PIMA COUNTY
REGIONAL WASTEWATER RECLAMATION DEPARTMENT
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March 1, 2016

TO: Jackson Jenkins, Director

FROM: Kathleen Chavez, Water Policy Manager

SUBJECT: Quarterly Drought Update – February 2016

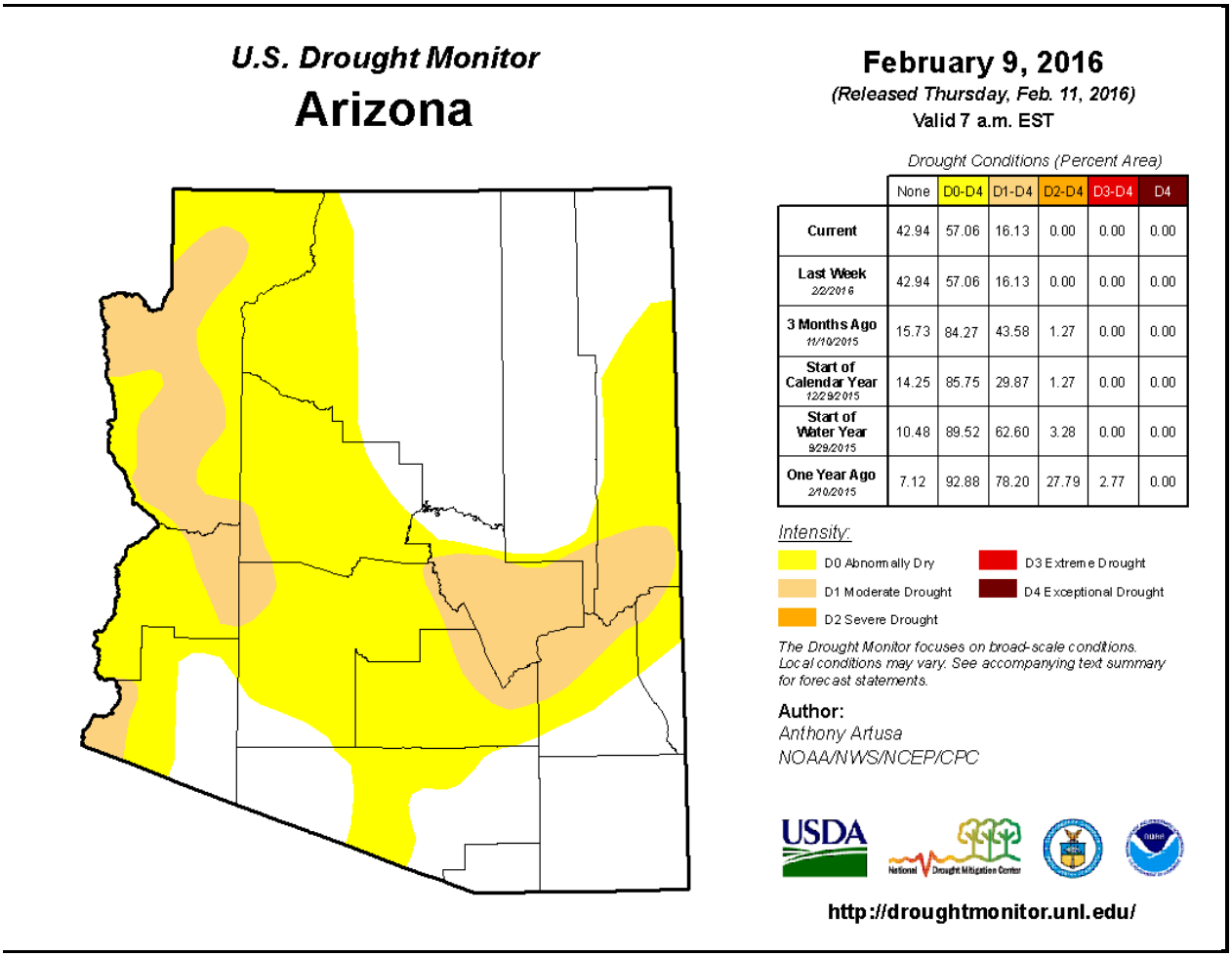
As requested by the Board in August 2014, attached is an update on the status of drought in Pima County. The previous update was prepared in August 2015. Several key points are noted since the last update.

- Short term drought conditions throughout Arizona have improved as of February 9, 2016. Most of Pima County no longer in drought, except for central Pima County which is designated abnormally dry.
- The Long term drought status through December 2015 also shows improvement with most of Pima County abnormally dry, according to the ADWR drought status map
- The early winter increase in precipitation does not signal the end of drought conditions. Multiple years of above-average precipitation would be needed to reverse drought conditions that have persisted for over a decade. Climate experts caution against easing drought diligence and response actions locally and in the Colorado River Basin
- Although El Niño conditions have produced drought relief early this winter, conditions into late winter and early spring are yet unknown, especially in the all-important Colorado River.
- This summer's monsoon season produced above-average rainfall (+0.55 inches); however, temperatures were the 2nd warmest on record adding up to 17 straight years of above-average temperatures
- Satellite observations of soil characteristics and vegetation confirm drought conditions in Pima County
- Upper Colorado Basin snow pack was promising earlier this winter, but February's high pressure conditions have left warmer and drier weather causing some areas to fall below median snowpack
- Inflow to Lake Powell is projected to be near average and substantially better than 2012 and 2013. Unfortunately, a large surplus is needed to counteract drought conditions and demand
- Lake Mead is 39% full and Lake Powell is 47% full

Should you have any questions, please feel free to let me know.

Attachment

Short-Term Drought Status (NDMC)



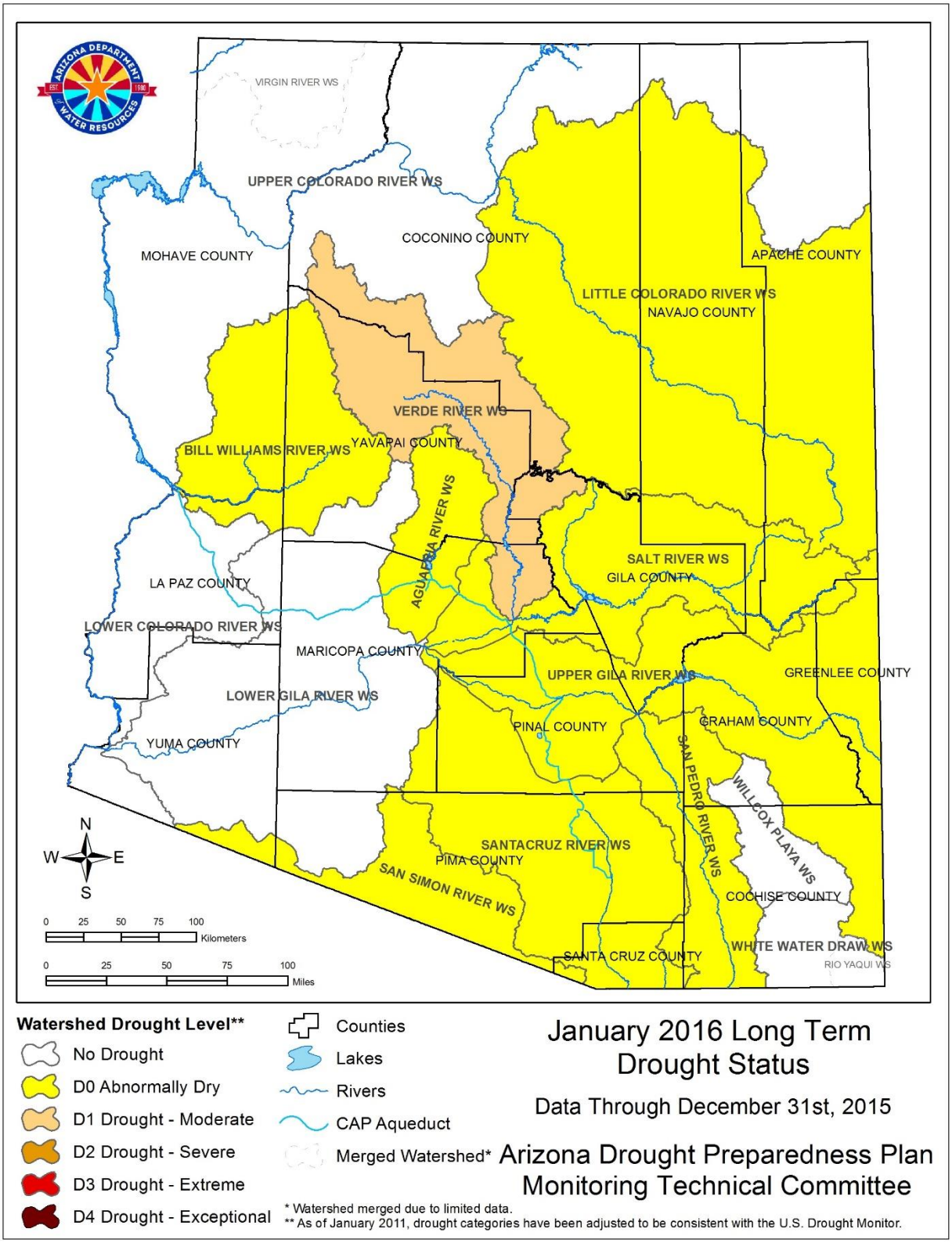
Short-Term Drought Summary (ADWR-MTC)

Rain and snowfall due to a strong storm system that moved through the state from January 4th through the 10th brought short term drought relief to some parts of the state, although precipitation was not uniformly distributed. This has led to improvement in southern Gila County and across northern Arizona, primarily in Navajo, eastern Coconino and northern Apache counties. In some rangeland areas, precipitation filled stock ponds and saturated the soils, however, some areas in the northwestern part of the state have been consistently missed by both rainfall and snowfall for quite some time.

We anticipate that the precipitation will continue over the next few months as El Niño remains strong. If the precipitation continues as expected through March, there will be more short-term drought improvement.

Reflects changes during the month of January. Prepared by the State Drought Monitoring Technical Committee February 2, 2016.

Long-Term Drought Status (ADWR-MTC)



Long-Term Drought Update (ADWR-MTC)

Early winter precipitation occurred in some parts of the state, but has not resulted in sufficient accumulation to warrant long-term drought improvement. While streamflow is near normal in some areas, it is below average in many parts of the state, and snow pack is not sufficient to indicate improvement in water resources. Aquifer recharge is slow across much of Arizona and groundwater resources will be reassessed in spring after the snowmelt has begun.

Reflects October-December 2015 precipitation and streamflow percentiles for the past 24, 36 and 48 months to a 40 year historical record. Prepared by the State Drought Monitoring Technical Committee January 28, 2016.

ADWR: How Do We Know When the Drought is Over?

Since an uptick in precipitation events in 2014 and 2015, as El Nino built momentum, ADWR and climate experts have cautioned against easing from a diligent drought stance and response as majority of opinion holds multiple years of above average precipitation is required to reverse more than a decade of drought condition and impacts occurring both locally and in the Colorado River Basin region.

Is Arizona's drought over? Not so fast ...

Weldon B. Johnson, The Republic | azcentral.com January 22, 2016

Last week the U.S. Drought Monitor released a graphic showing drought relief for Arizona as a result of the rain and snow that soaked the state in early January. Thanks to the El Niño-fueled precipitation that soaked the state there were no areas of severe drought in Arizona for the first time since January of 2011.

While this is certainly good news for the state, we have to take a look at exactly what the Drought Monitor report means. We have to look at the difference between short-term drought and long-term drought.

University of Arizona Climatologist **Mike Crimmins** took part in the discussion behind the Drought Monitor map. He offered a bit of clarification. Crimmins explained that short-term drought had more to do with things like the condition of the soil for plant growth or dry vegetation. Long-term drought has more to do with ground water levels or the condition of large storage reservoirs.

"Those (short-term) conditions can change very quickly," Crimmins said. "Water resource-type droughts take a long time to develop and they take a long time to go away."

He said snowpack in the high country was above last year's levels and that some of the smaller reservoirs were seeing some relief. In addition, the vegetation and other parts of the ecosystem that respond to seasonal precipitation are looking good.

"You need to have a summer like last summer and a winter like this winter and you need to do that for a few years to say that long-term drought is going away," Crimmins said.

7 things to know about El Niño's effect on the drought

Brandon Loomis, The Republic | azcentral.com January 7, 2016

The Great El Niño of 2015-2016 is delivering drought relief as promised within Arizona, but whether it will bless the all-important Colorado River remains up in the air.

Federal forecasters and local water managers think you can count on big spring flows on Arizona's Salt and Verde rivers, and maybe even some excess to refill desert aquifers.

But what if you rely on water from the Colorado and Lake Mead?

"We're definitely predicting a banner year for both snowpack and streamflow in (Arizona's) major basins," NRCS water-supply specialist Dino DeSimone said.

Unless Arizona's winter goes suddenly and unexpectedly quiet, it's going to be a wet one. But the forests, ranges and — crucially for Arizona and its neighbors — Lake Powell and Lake Mead need years to recover.

It's been kind of a ho-hum winter so far in the mountains of the upper Colorado River Basin, where most of the river's water originates. In a monthly briefing Thursday, the Colorado Basin River Forecast Center (CBRFC) projected flows into Lake Powell lagging the long-term average by about a tenth. It's not as ugly as a lot of years have been, but especially in the high country above 10,000 feet the snows came late and the dirt stayed dry. Come spring, lots of moisture will seep into the ground instead of rushing to the river.

Working in Lake Mead's favor are the current above-normal conditions of the Virgin and Little Colorado rivers, two tributaries upstream of Mead. El Niño winters like this one are usually pretty wet there and further south, said Greg Smith, senior hydrologist with the federal CBRFC.

Recent rain, snow don't add up to end of Arizona drought

Weldon B. Johnson, The Republic | azcentral.com January 22, 2015

Strong monsoon rains, early winter storms and the presence of El Niño provide some relief from the ongoing drought… but to break the grip of the drought that is approaching 20 years by some estimates, it will take several years of above average precipitation.

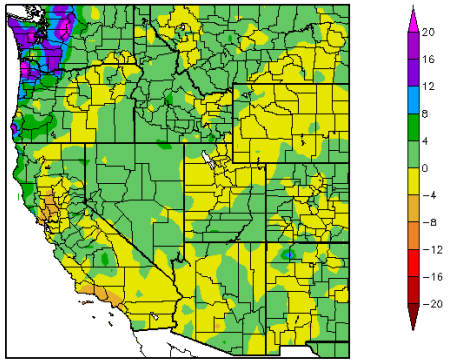
Nancy Selover, a research professor at Arizona State University and the State Climatologist, said a series of cool winters with lots of snow in the mountains are what's needed.

"We need to have a situation where we store water when it's cold and we're not demanding it," Selover said. "We need to have it melt and runoff so we can recharge the ground water system and some of the streams. To have real drought recovery is going to require several years of above average precipitation, particularly winter precipitation."

Mike Crimmins is an associate professor and climate science extension specialist at the University of Arizona. He also serves as a drought monitoring expert on the Governor's Drought Task Force. Crimmins said the heavy rains have helped, but even that depends on what part of the state you're talking about. He agreed with Selover that it would take years of above average rain and snow to put an end to the dry spell.

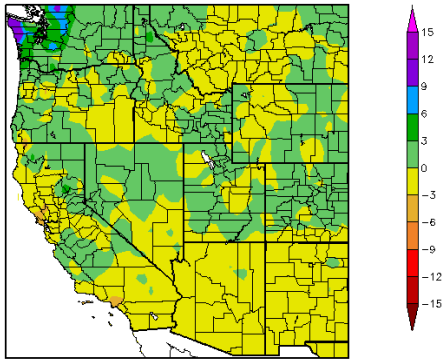
And though there have been a number of rain storms…the state has also experienced warmer than usual weather. Above average temperatures also play a role in perpetuating the drought.

Departure from Normal Precipitation (in)
8/17/2015 – 2/16/2016



Generated 2/17/2016 at HPRCC using provisional data. Regional Climate Centers

Departure from Normal Precipitation (in)
1/18/2016 – 2/16/2016



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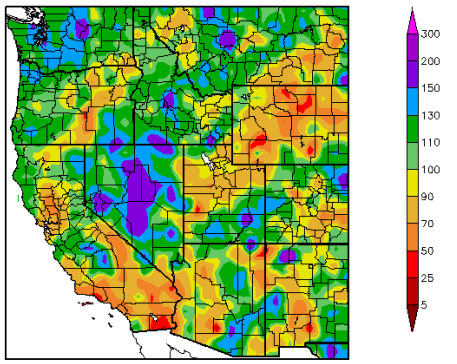
Percent of Normal Precipitation (%)
8/17/2015 – 2/16/2016



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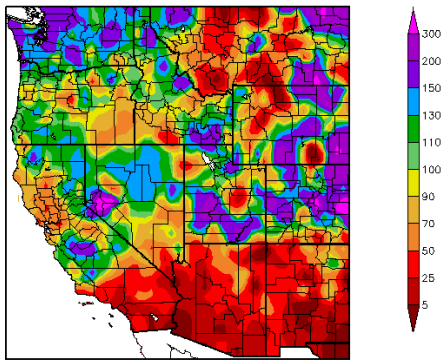
Percent of Normal Precipitation (%)
1/18/2016 – 2/16/2016



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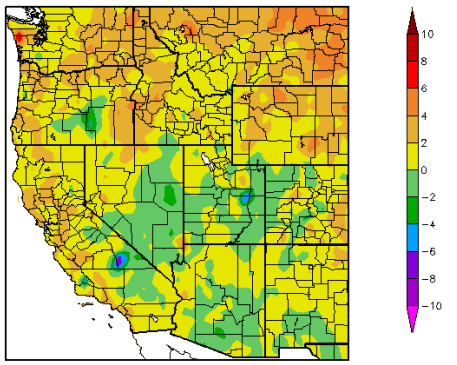
Departure from Normal Temperature (F)
10/1/2015 – 2/16/2016



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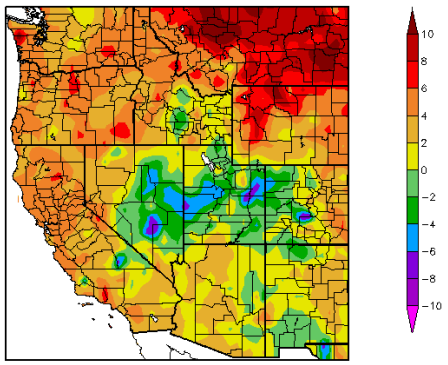
Departure from Normal Temperature (F)
1/18/2016 – 2/16/2016



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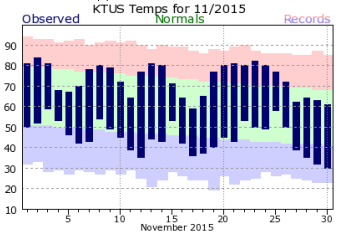
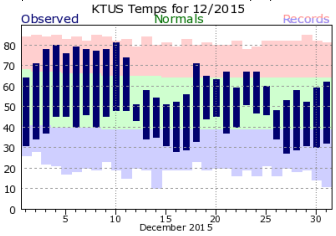
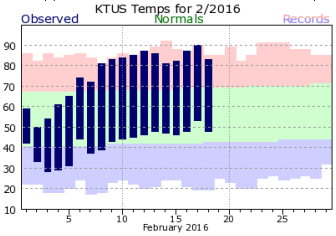






	PCPN	+/-	AvgT	+/-
September	2.40"	1.11"	82.8°	1.2°
October	2.25"	1.36"	73.6°	2.6°
November	0.16"	-0.41"	59.1°	-0.7°
December	0.47"	-0.46"	51.5°	-0.4°
January	1.53"	0.59"	52.5°	-0.1°
	6.81"	2.19"		

RAIN – ABOVE AVERAGE

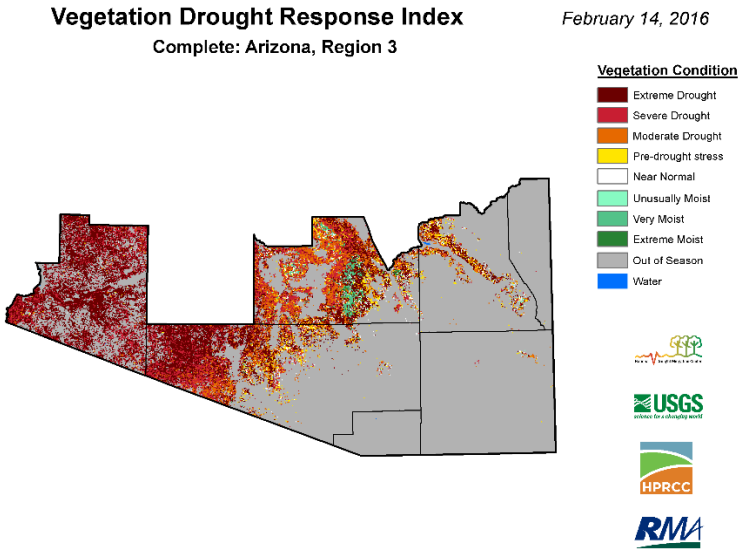
Last year's monsoon ended above average (+ 0.55"), the first surplus since 2011, with 6.63" of rain. Wetter than average conditions held as Pacific storm systems contributed to the 8th wettest October on record followed by a dry and cooler November and December. Last year ended as the wettest since 1998- also of note, last Water Year ended above average (+2.45") and the current Water Year continues in surplus (+1.08"). Additional Pacific storm systems brought rain and snow the first week of 2016, pushing January and winter season precipitation above average but rainfall then stalled into February.

EL NINO

NOAA now concludes El Nino may have peaked and a neutral ENSO signal may emerge, reversing wetter than average conditions. Worse, a La Nina event is favored to occur by this fall, supported by historical tendency after a strong El Nino, indicating a possible dry winter. Though El Nino is expected to continue through spring, successive wet winters are needed to recover from drought- this potential change in forecast would impede recovery and present relief from drought conditions could revert in the long term. However, the next three months are predicted above average chance for rain and even chance for temperatures above, below or average.

TEMPERATURE – ABOVE AVERAGE

Last year was the 2nd warmest on record following 2014's record setting warmth, all adding up to 17 straight years of above average temperatures. A very warm start to fall ceased with below normal temperatures at year end with a mix of extremes from above 100° to a low of 27°. In December, the first 11 days were recorded as the 10th warmest of record (average high of 76.0°) but then the last 20 days ranked the 17th coldest (average low of 36.3°). Despite a slight below average January, record daily highs occurred in Tucson, some 9-15° above normal. Regionally, warmth in February began impacting snowpack and reducing snow water equivalent (a measure of potential water supply).

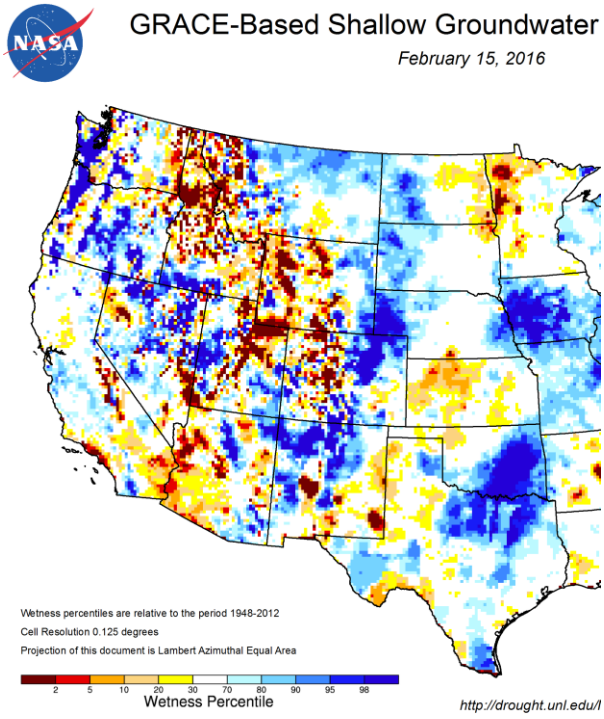


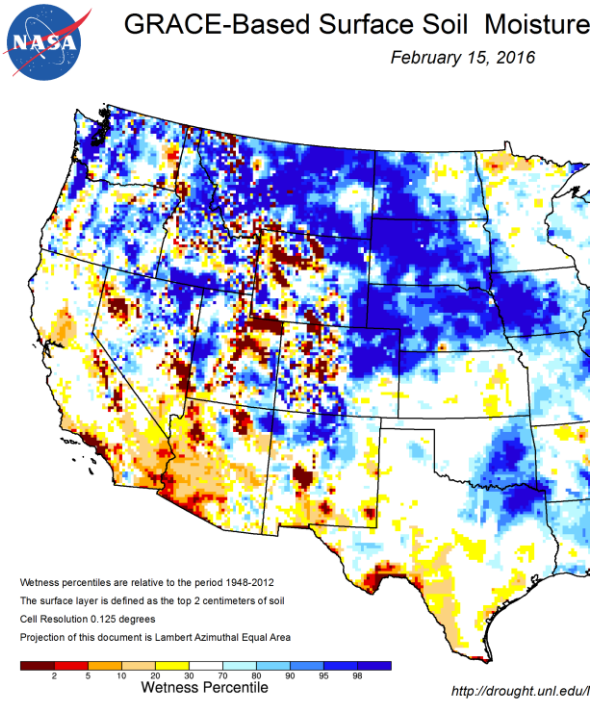
VegDRI (NDMC/USGS) GRACE

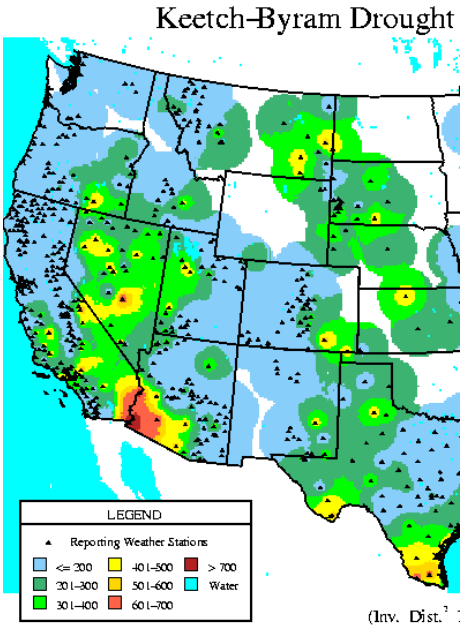
VegDRI uses satellite observation and climate indexes such as the SPI and soil characteristics to measure the relative state and the condition of vegetation compared to a historical average to determine drought's effect on vegetation.

VegDRI indicates vegetation along the western state border in extreme drought condition with western Pima County radiating from extreme and severe drought to moderate and pre-drought condition in central Pima County.

GRACE satellite observation appears to corroborate a dryness in western Pima County with wetter conditions in central and eastern areas.



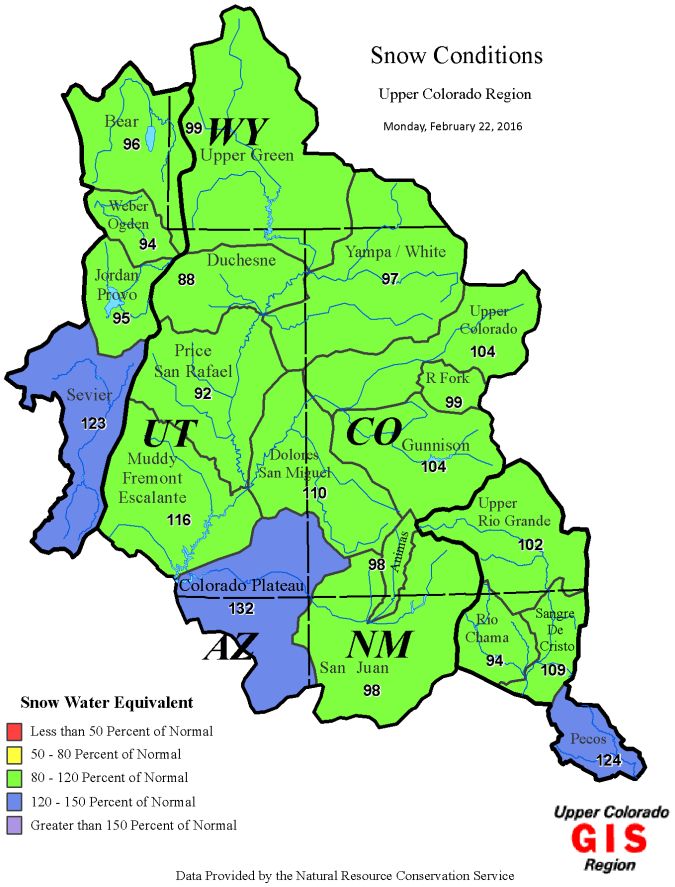




K-B Drought Index (USFS)

This drought index is designed specifically for fire potential assessment. It is a number representing the net effect of evapotranspiration and precipitation in producing cumulative moisture deficiency in deep duff and upper soil layers. It is a continuous index, relating to the flammability of organic material in the ground.

Again, western Pima County is in a severe vegetative drought, with increased wildfire occurrence with live fuels expected to burn actively at these levels. The threat reduces easterly with vegetation typical of late spring, early growing season. Lower litter and duff layers are drying and beginning to contribute to fire intensity.

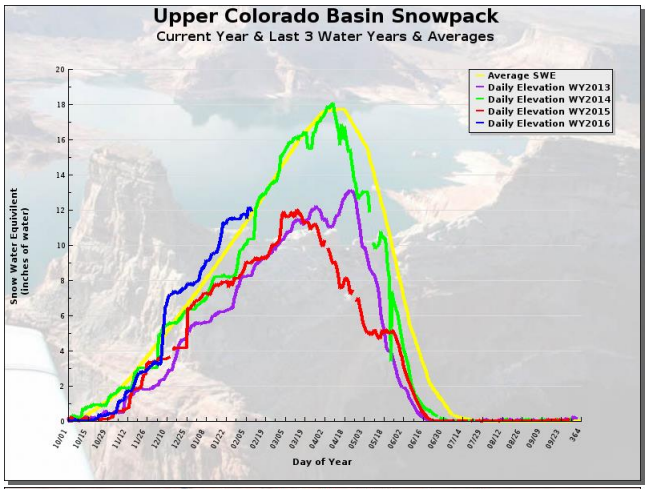


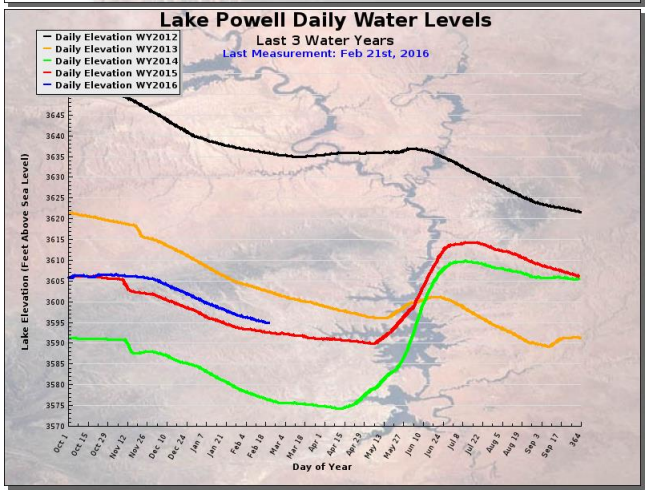
Upper Basin Snow Pack (NRCS)

While early winter snowpack seemed promising and basins remain near to above average, February's high pressure, both locally and regionally, negated Pacific storm system activity leaving drier and warmer weather causing some areas to fall below median snowpack.

As a result, modeling has trended runoff forecast volumes and the water supply forecast downward; Lake Powell forecast inflow has decreased by 200,000 af to 6.5 million af, or from 94% to 91% of average at this time.

Going into winter, soil moisture was lacking which will impact runoff efficiency. In all, conditions are variable and will depend on remaining storm generation this El Nino is capable of- activity will continue into early spring with a potential to impact water supply.





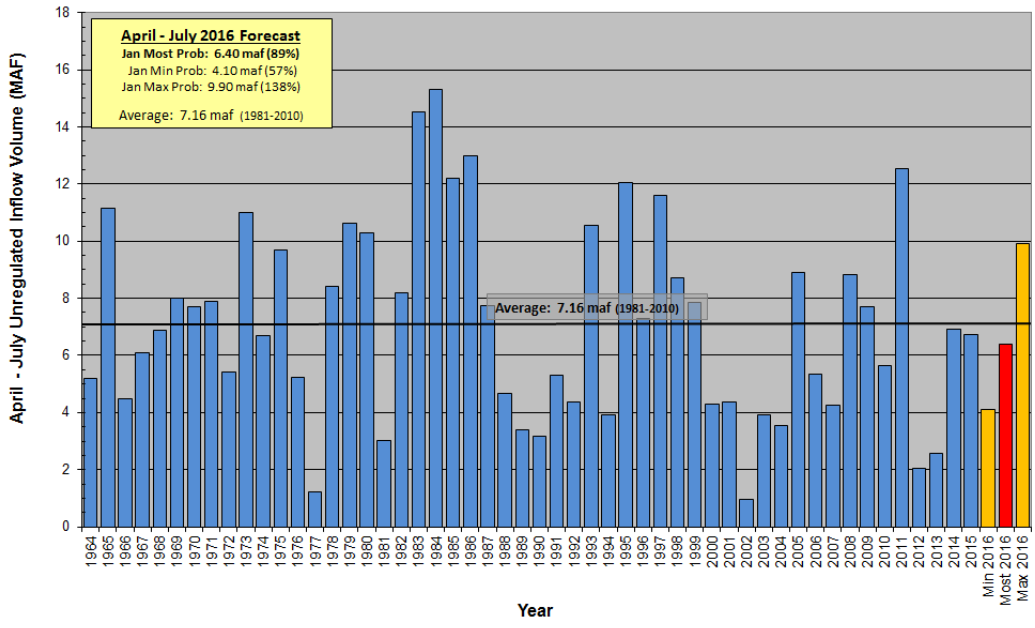
Reservoir Storage

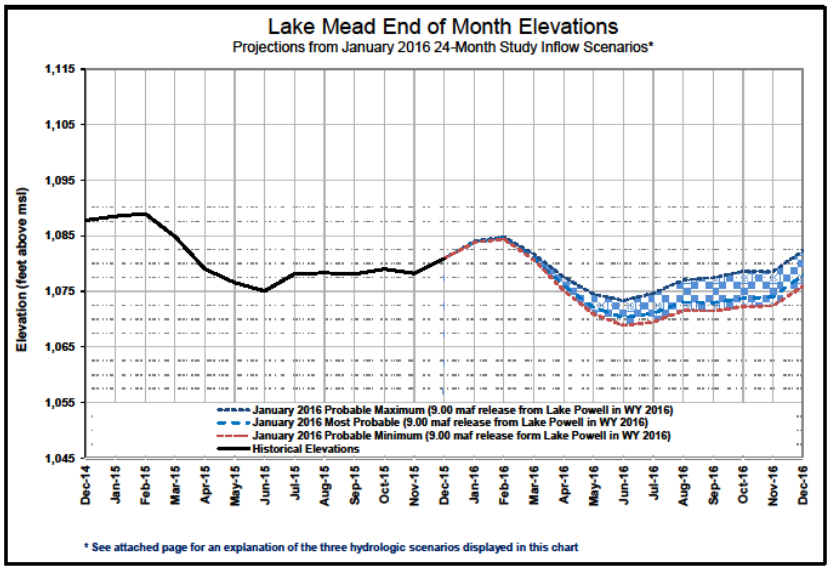
As noted, forecasts are trending down. Lake Powell inflow for the water year is forecast at 90% of average, or a total of 9.79 million af. This would be just above the recent Most Probable Inflow Scenario determined by Reclamation. Under the 2007 Interim Guidelines, the current scenario prescribes a 9.0 million af release to Lake Mead in 2016 and 2017. Should projections err and Lake Powell fall below a certain elevation for lack of inflow, though unlikely, Mead would in turn receive less water in 2017.

Elevation at Mead is projected at 1,072.96' on Sept 30, 2016. Rising to 1,075' at that date would trigger lower release.

While this El Nino water year may be less than anticipated, Powell inflow is expected to be near average and substantially better than 2012 and 2013. In fact, this could be the third consecutive year of near average inflow. Unfortunately, a large surplus is needed to counteract drought and demand.

Lake Powell Unregulated Inflow
April - July 2016 Forecast
Comparison with History





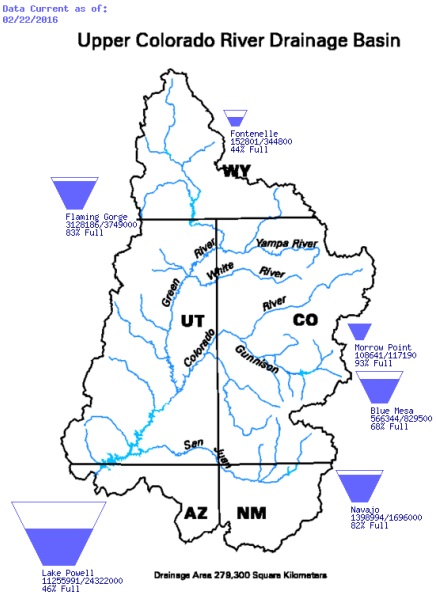
Lake Mead

39% Full
10.28 MAF
Current Elevation
1,084.34'
Projected (Sep2016)
1,073.12'
Projected (Dec2016)
1,077.51'
Projected (Dec2017)
1,073.79'

Lake Powell

47% Full
11.51 MAF
Current Elevation
3,594.89'
Projected (Sep2016)
3,612.69
Projected (Dec2016)
3,606.66'
Projected (Dec2017)
3,617.40'

Total System Content: 29 MAF, 49%



CAP Shortage

As is evident, our water supply is dependent on many factors- snow, temperature, runoff and administration of large storage and conveyance projects impact water management decisions. Drought in distant basins can reduce our water supply while local drought increases water demand. It is still early to ascertain, however Lake Mead is forecast to be just feet above shortage for 2017 but below threshold by 2018 and in shortage.

Officially, a 17-37% chance remains for Tier 1 shortage in 2017. In 2018, the probability for same level of shortage jumps to 49% with a 10% chance of escalating to a Tier 2. Chance of Tier 2 escalates to 16% and 18% in 2019 and 2020 respectively.

CAP would lose 320,000 af in a call for Tier 1. CAP states "Arizona's cities, towns, industries, mines and tribes using CAP water will not be impacted by shortage during the next five years… [shortage would] eliminate CAP water supplies to the Arizona Water Banking Authority and a portion of the CAP water supply for groundwater replenishment, will impact agricultural users in central Arizona and may cause an increase in CAP water rates."

Event or System Condition	2016	2017	2018	2019	2020
Shortage Condition – any amount (Mead ≤ 1075 ft)	**0**	**17/37**	**59**	**60**	**59**
Shortage – 1st level (Mead ≤ 1075 and ≥ 1050 ft)	0	17/37	49	41	35
Shortage – 2nd level (Mead < 1050 and ≥ 1025 ft)	0	0	10	16	18
Shortage – 3rd level (Mead < 1025 ft)	0	0	0	3	6
Surplus Condition – any amount (Mead ≥ 1145 ft)	0	0	5	7	14
Surplus – Flood Control	0	0	0	1	2
Normal or ICS Surplus Condition	100	83/63	36	33	27