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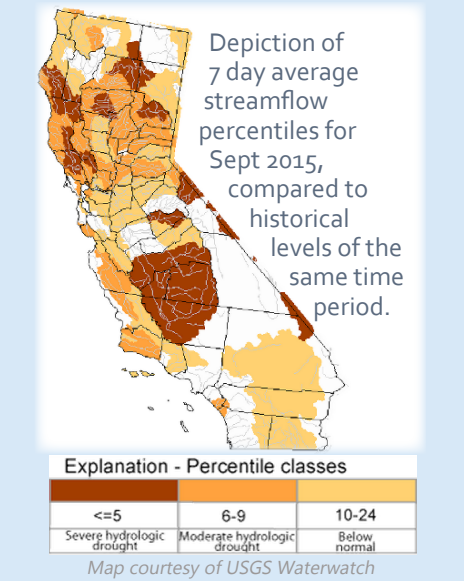
California Drought Fact Sheet Series 6
Informing the general public about the 2012-16 drought

What to Do When the Drought Ends

There is growing scientific consensus that rising temperatures are increasing the probability of extreme drought conditions occurring in the future [1]. Therefore, if or when some aspect of this drought ends, we should be careful not to become complacent. Being prepared for future droughts will necessitate careful water usage even in wet years, especially since drought recovery will take time and be spatially heterogeneous. Even in a wet year, we could still be experiencing other lasting types of water deficit in different areas of the state.

What does it mean for the drought to "end"? How will that be defined?

It is difficult to include all the possible aspects of drought into one definition, and there are various terms to describe different types of water deficits. The California Department of Water Resources (DWR) defines drought loosely as an abnormal water deficit. Different components of the hydrologic cycle (such as precipitation, soil moisture, streamflow, and groundwater) could be in deficit, while another could be in surplus [2]. Therefore, when thinking about the "end" of the drought, it must be in relation to a specific component. If precipitation levels return to the long-term average, we can say that the "meteorological drought" is over, but we will still be experiencing a "hydrological drought" because streamflow and especially groundwater levels will not recover immediately.



Map courtesy of USGS Waterwatch

To define drought more comprehensively, the US Drought Monitor designates drought classifications based on 5 main indicators, and numerous supplemental indicators. Thus, it will be a more meaningful end a region's drought if the Drought Monitor lifts its "drought" designation than if precipitation, for example, returns to normal [3].

Which drought effects will be long-term?

Groundwater: Overdrafted groundwater basins will take years to recover, and aquifer storage capacity lost to subsidence may not be recoverable. In January 2016, the DWR identified a list of 21 water basins in California which have been critically overdrafted, not including overdraft during drought years [4].

This means that continued extraction at present rates will most likely result in significant impacts, including but not limited to saltwater intrusion in coastal areas, subsidence, and ecosystem damage. These basins will thus be subjected to the earliest deadlines for filing Groundwater Sustainability Plans, part of the state's 2014 Sustainable Groundwater Management Act.

The vast majority of these basins are in the San Joaquin Valley, and this area is consequently subsiding faster than ever recorded. This has become a serious issue in California, as subsidence damages infrastructure, reduces storage capacity in aquifers, and increases flood risk. According to a new NASA report, the two most hard-hit areas experienced 9" and 13" of subsidence just between May 2014 and January 2015. This rapid subsidence is particularly unfortunate in these areas, which have already experienced up to 24" and 37" of sinking from 2006–2010 [5].

Photo: Richard Ireland, USGS

Signs on a telephone pole mark the amount of subsidence at the area of maximum impact in the San Joaquin Valley near Mendota. The land sunk almost 30 feet between 1926 and 1977 due to aquifer compaction [6].

One of the biggest long term implications of subsidence is that it can cause permanent loss of groundwater storage capacity through irreversible compaction of sediment layers [5]. Thus, even if we eventually experience enough rainfall to recharge groundwater basins, some areas will never have as much groundwater available as they did in the past.

Extreme cases of subsidence have also caused damage to infrastructure, including roads, bridges, buildings, well casings, and canals. Repairs are expensive and some damage is permanent, such as reduced flow capacity in the San Joaquin Valley's Delta-Mendota Canal [7].

Photo: California Department of Water Resources

Land subsidence at the Delta-Mendota Canal has sunk this bridge to just above water level.

Forests: In addition to groundwater, there will also be a substantial lag in forest recovery after meteorological drought ends. Trees take on average 2-4 years to recover from drought, with pine forests (very common in California) taking especially long [8]. During this time of recovery, the amount of carbon that trees can sequester will continue to be suboptimal, and trees will remain abnormally susceptible to fire and bark beetles during this time. For more information, see Fact Sheet #2.

Other ecosystems are facing severe long-term impacts from the drought because they do not have the adaptative capacity of human systems. A recent PPIC report [9] offers insight regarding the impacts on:

Water bird habitat – the loss of wetlands along the Pacific Flyway, which provides winter habitat to over 5 million migratory birds, is reducing food supplies and increasing the risk of disease due to overcrowding.

Native fish habitat – low streamflow and warmer waters have put 18 native fish species, including salmon and steelhead trout, at high risk of extinction.

Photo: Pacific Northwest National Laboratory via Flickr

Only 5% of Chinook Salmon in the Sacramento River winter-run survived in 2014 [10].

What if the drought doesn't end soon?

We shouldn't count on El Niño to end the drought; its correlation with rainfall is weak, especially in Northern California [11]. We can make up for the majority of surface water shortage in the short-term by continuing to pump groundwater (as has happened in the Central Valley so far), but continued overdraft will only cause further subsidence and aquifer compaction. Rural regions in the San Joaquin Valley, including those housing disadvantaged communities, have already been especially hard-hit by dried up household wells—a problem that will siphon from a $38 million portion (designated for drinking and household water deliveries) of the state's $3.7 billion drought relief fund [12]. The longer this drought goes on, the larger a toll it will take on communities, ecosystems, and individuals.

Fortunately, with both policymakers and individuals focused on building drought resilience, the state will be all the more prepared for drought in the coming years.

What you can do to help or get help:

- Rebates for replacing lawns or toilets: http://www.saveourwaterrebates.com
- Tips on saving water: http://saveourwater.com
- Report a dry household well: https://mydrywatersupply.water.ca.gov/report
- Contact your local water supply agency/ company about conservation programs

1. http://www.pnas.org/content/112/13/3931.full
2. http://www.water.ca.gov/climatechange/docs/2015/Perspectives_Guidance_Climate_Change_Analysis.pdf (Chapter 3.2.2)
3. http://droughtmonitor.unl.edu/AboutUs/ClassificationScheme.aspx
4. http://www.water.ca.gov/groundwater/sgm/cod.cfm
5. http://water.ca.gov/groundwater/docs/NASA_REPORT.pdf
6. http://gallery.usgs.gov/photos/09_15_2010_b2Vi84Kxx6_09_15_2010_0#.VfCc79K6fct
7. http://pubs.usgs.gov/circ/circ1182/pdf/06SanJoaquinValley.pdf
8. http://www.sciencemag.org/content/349/6247/528.full
9. http://www.ppic.org/main/publication_quick.asp?i=1160
10. https://cdfgnews.wordpress.com/2015/01/26/agencies-taking-measures-to-protect-winter-run-chinook-preparing-to-release-approximately-600000-fish/
11. http://drought.ca.gov/pdf/Drought_ENSO_handout.pdf
12. http://myinforms.com/en/a/15970851-wells-run-dry-in-okieville-amid-historic-drought/

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