	98%	2650	3000	2480
Spokane R at Long Lake ²	APR-JUL	1920	2290	2540	97%	2790	3150	2620
	APR-SEP	2150	2530	2790	98%	3050	3430	2850
Chamokane Ck nr Long Lake	MAY-AUG	7.4	9.5	11	118%	12.5	14.7	9.3

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

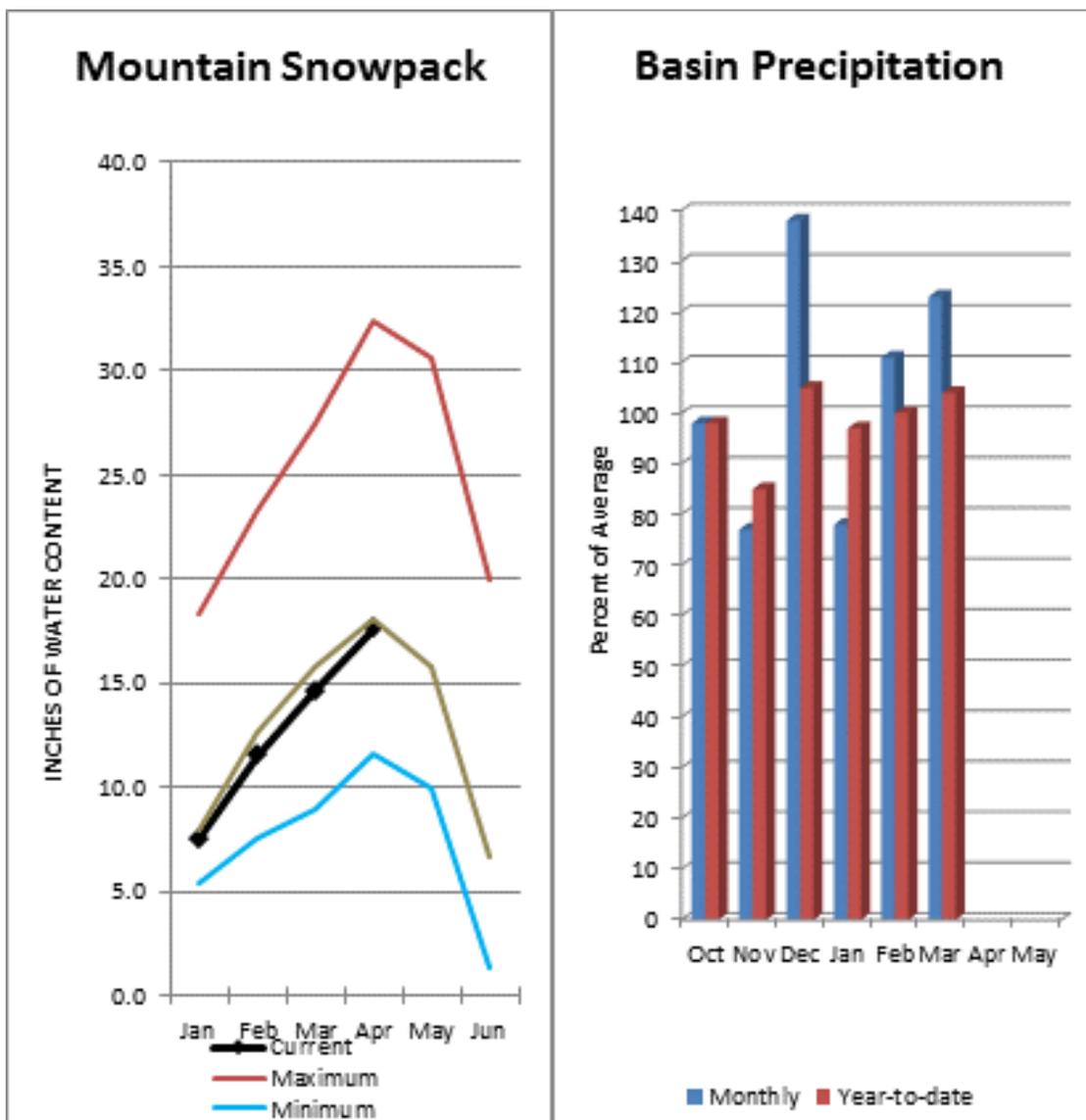
2) Forecasts are for unimpaired flows. Actual flow will be dependent on management of upstream reservoirs and diversions

3) Median value used in place of average

Reservoir Storage End of March, 2016	Current (KAF)	Last Year (KAF)	Average (KAF)	Capacity (KAF)
Lake Coeur d' Alene	181.3	227.3	165.5	238.5
Basin-wide Total	181.3	227.3	165.5	238.5
# of reservoirs	1	1	1	1

Watershed Snowpack Analysis April 1, 2016	# of Sites	% Median	Last Year % Median
Spokane	16	95%	31%
Newman Lake	3	120%	1%

Pend Oreille River Basins



The April – September average forecast for the Priest River near the town of Priest River is 113% and the Pend Oreille below Box Canyon is 98%. March streamflow was 135% of average on the Pend Oreille River and 132% on the Columbia at Birchbank. April 1 snow cover was 98% of normal in the Pend Oreille Basin River Basin. Bunchgrass Meadows SNOTEL site had 29 inches of snow water on the snow pillow. Normally Bunchgrass would have 26.2 inches on April 1. Precipitation during March was 123% of average, dropping the year-to-date precipitation at 104% of average. Reservoir storage in the basin, including Lake Pend Oreille and Priest Lake was 82% of normal. Average temperatures were 2-3 degrees above normal for March and 3-5 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 - April 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	APR-JUL	9720	10800	11500	97%	12200	13200	11800
	APR-SEP	10500	11700	12500	98%	13300	14500	12800
Priest R nr Priest River ²	APR-JUL	755	830	880	113%	935	1010	780
	APR-SEP	795	875	935	113%	990	1080	830
Pend Oreille R bl Box Canyon ²	APR-JUL	9890	10900	11700	98%	12400	13400	11900
	APR-SEP	10600	11800	12700	98%	13500	14700	13000

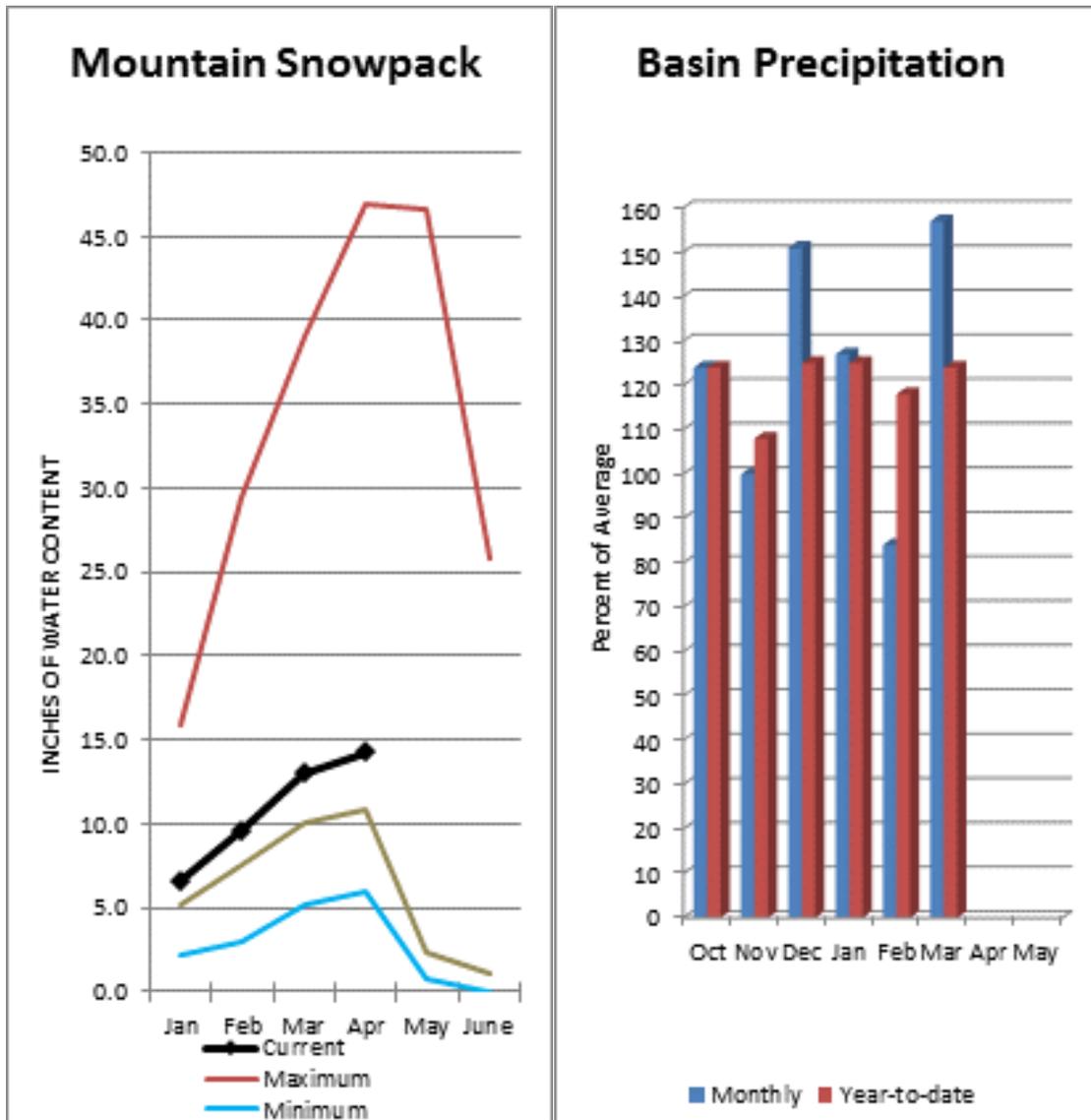
1) 90% and 10% exceedance probabilities are actually 95% and 5%

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 March, 2016	Current (KAF)	Last Year (KAF)	Average (KAF)	Capacity (KAF)
Lake Pend Oreille	605.6	754.7	773.0	1561.3
Priest Lake	83.1	100.2	67.6	119.3
Basin-wide Total	688.7	854.9	840.6	1680.6
# of reservoirs	2	2	2	2

Watershed Snowpack Analysis April 1, 2016	# of Sites	% Median	Last Year % Median
Pend Oreille Basins	71	98%	69%
Colville River	3	108%	4%
Kettle River	5	156%	57%



Summer runoff average forecast for the Okanogan River is 105%, Similkameen River is 96%, and Methow River is 130%. April 1 snow cover on the Okanogan was 141% of normal, Omak Creek was 133% and the Methow was 135%. March precipitation in the Upper Columbia was 157% of average, with precipitation for the water year at 124% of average. March streamflow for the Methow River was 230% of average, 150% for the Okanogan River and 169% for the Similkameen. Snow-water content at Salmon Meadows SNOTEL was 11.2 inches or 135% of normal for April 1. Combined storage in the Conconully Reservoirs was 15,500 acre-feet or 103% of normal. Temperatures were 1-3 degrees above normal for March and for the water year.

Upper Columbia River Basins

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Upper Columbia Basins Streamflow Forecasts - April 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	APR-JUL	1890	2070	2200	122%	2330	2510	1800
	APR-SEP	1920	2120	2260	120%	2400	2600	1880
Colville R at Kettle Falls	APR-JUL	67	103	128	108%	153	189	119
	APR-SEP	73	113	140	107%	167	205	131
Columbia R at Grand Coulee ^{1,2}	APR-JUL	47300	51000	52600	103%	54200	57900	51015
	APR-SEP	52500	59100	62100	103%	65100	71700	60110
Similkameen R nr Nighthawk ¹	APR-JUL	890	1070	1150	96%	1230	1410	1200
	APR-SEP	960	1150	1230	96%	1310	1500	1280
Okanogan R nr Tonasket ¹	APR-JUL	1090	1370	1500	101%	1630	1910	1480
	APR-SEP	1180	1500	1650	100%	1800	2120	1650
Okanogan R at Malott ¹	APR-JUL	1140	1420	1550	107%	1680	1960	1450
	APR-SEP	1230	1550	1700	105%	1850	2170	1620
Methow R nr Pateros	APR-JUL	940	1020	1080	129%	1140	1220	835
	APR-SEP	1010	1100	1160	130%	1220	1310	895
Columbia R at Birchbank ^{1,2}	APR-JUL	28200	32900	35100	104%	37200	41900	33840
	APR-SEP	38000	41700	43400	104%	45000	48700	41750

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

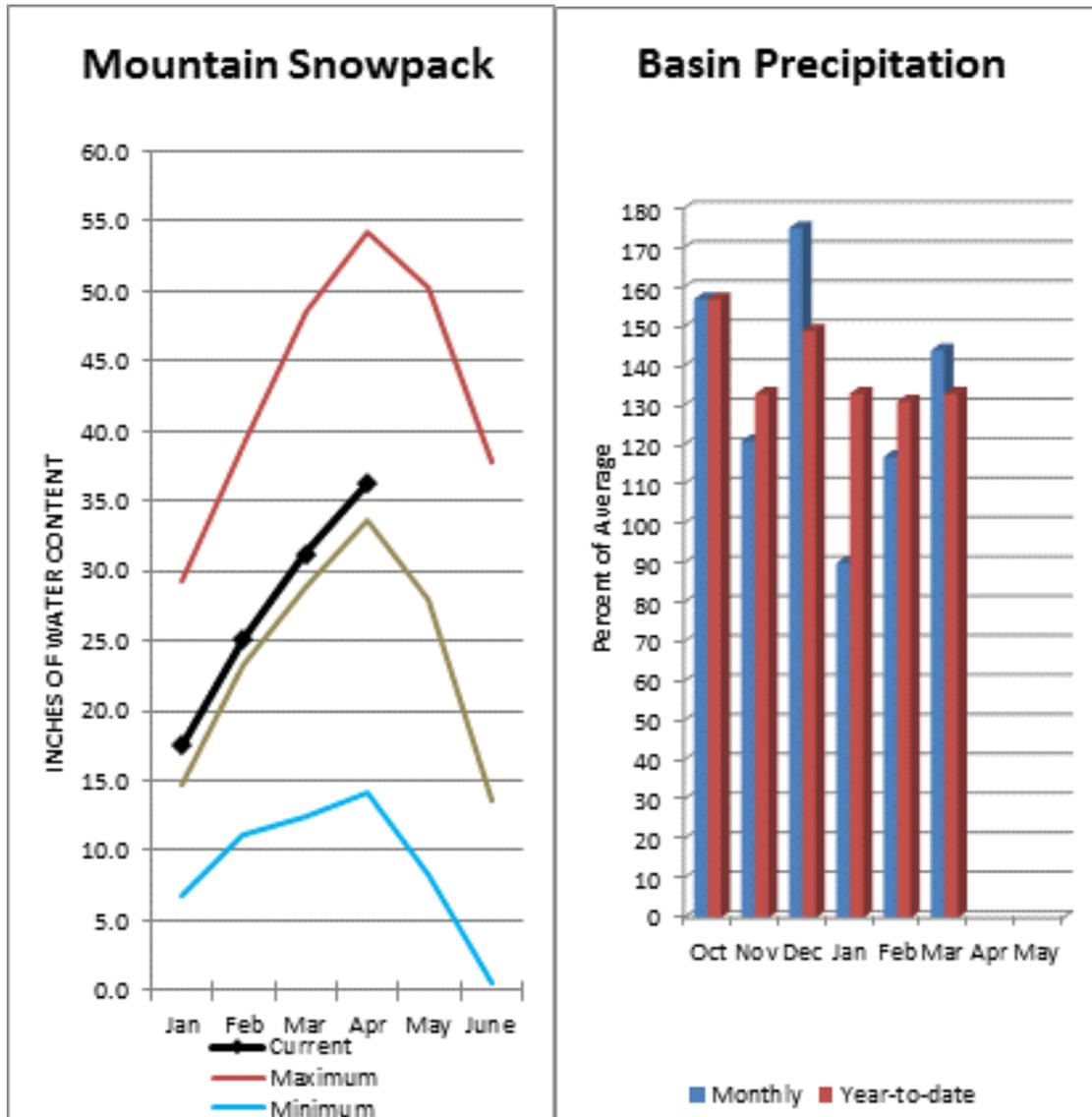
2) Forecasts are for unimpaired flows. Actual flow will be dependent on management of upstream reservoirs and diversions

3) Median value used in place of average

Reservoir Storage End of March, 2016	Current (KAF)	Last Year (KAF)	Average (KAF)	Capacity (KAF)
Conconully Lake (Salmon Lake Dam)	7.5	7.7	7.3	10.5
Conconully Reservoir	8.0	12.8	7.8	13.0
Basin-wide Total	15.5	20.4	15.1	23.5
# of reservoirs	2	2	2	2

Watershed Snowpack Analysis April 1, 2016	# of Sites	% Median	Last Year % Median
Upper Columbia Basins	24	132%	65%
Okanogan River	14	141%	66%
Omak Creek	1	133%	16%
Sanpoil River	1		
Similkameen River	5	106%	70%
Toats Coulee Creek	4	171%	48%
Conconully Lake	3	144%	11%
Methow River	5	135%	78%

Central Columbia River Basins



Precipitation during March was 141% of average in the basin and 133% for the year-to-date. Runoff for Entiat River is forecast to be 116% of average for the summer. The April-September average forecast for Chelan River is 113%, Wenatchee River at Plain is 105%, Stehekin River is 115% and Icicle Creek is 105%. March average streamflow on the Chelan River was 175% and on the Wenatchee River 163%. April 1 snowpack in the Wenatchee River Basin was 108% of normal; the Chelan, 119%; the Entiat, 94%; Stemilt Creek, 116% and Colockum Creek, 205%. Reservoir storage in Lake Chelan was 111% of average and 42% of capacity. Lyman Lake SNOTEL had the most snow water with 66.3 inches of water. This site would normally have 57.6 inches on April 1. Temperatures were 1-2 degrees above normal for March and 1-3 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 - April 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	APR-JUL	675	735	775	114%	820	880	680
	APR-SEP	810	870	905	115%	945	1010	790
Chelan R at Chelan	APR-JUL	1020	1080	1110	111%	1150	1200	1000
	APR-SEP	1170	1220	1260	113%	1290	1350	1120
Entiat R nr Ardenvoir	APR-JUL	210	225	235	118%	245	260	200
	APR-SEP	230	245	255	116%	265	280	220
Wenatchee R at Plain	APR-JUL	915	985	1030	104%	1070	1140	990
	APR-SEP	1010	1080	1130	105%	1180	1250	1080
Icicle Ck nr Leavenworth	APR-JUL	255	275	290	105%	300	320	275
	APR-SEP	275	300	315	105%	330	350	300
Wenatchee R at Peshastin	APR-JUL	1280	1360	1420	104%	1480	1570	1370
	APR-SEP	1390	1490	1550	104%	1620	1720	1490
Columbia R bl Rock Island Dam ²	APR-JUL	52000	55700	58200	104%	60700	64300	55770
	APR-SEP	61200	65500	68400	105%	71400	75700	65200

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

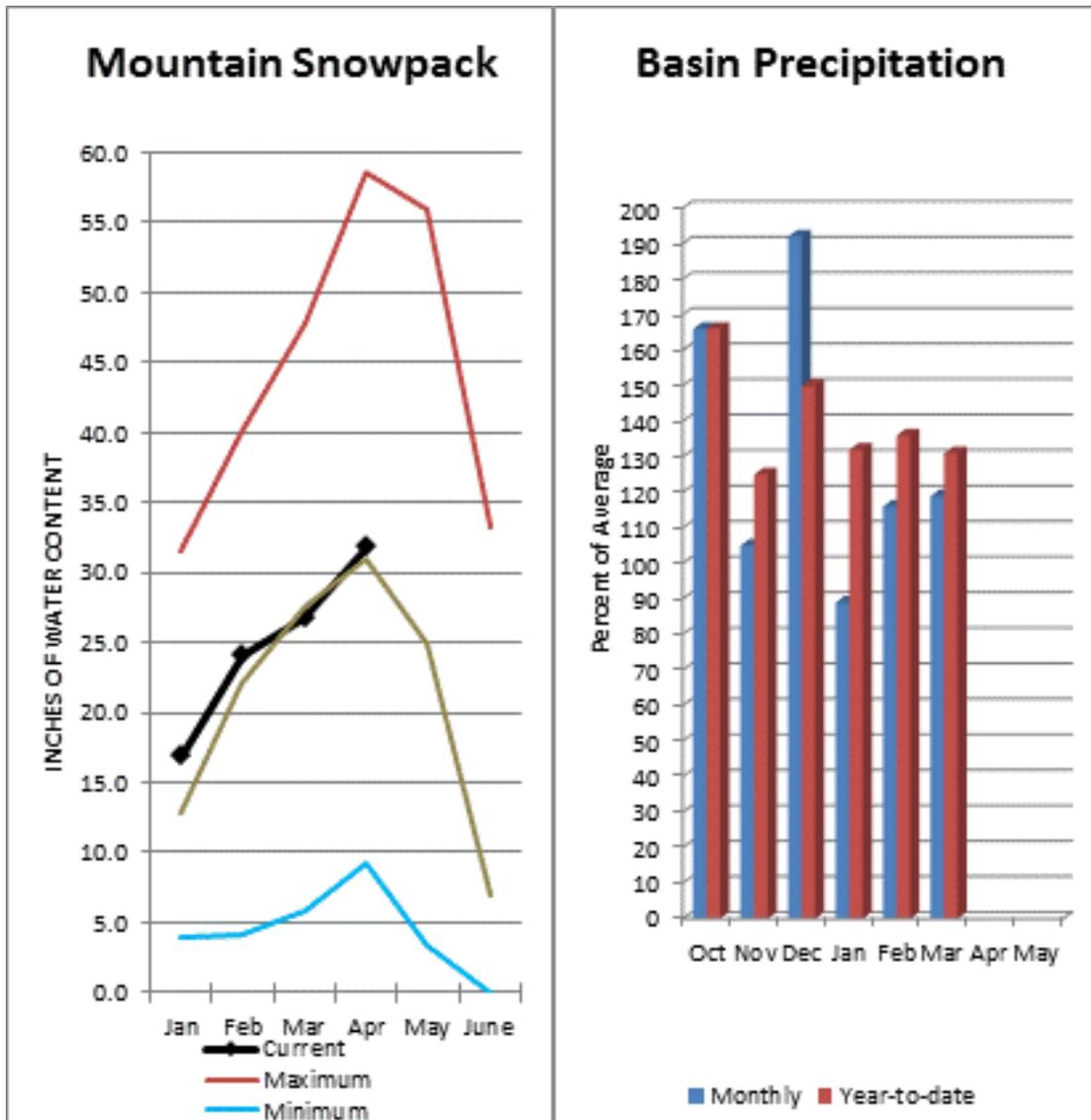
2) Forecasts are for unimpaired flows. Actual flow will be dependent on management of upstream reservoirs and diversions

3) Median value used in place of average

Reservoir Storage End of March, 2016	Current (KAF)	Last Year (KAF)	Average (KAF)	Capacity (KAF)
Lake Chelan	283.6	435.4	256.1	676.1
Basin-wide Total	283.6	435.4	256.1	676.1
# of reservoirs	1	1	1	1

Watershed Snowpack Analysis April 1, 2016	# of Sites	% Median	Last Year % Median
Central Columbia Basins	3	119%	63%
Chelan Lake Basin	3	119%	63%
Entiat River	1	94%	3%
Wenatchee River	7	108%	33%
Stemilt Creek	1	116%	14%
Colockum Creek	1	205%	5%

Upper Yakima River Basin



April 1 reservoir storage for the Upper Yakima reservoirs was 664,000-acre feet, 130% of average. Forecasts for the Yakima River at Cle Elum are 99% of average and the Teanaway River near Cle Elum is at 105%. Lake inflows are all forecasted to be near average this summer as well. March streamflow's within the basin were Cle Elum River near Roslyn at 130%. April 1 snowpack was 103% based upon 9 snow course and SNOTEL readings within the Upper Yakima Basin. Precipitation was 119% of average for March and 131% 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

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Upper Yakima River Streamflow Forecasts - April 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	APR-JUL	99	111	118	102%	126	137	116
	APR-SEP	108	120	128	102%	136	149	126
Kachess Reservoir Inflow ²	APR-JUL	92	101	107	103%	113	122	104
	APR-SEP	99	108	114	101%	121	130	113
Cle Elum Lake Inflow ²	APR-JUL	355	375	390	101%	405	430	385
	APR-SEP	380	405	425	102%	440	465	415
Yakima R at Cle Elum ²	APR-JUL	635	710	760	101%	810	880	755
	APR-SEP	680	765	825	99%	885	975	830
Teanaway R bl Forks nr Cle Elum	APR-JUL	107	124	136	105%	148	165	130
	APR-SEP	111	128	140	105%	152	169	133

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

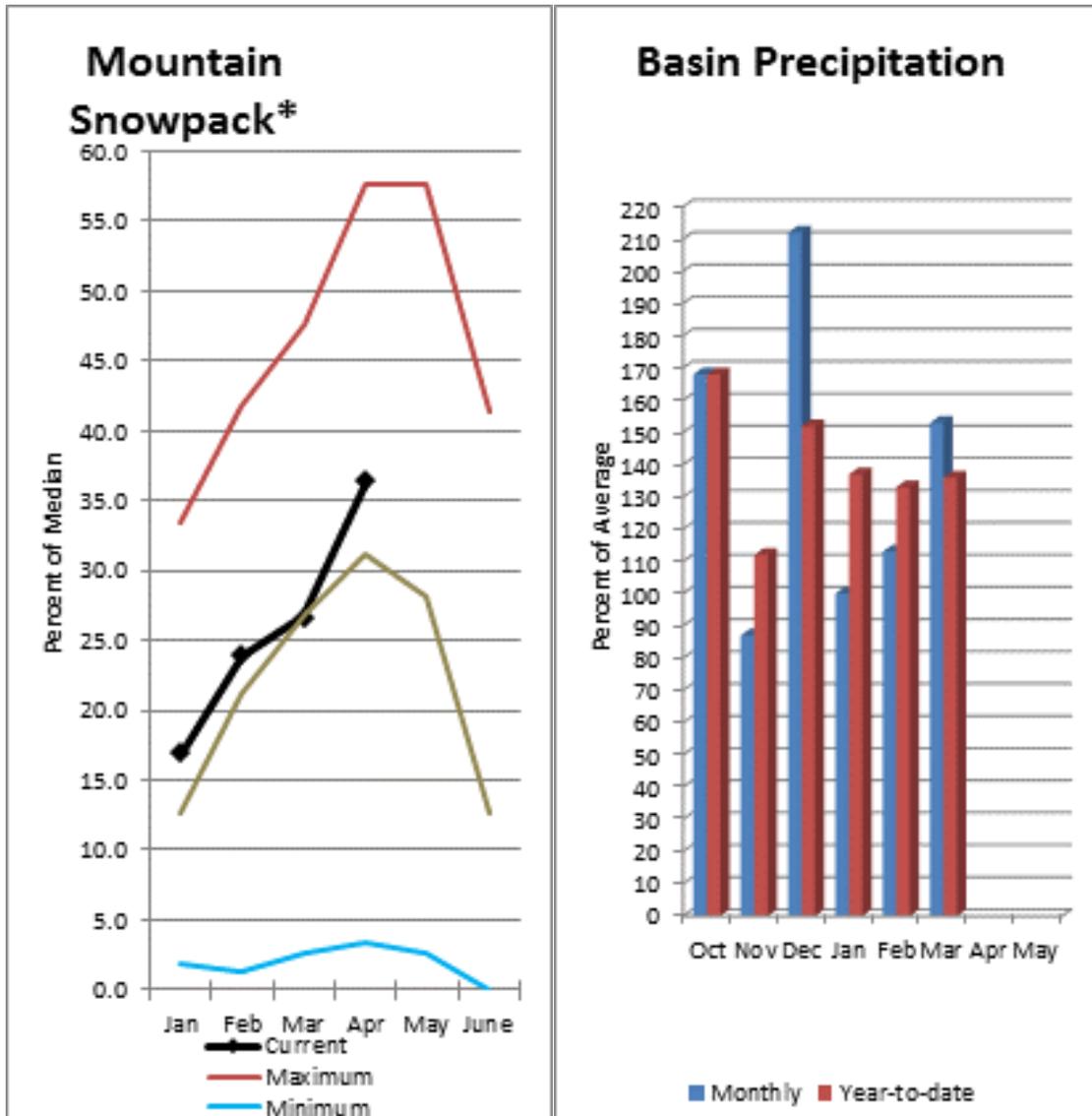
2) Forecasts are for unimpaired flows. Actual flow will be dependent on management of upstream reservoirs and diversions

3) Median value used in place of average

Reservoir Storage End of March, 2016	Current (KAF)	Last Year (KAF)	Average (KAF)	Capacity (KAF)
Keechelus	145.0	158.1	106.3	157.8
Kachess	172.9	238.8	159.8	239.0
Cle Elum	346.3	436.3	246.3	436.9
Basin-wide Total	664.2	833.2	512.4	833.7
# of reservoirs	3	3	3	3

Watershed Snowpack Analysis April 1, 2016	# of Sites	% Median	Last Year % Median
Upper Yakima River	9	103%	11%

Lower Yakima River Basin



March average streamflow's within the basin were: Yakima River near Parker, 177% and the Naches River near Naches, 199%. April 1 reservoir storage for Bumping and Rimrock reservoirs was 196,000-acre feet, 130% of average. Forecast averages for Yakima River near Parker are 117%; American River near Nile, 111%; Ahtanum Creek, 166%; and Klickitat River near Glenwood, 126%. April 1 snowpack was 117% based upon 7 snow course and SNOTEL readings within the Lower Yakima Basin and Ahtanum Creek reported in at 122% of normal. Precipitation was 153% of average for March and 136% for the water-year. Temperatures were 1-3 degrees above normal for March 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 - April 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	APR-JUL	112	123	130	114%	137	148	114
	APR-SEP	121	132	140	114%	148	159	123
American R nr Nile	APR-JUL	98	106	112	110%	118	126	102
	APR-SEP	108	116	122	111%	128	136	110
Rimrock Lake Inflow ²	APR-JUL	194	205	215	115%	225	240	187
	APR-SEP	230	245	255	116%	265	280	220
Naches R nr Naches	APR-JUL	695	750	790	113%	830	885	700
	APR-SEP	750	815	855	113%	895	960	760
Ahtanum Ck at Union Gap	APR-JUL	37	41	44	163%	47	51	27
	APR-SEP	41	45	48	166%	51	55	29
Yakima R nr Parker ²	APR-JUL	1720	1850	1930	116%	2010	2140	1660
	APR-SEP	1910	2040	2130	117%	2220	2350	1820
Klickitat R nr Glenwood	APR-JUL	140	152	160	127%	168	180	126
	APR-SEP	152	166	175	126%	184	198	139
Klickitat R nr Pitt	APR-JUL	475	525	560	129%	590	640	435
	APR-SEP	565	625	665	128%	705	760	520

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

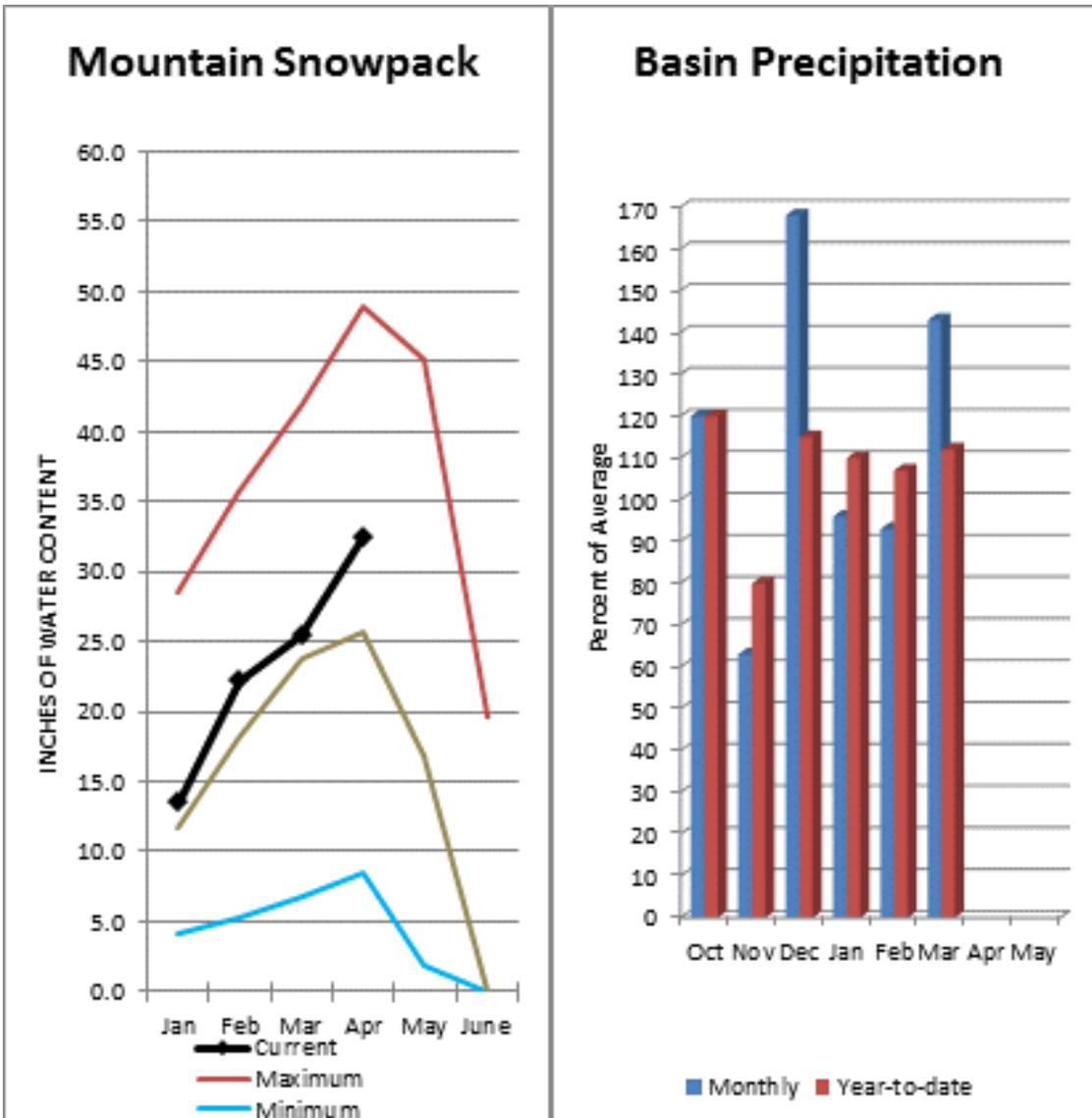
2) Forecasts are for unimpaired flows. Actual flow will be dependent on management of upstream reservoirs and diversions

3) Median value used in place of average

Reservoir Storage End of March, 2016	Current (KAF)	Last Year (KAF)	Average (KAF)	Capacity (KAF)
Bumping Lake	17.5	34.0	14.6	33.7
Rimrock	178.6	197.9	136.6	198.0
Basin-wide Total	196.0	231.9	151.2	231.7
# of reservoirs	2	2	2	2

Watershed Snowpack Analysis April 1, 2016	# of Sites	% Median	Last Year % Median
Lower Yakima River	7	117%	24%
Ahtanum Creek	2	122%	19%

Walla Walla River Basin



March precipitation was 143% of average, maintaining the year-to-date precipitation at 112% of average. Snowpack in the basin was 127% of normal. Streamflow forecasts are 111% of average for Mill Creek and 106% for the SF Walla Walla near Milton-Freewater. Average temperatures were 1-2 degrees above normal for March and 2-3 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 - April 1, 2016

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

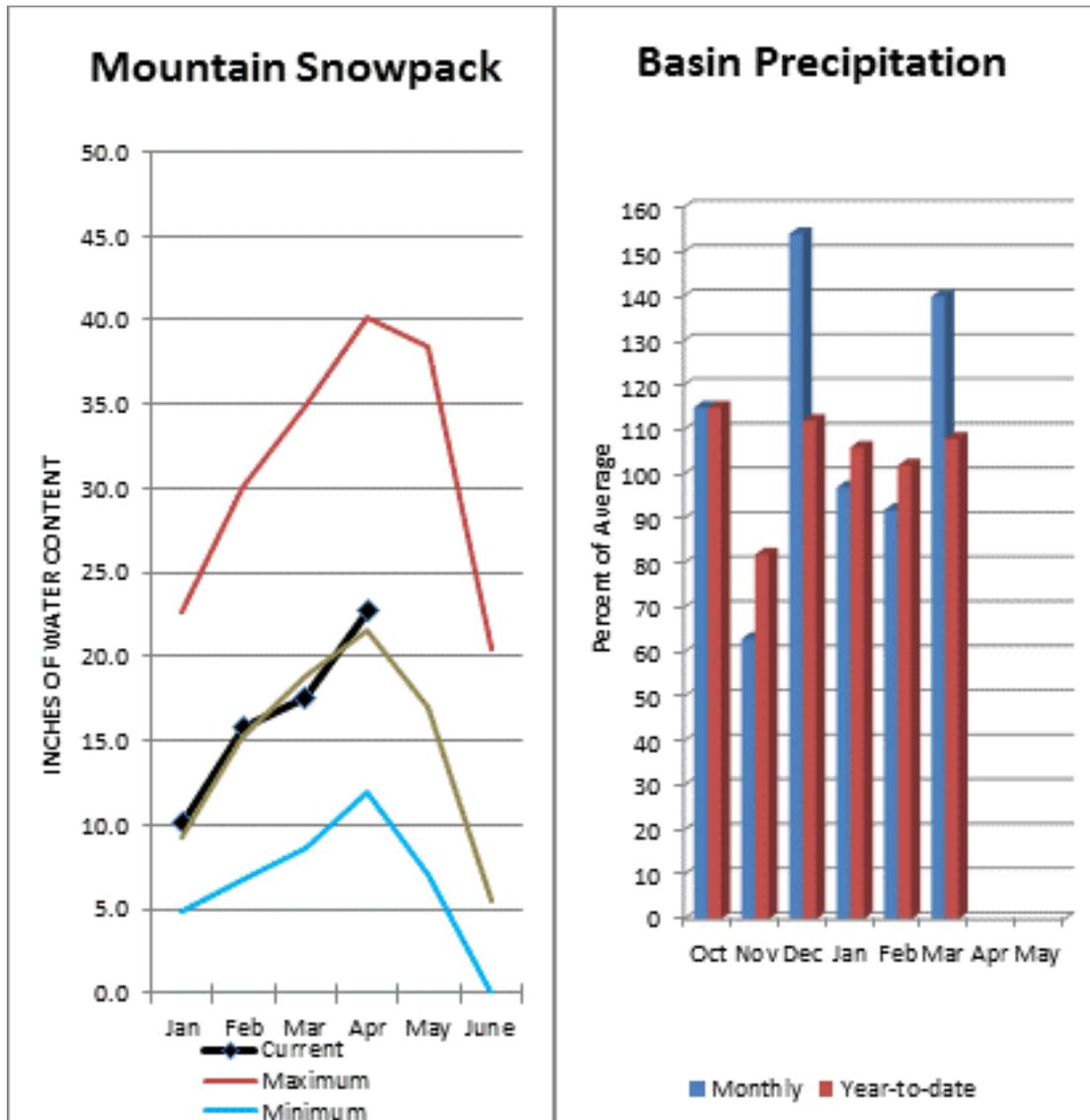
Walla Walla River	Forecast Period	90% (KAF)	70% (KAF)	50% (KAF)	% Avg	30% (KAF)	10% (KAF)	30yr Avg (KAF)
SF Walla Wall R nr Milton-Freewater	APR-JUL	47	53	57	106%	61	68	54
	APR-SEP	59	66	70	106%	75	82	66
Mill Ck nr Walla Walla	APR-JUL	21	24	26	108%	29	32	24
	APR-SEP	24	27	30	111%	32	36	27

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 April 1, 2016	# of Sites	% Median	Last Year % Median
Walla Walla River	2	127%	27%



The Grande Ronde River can expect summer flows to be about 112% of normal. The forecast for Asotin Creek at Asotin predicts 103% of average flows for the April – July runoff period. March precipitation was 140% of average, bringing the year-to-date precipitation to 108% of average. April 1 snowpack readings averaged 105% of normal. March streamflow was 109% of average for Snake River below Lower Granite Dam and 118% for Grande Ronde River near Troy. Dworshak Reservoir storage was 121% of average. Average temperatures were 1-2 degrees above normal for March and 2-3 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 - April 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	APR-JUL	1070	1250	1370	112%	1490	1670	1220
	APR-SEP	1160	1340	1470	112%	1590	1770	1310
Asotin Ck at Asotin	APR-JUL	24	31	36	103%	42	49	35
Clearwater R at Spalding ²	APR-JUL	6160	6930	7460	108%	7980	8750	6890
	APR-SEP	6480	7290	7840	108%	8390	9210	7270
Snake R bl Lower Granite Dam ¹²	APR-JUL	15300	18700	20300	102%	21800	25200	19848
	APR-SEP	17300	21100	22800	102%	24500	28300	22280

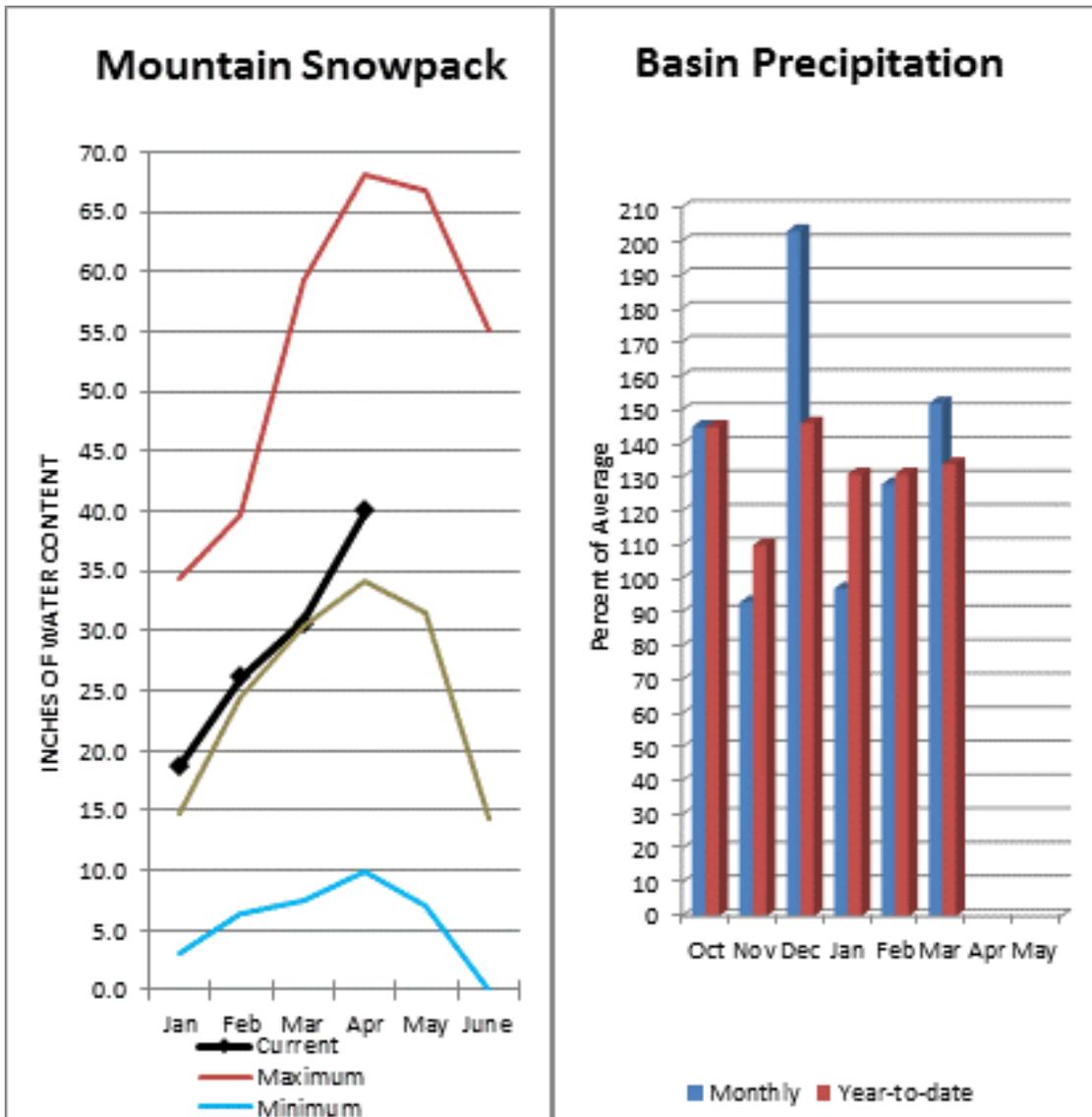
1) 90% and 10% exceedance probabilities are actually 95% and 5%

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 March, 2016	Current (KAF)	Last Year (KAF)	Average (KAF)	Capacity (KAF)
Dworshak Reservoir	2918.4	3214.1	2417.0	3468.0
Basin-wide Total	2918.4	3214.1	2417.0	3468.0
# of reservoirs	1	1	1	1

Watershed Snowpack Analysis April 1, 2016	# of Sites	% Median	Last Year % Median
Lower Snake, Grande Ronde, Clearwater Basins	16	105%	54%



Forecasts for April – September streamflows within the basin are Lewis River at Ariel, 107% and Cowlitz River at Castle Rock, 112% of average. The Columbia at The Dalles is forecasted to have average flows this summer according to the River Forecast Center. March average streamflow for Cowlitz River was 163%. The Columbia River at The Dalles was 130% of average. March precipitation was 152% of average and the water-year average was 134%. April 1 snow cover for Cowlitz River was 115%, and Lewis River was 118% of normal. Temperatures were near normal during March and 1-2 degrees above for the water year.

Lower Columbia River Basins

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Lower Columbia Basins Streamflow Forecasts - April 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	APR-JUL	72900	78300	82000	103%	85700	91200	79855
	APR-SEP	84600	90900	95200	103%	99500	106000	92704
Klickitat R nr Glenwood	APR-JUL	140	152	160	127%	168	180	126
	APR-SEP	152	166	175	126%	184	198	139
Klickitat R nr Pitt	APR-JUL	475	525	560	129%	590	640	435
	APR-SEP	565	625	665	128%	705	760	520
Lewis R at Ariel ²	APR-JUL	780	950	1060	109%	1180	1350	970
	APR-SEP	905	1080	1200	107%	1320	1500	1120
Cowlitz R bl Mayfield ²	APR-JUL	1580	1790	1930	119%	2070	2280	1620
	APR-SEP	1790	2020	2170	118%	2320	2550	1840
Cowlitz R at Castle Rock ²	APR-JUL	2030	2320	2520	113%	2720	3020	2230
	APR-SEP	2290	2610	2820	112%	3030	3340	2520

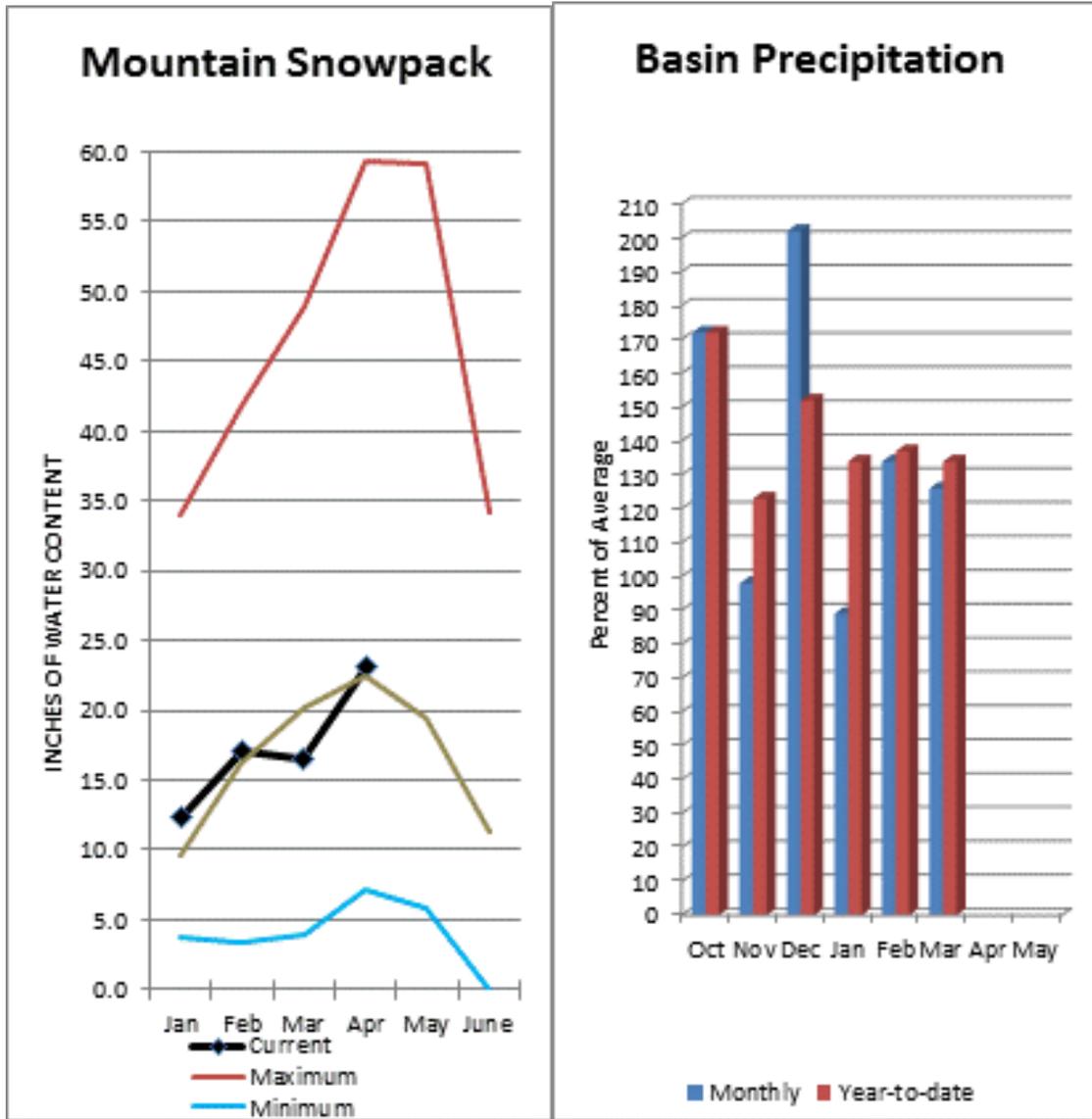
1) 90% and 10% exceedance probabilities are actually 95% and 5%

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 April 1, 2016	# of Sites	% Median	Last Year % Median
Lower Columbia Basins	11	117%	16%
Lewis River	5	118%	4%
Cowlitz River	6	115%	29%

South Puget Sound River Basins



Summer runoff is forecast to be 90% of normal for the Green River below Howard Hanson Dam and 114% for the White River near Buckley. April 1 snowpack was 109% of average for the White River, 106% for Puyallup River and 87% in the Green River Basin. March precipitation was 126% of average, bringing the water year-to-date to 134% of average for the basins. Average temperatures in the area were 1-2 degrees above normal for March and 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 - April 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}	APR-JUL	380	455	490	114%	520	595	430
	APR-SEP	460	545	585	114%	625	710	515
Green R bl Howard A Hanson Dam ^{1,2}	APR-JUL	134	183	205	87%	225	275	235
	APR-SEP	159	210	235	90%	260	310	260

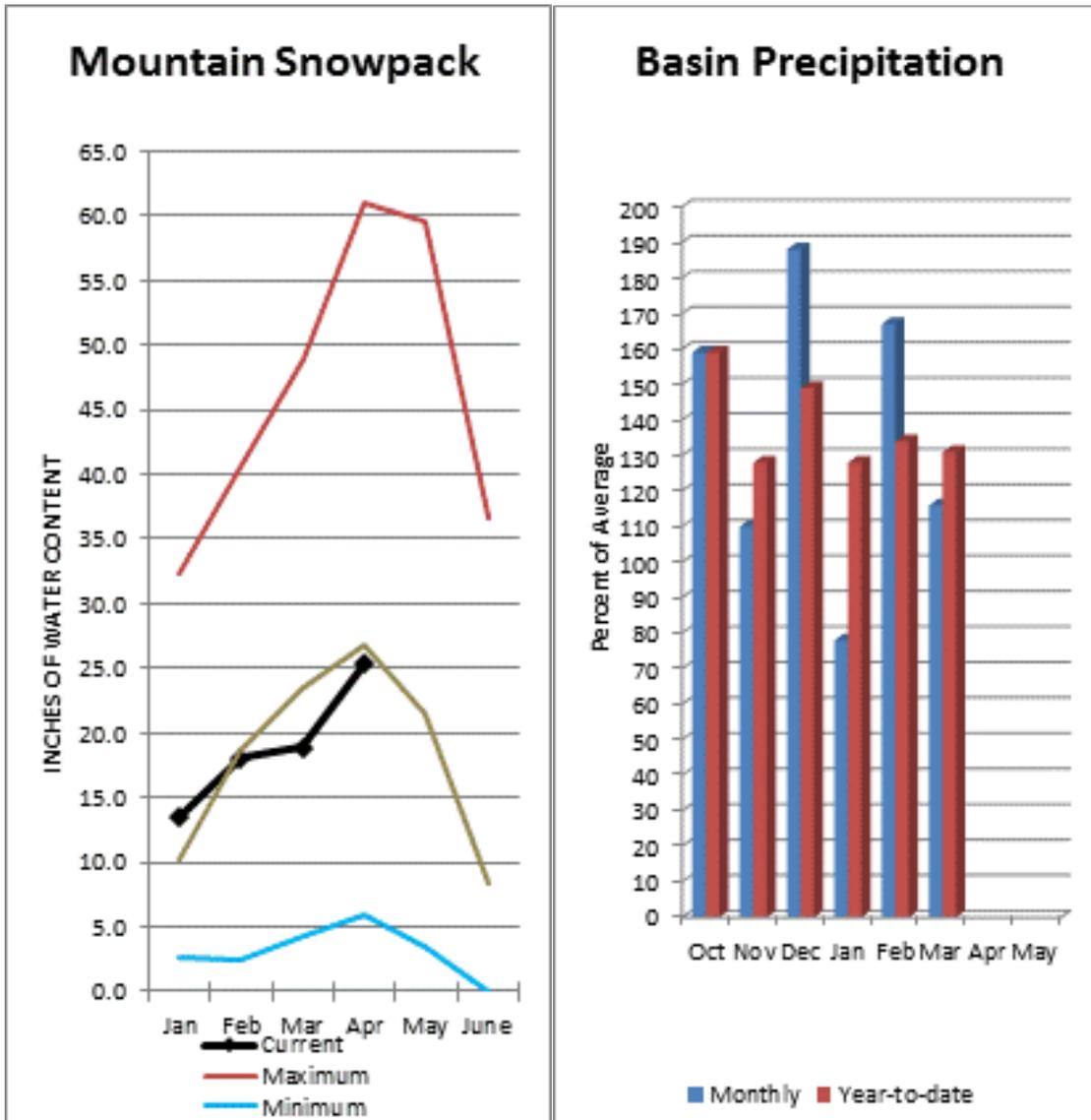
1) 90% and 10% exceedance probabilities are actually 95% and 5%

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 April 1, 2016	# of Sites	% Median	Last Year % Median
South Puget Sound Basins	10	103%	29%
White River	3	109%	41%
Green River	2	87%	0%

Central Puget Sound River Basins



Forecast for spring and summer flows are: 116% for Cedar River near Cedar Falls; 111% for Rex River; 112% for South Fork of the Tolt River; and 108% for Taylor Creek near Selleck. Basin-wide precipitation for March was 116% of average, bringing water-year-to-date to 131% of average. April 1 median snow cover in Cedar River Basin was 112%, Tolt River Basin was 77%, Snoqualmie River Basin was 88%, and Skykomish River Basin was 80%. Temperatures were 1-3 degrees above normal for March and 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 - April 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	APR-JUL	68	76	81	116%	87	95	70
	APR-SEP	73	82	88	116%	94	103	76
Rex R nr Cedar Falls	APR-JUL	22	25	28	117%	31	35	24
	APR-SEP	23	28	30	111%	33	37	27
Taylor Ck nr Selleck	APR-JUL	17.6	20	22	110%	23	26	20
	APR-SEP	21	24	26	108%	27	30	24
SF Tolt R nr Index	APR-JUL	12.2	14.3	15.7	111%	17.1	19.2	14.2
	APR-SEP	13.9	16.3	18	112%	19.7	22	16.1

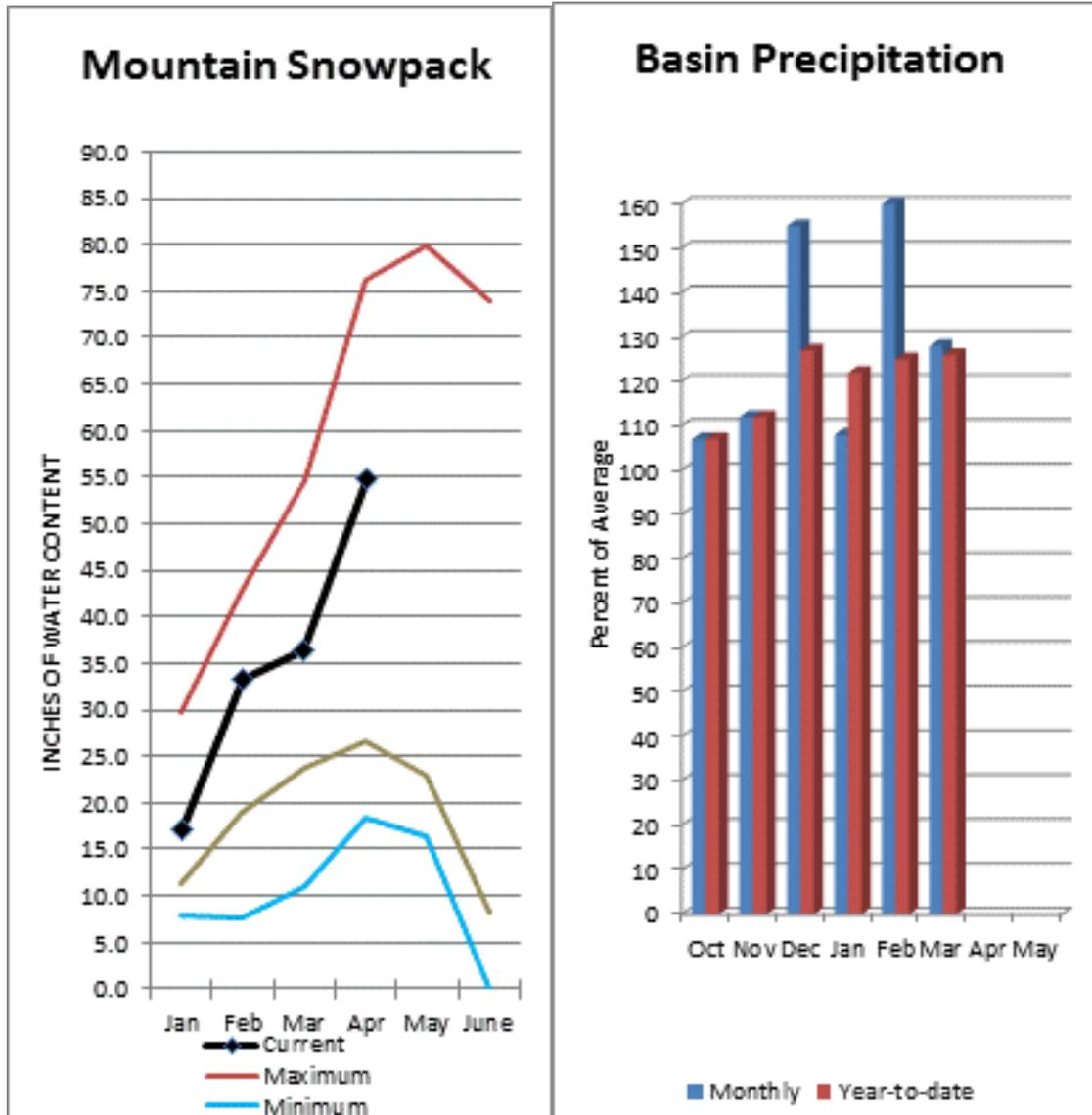
1) 90% and 10% exceedance probabilities are actually 95% and 5%

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 April 1, 2016	# of Sites	% Median	Last Year % Median
Central Puget Sound Basins	14	95%	4%
Puyallup River	5	106%	35%
Cedar River	5	112%	2%
Tolt River	3	77%	1%
Snoqualmie River	5	88%	3%
Skykomish River	3	80%	6%

North Puget Sound River Basins



Forecast for Skagit River streamflow at Newhalem is 116% of average for the spring and summer period. March streamflow in Skagit River was 143% of average. Other forecast points included Baker River at 115% and Thunder Creek at 106% of average. Basin-wide precipitation for March was 128% of average, bringing water-year-to-date to 126% of average. April 1 average snow cover in Skagit River Basin was 114%, Nooksack River Basin was 91% and Baker River Basin was 103% of normal. April 1 Skagit River reservoir storage was 64% of average and 33% of capacity. Average temperatures were 1-3 degrees above normal for March and 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 - April 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	APR-JUL	220	235	250	106%	265	280	235
	APR-SEP	315	335	350	106%	365	385	330
Skagit R at Newhalem ²	APR-JUL	1820	1930	2000	119%	2070	2180	1680
	APR-SEP	2140	2270	2350	116%	2440	2560	2030
Baker R at Concrete	APR-JUL	750	835	890	114%	950	1030	780
	APR-SEP	920	1050	1130	115%	1220	1350	980

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

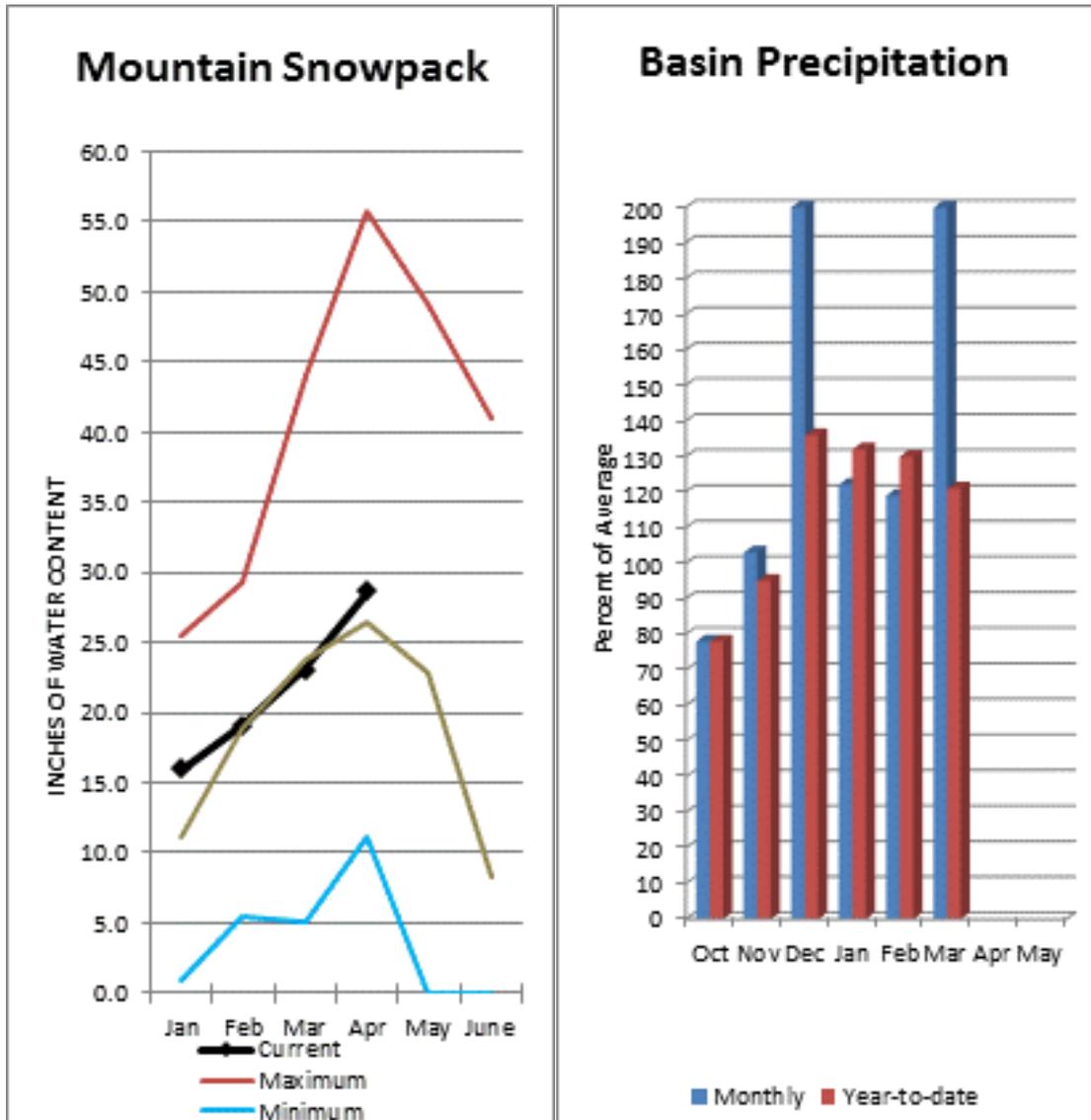
2) Forecasts are for unimpaired flows. Actual flow will be dependent on management of upstream reservoirs and diversions

3) Median value used in place of average

Reservoir Storage End of March, 2016	Current (KAF)	Last Year (KAF)	Average (KAF)	Capacity (KAF)
Ross	466.8	712.5	730.5	1404.1
Diablo Reservoir			86.0	90.6
Basin-wide Total	466.8	712.5	730.5	1404.1
# of reservoirs	1	1	1	1

Watershed Snowpack Analysis April 1, 2016	# of Sites	% Median	Last Year % Median
North Puget Sound Basins	22	105%	34%
Skagit River	13	114%	58%
Baker River	6	103%	21%
Nooksack River	3	91%	13%

Olympic Peninsula River Basins



Forecasted average runoff for streamflow for the Dungeness River is 99% and Elwha River is 101%. March runoff in the Dungeness River was 176% of normal. Big Quilcene and Wynoochee rivers may expect near average runoff this summer as well. March precipitation was 204% of average. Precipitation has accumulated at 141% of average for the water year. March precipitation at Quillayute was 146% of normal. Olympic Peninsula snowpack averaged 108% of normal on April 1. Temperatures were 1-2 degrees above average and 1-3 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 - April 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	APR-JUL	97	111	120	100%	129	143	120
	APR-SEP	115	132	144	99%	156	173	145
Elwha R at McDonald Bridge nr Port Angeles	APR-JUL	335	375	400	100%	430	465	400
	APR-SEP	395	445	475	101%	510	560	470

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 April 1, 2016	# of Sites	% Median	Last Year % Median
Olympic Peninsula	6	108%	2%

Issued by

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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*:

Canada	Snow Survey Network Program – British Columbia Ministry of Environment River Forecast Center – British Columbia Ministry of Forests, Lands and Natural Resource Operations
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
Private	Okanogan Irrigation District Wenatchee Heights Irrigation District Newman Lake Homeowners Association Whitestone Reclamation District

*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

