Issued: November 23, 2004

CLIMAS
Southwest Climate Outlook

November 2004 Climate Summary

Hydrological Drought – Hydrological drought continues for much of the Southwest.

- Eastern and southeastern New Mexico is free of all drought categories.
- Storage in many reservoirs in Arizona and New Mexico held nearly steady this month.
- Northeastern Arizona and northwestern New Mexico remain in extreme drought.

Precipitation – Western Arizona and eastern New Mexico are much wetter than average, while the remainder of the Southwest is dry.

Temperature – Water year temperatures are generally cooler than average in the Southwest.

Climate Forecasts – Long-lead forecasts call for increased chances of above-average temperatures in Arizona and western New Mexico for the next six months. Slightly increased chances of wetter-than-average conditions are predicted from January to May.

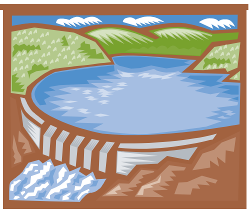
El Niño – Sea surface temperatures in the tropical Pacific Ocean are indicative of a weak El Niño, which is expected to continue into early spring, but the impact of this event is currently uncertain.

The Bottom Line – The Southwest is expected to see limited improvement in drought conditions through early 2005.

The climate products in this packet are available on the web:
http://www.ispe.arizona.edu/climas/forecasts/swoutlook.html

Glen Canyon

The latest news concerning the Colorado River involves salinity management and water release at the Glen Canyon Dam. The U.S. Department of Agriculture provided a total of $19.5 million to Colorado, Utah, and Wyoming to control salinity in the Colorado River Basin. To date agricultural producers have already reduced salt by 404,000 tons—57 percent of the 2020 goal.



Sediment build-up behind Glen Canyon Dam has led the U.S. Bureau of Reclamation to conduct a controlled water release this week. The release will stir up approximately 880,000 tons of sediment, which will be redistributed downstream. The goal is to build up beaches and sandbars and aid vegetation and aquatic animals.

See Arizona Reservoir Levels on page 9 for details

In this issue:

The Southwest Climate Outlook is published monthly by the Climate Assessment for the Southwest Project at the University of Arizona. This work is funded, in part, by the U.S. Bureau of Reclamation and the Technology Research Initiative Fund of the University of Arizona Water Sustainability Program.

THE UNIVERSITY OF ARIZONA®

Low flow in the Colorado River Basin spurs water shortage discussion among seven states

by Melanie Lenart

The reservoirs in the Colorado River system provide a cushion in times of trouble, much like money in the bank. But about half of the rainy day water savings have been spent during the past five years of drought, spurring water managers in Arizona and New Mexico and the five other states that depend on the Colorado to seriously discuss how they might share a potential shortage.

The main issue of contention is that Glen Canyon Power will be unable to produce electricity by 2007 if the drought continues unabated and no changes are made in management decisions. At full capacity, the company uses Lake Powell to generate enough electricity to power about 1.5 million homes, including users in Arizona and New Mexico.

"We don't know if this is a 5-year drought or the fifth year of a 15-year drought," explained Robert Johnson, regional director of the Lower Colorado Region for the U.S. Bureau of Reclamation (USBR), which tracks and distributes Colorado River water. "From a management perspective, we've got to hope for the best and plan for the worst."

Johnson displayed his optimism during a recent talk at the University of Arizona's Water Resources Research Center. He noted that the reservoirs can store about 60 million acre-feet, about four times the Colorado's annual average streamflow, mainly in Lake Powell and Lake Mead. Both lie along Arizona's borders.

"What that means is we've got the ability to weather drought. In fact, we have weathered drought—we've had five years of drought and the reservoirs are still half full," he told the group.

At the end of October, Lake Powell was filled to 38 percent of its capacity, while Lake Mead was registering 54 percent of its capacity. However, USBR numbers indicate only about 12 million acre-feet could be jointly withdrawn from the two reservoirs before power production ceased completely, assuming no changes to the generating system and no additional water deposits beyond that for downstream use.

Timothy Henley, manager of the Arizona Water Banking Authority, found some reason for hope in that historic droughts affecting the Colorado River basin tend to last four to six years (see Table 1), based on instrumental records of streamflow since 1906. In October, storm fronts, including in northwestern Arizona, finally broke the nearly five-year streak of below-average monthly precipitation tallies that the Bureau of Land Management had been reporting for the watersheds feeding the Colorado River as a whole.

Colorado River flow throughout the system averaged 9.9 million acre-feet a year since 2000, which puts average river flow during this 5-year period even lower then during the 1950s drought and others of similar 4- to 6-year time spans (Table 1). Meanwhile, the seven western U.S. states and two Mexican states using Colorado River water consume about 96 percent of the annual average river flow. An acre-foot is roughly 326,000 gallons of water, enough to supply an average family of four for a year.

There have been media reports that Lake Mead, in particular, might never refill even if streamflow returned to its "average" of 15.1 million acre-feet a year, an estimate based on measurements since 1906. In the next couple of decades, basinwide water consumption is expected to grow with the population of the Upper Basin states to reach the allocated 16.5 million acre-feet from its current 14.5 million acre-feet a year (Table 2). However, as a USBR slide show reminded, "we never get average hydrology." The estimated natural flow of the Colorado River registers as a series of ups and downs that ranged from about 5 million acre-feet in 1977 to more than 24 million acre-feet in both the 1983 and 1984 calendar years, based on measurements at Lee's Ferry in Arizona (Figure 1).

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Table 1. Average flow during the current drought (top row) was lower than during any other drought in the instrumental record.

Time frame	Duration	Average Annual Flow (in acre-feet)
2000–2004	5 years	9,900,000*
1953–1956	4 years	10,200,000
1988–1992	5 years	10,900,000
1959–1964	6 years	11,400,000
1931–1935	5 years	11,400,000

Source: U.S. Bureau of Reclamation.
*Preliminary estimate.

Table 2. The Colorado River is overallocated even when the period of flow attains its natural flow average of 15.1 million acre-feet a year. However, the Upper Basin states are not using all of their allocations at this point in time.

Political Entity	Annual allocation (in acre-feet)
Upper Basin States	7,500,000*
Colorado	3,900,000*
New Mexico	800,000*
Utah	1,700,000*
Wyoming	1,000,000*
Lower Basin States	7,500,000
California	4,400,000
Arizona	2,800,000
Nevada	300,000
Mexico	1,500,000
Total	16,500,000

Source: U.S. Bureau of Reclamation.
* The Upper Basin states use a percentage formula rather than acre-feet to divide its allocation, which is why these rounded-off numbers do not tally 7.5 million acre-feet. Also, New Mexico's share comes from a Colorado tributary, the San Juan River.

Low Flow, continued

"Between 1983 and 1986, we spilled about 45 million acre-feet of water to Mexico. If you see events like that, the reservoirs are going to fill," Henley said.

Henley, one of two Arizona representatives in ongoing discussions among the seven U.S. states vying for Colorado River water in these days of pending shortage, reported ongoing progress on interstate discussions during a November 9 public meeting at the Arizona Department of Water Resources' (ADWR) headquarters in Phoenix. The interstate group is essentially hoping to buy time, working out interim agreements on how to share the shortage in the hopes that the river hydrology will shift into a more plentiful mode before they have to seriously weigh whether to short Arizona users or lose power.

If an official shortage were declared in the Lower Basin, non-Indian agricultural users of Central Arizona Project (CAP) water—the 336-mile long system of aqueducts that delivers 1.8 million acre-feet a year to Maricopa, Pinal, and Pima counties—legally would take the first cut. About 80 percent of Arizona's share of the Colorado River goes to agriculture.

ADWR Director Herb Guenther reminded the approximately 75 people attending the Phoenix meeting that long-term records based on tree rings and isotopes indicate modern records might give an exaggerated version of "normal" streamflow.

"We're concerned that we're returning to a more 'normal' mode, rather than a 'shortage' mode," Guenther said, alluding to the evidence that the Colorado has been running high for most of the instrumental record when compared to the longer records of past climate.

Tree-ring records also reveal evidence of infrequent but severe droughts that span decades, which climatologists call "megadroughts." Previous megadroughts, such as one in 16th century North America, wreaked havoc on local populations. However, even during a drought or megadrought, individual years of above-average streamflow can occur.

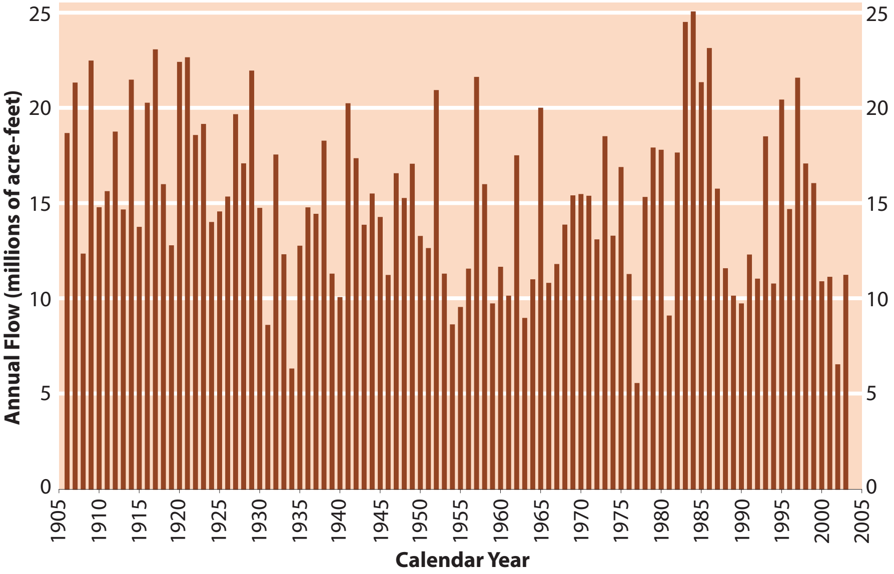


Figure 1. Estimates of Colorado River flow from 1906–2003 show that river levels fluctuate extensively around the average flow of 15.1 million acre-feet a year. The estimates are for flow throughout Colorado River's 246,000-square mile basin and were reconstructed by the U.S. Bureau of Reclamation based on gauged flow at Lee's Ferry in Arizona.

In fact, some note that the 1957 strong El Niño event that helped boost Colorado River streamflow to about 22 million acre-feet that year could be seen as an unusually wet year during a drought that actually stretched from 1953–1964. (See Table 1 and Figure 1 for illustration.)

However, even a couple of wet years like 1957 and 1958 within a stretch of dry years would do little to alleviate potential problems from the current drought, as researchers discovered when they modeled a long-term drought by adding the streamflow values for 1953–1964 to the current record.

Although the Lower Basin states theoretically could receive their full annual allocation during such a scenario, it would come at the cost of Glen Canyon hydropower. In the modeled "worst-case" scenario, Lake Powell's levels would be too low to yield electrical power for 10 of the next 17 years, as Don Ostler of the Upper Colorado River Commission summarized in a report available on the website for the ongoing Arizona Colorado River Shortage Workshops (http://www.awba.state.az.us/annc/AZ_CO_river_shortages.htm).

"Lake Powell takes most of the swings of the drought," as the USBR's Johnson noted. Lake Powell serves as the collection site for annual contribution from the Upper Basin states—New Mexico, Colorado, Utah and Wyoming—to the Lower Basin states of Arizona, California and Nevada.

After generating power through Powell's Glen Canyon dam, the water is channeled to the slightly larger Lake Mead. Glen Canyon Dam's power intake pipes are higher than the pipes that can supply water to the Lower Basin. As it is, electricity production is down to about 900 megawatts from its potential capacity of 1300, in part because the lower reservoir level means incoming water exerts less force on the turbines that generate power, explained Leslie James, executive director of the Colorado River Energy Distributors Association.

If push comes to shove, providing water to the agricultural users takes priority

continued on page 4

Low Flow, continued

over providing power, according to one of the many legal agreements guiding Colorado River use. Also, legal agreements have been interpreted as requiring the Upper Basin states, which produce about 90 percent of the runoff that feeds the Colorado River, to pass along the water allocated to the Lower Basin states even if it means shorting its own users.

The Lower Basin states have always received at least the full 7.5 million acre-feet allocated to them, Johnson noted, plus half of the 1.5 million acre-feet promised to Mexico as part of a 1944 treaty. But now some Upper Basin state managers are challenging the need to deliver the usual 7.5 million acre-feet a year—pointing out that legally they must deliver 75 million acre-feet every decade—and arguing that Lower Basin tributaries should contribute to Mexico's share.

One potential bargaining chip held by the Upper Basin is that a shortage of power would hurt the Lower Basin states as well, beyond increasing the cost of electricity to those who normally depend upon Glen Canyon Power sources. The utility provides about three-quarters of the $130 million Basin Fund revenues, some of which goes to protect endangered species, according to Ostler's report. So Arizona and New Mexico have more than a passing interest in reaching an interim agreement with the Upper Basin to avoid the need for official, and therefore heavily regulated, action.

Additional coverage of Colorado River Basin issues can be found in other University of Arizona publications, including Arizona Water Resource, available at http://www.ag.arizona.edu/AZWATER/awr/awrmain.html, and Southwest Hydrology, at http://www.swhydro.arizona.edu/.

Melanie Lenart is a post-doctoral research associate with the Climate Assessment for the Southwest.

Water managers share a range of viewpoints on the outlook for Colorado River water supplies

BY HOLLY HARTMANN

Do forecasts of El Niño, winter temperatures and precipitation, snowfall, and water supplies bode well for water managers in the Southwest? As with so many things in life, it depends on your perspective. A variety of viewpoints about future Colorado River Basin water supplies were in evidence at a recent interagency briefing held November 9 in Salt Lake City.

According to Tim Ryan, of the Bureau of Reclamation, Lake Powell and Lake Mead were at only 38 percent and 54 percent of 'live capacity' as of November 7, 2004. Lake Powell hasn't been this low since 1970, 6 years into the 16 years required for the reservoir to fill after completion of Glen Canyon Dam.

The Bureau sees the low levels as indicating successful water management, because the system was designed to have low water levels during times of drought. And there is no question the basin is experiencing drought. The 2000–2004 period has been the worst mid-range drought in historical records. Lake Powell had no above-average flows since September 1999, until they finally reappeared in October 2004.

Even with above-average flow, there's concern about the runoff efficiency of the basin. While precipitation has been about 85 percent of average, inflows to Lake Powell have been only about 50 percent of average. This results from soil moisture deficits, which Tom Pagano of the Natural Resources Conservation Service likened to high-interest credit card debts that take significant 'extra revenue' to pay back.

Soil moisture rose dramatically in parts of the Southwest with the extreme storms in October, to levels usually experienced only during spring snowmelt. But the Upper Colorado Basin notably missed out on that precipitation. Also, short-term relief of surface soil moisture should not be confused with long-term recovery to pre-drought groundwater, riverflow, or reservoir conditions. According to Doug LeCompte of the Climate Prediction Center, even the wettest winter on record in the region would raise the Palmer Drought Index (an indicator of soil moisture) only slightly.

The Colorado Basin River Forecast Center has been making early outlooks of Lake Powell inflows using their probabilistic forecast system. Their most recent outlook, computed November 7, gives a 50 percent chance of unregulated inflows above 6.7 million acre-feet (MAF) during April–July 2005, but also a 50 percent chance of having lower inflows. That's higher than the 5.1 MAF outlook estimated in August, but still lower than the long-term average of 7.9 MAF.

There may be some cause for optimism based on the weak El Niño declared earlier this year. El Niño is sometimes correlated with increased winter precipitation for the Southwest. But as Klaus Wolter of the Climate Diagnostics Center stressed, El Niño has many flavors. This event's ocean temperature patterns are quite unlike the 1982/83 and 1997/98 events that brought wet winters and high water supplies to the Southwest.

In fact the hope of El Niño may turn to pessimism when looking at similar El Niño events in the past. One analog includes the dramatically dry winter of 1976/77 and others suggest a drier winter is more likely than a wetter winter unless the El Niño strengthens rapidly over the late winter and spring. Another concern is the strong trend of warmer winter temperatures that can decimate snowpacks and dramatically reduce subsequent river flows, like in March 2004.

A pragmatic perspective is to consider how to avoid the worst consequences if Colorado River flows and reservoir levels continue to be low—Lake Powell is unlikely to be refilled in 2005. But El Niño, watershed conditions, and climate outlooks should be monitored and reconsidered in a couple months before taking any irreversible actions.

Holly Hartmann is an assistant research scientist in Hydrology and Water Resources at the University of Arizona

Temperature (through 11/17/04)

Sources: Western Regional Climate Center, High Plains Regional Climate Center

Much of the Southwest experienced below-average temperatures during the first two months of the current water year (Figure 1a). Except for central and southeastern Arizona and western New Mexico, the region is 1–3 degrees F cooler than average. The warmest temperatures continue to be in southwestern Arizona (Figure 1b). Figures 1c-d show that the past 30 days have been below average for nearly all of Arizona, while New Mexico has been near or below average. Similar to last month, one of the coolest areas was west-central Arizona.

The Albuquerque National Weather Service (NWS) forecast office reports that, despite a series of cold fronts affecting the state, near-average temperatures dominated New Mexico during October. The maximum temperatures, which were generally below-average in the latter part of October, were nearly balanced by above-average minimum temperatures. Through November 20, Albuquerque is 1 degree F above average, while Clayton and Roswell are 1–3 degrees F below average. Two late October cold fronts in Arizona contributed to the slightly cooler-than-average conditions across the state (Tucson NWS). Temperatures across the southern portion of Arizona in November are showing a mixed pattern with above-average values in Tucson and below-average values in Nogales.

Notes:

The water year begins on October 1 and ends on September 30 of the following year. Water year is more commonly used in association with precipitation; water year temperature can be used to measure the temperatures associated with the hydrological activity during the water year.

Average refers to the arithmetic mean of annual data from 1971–2000. Departure from average temperature is calculated by subtracting current data from the average. The result can be positive or negative.

The continuous color maps (Figures 1a, 1b, 1c) are derived by taking measurements at individual meteorological stations and mathematically interpolating (estimating) values between known data points. The dots in Figure 1d show data values for individual stations. Interpolation procedures can cause aberrant values in data-sparse regions.

Figures 1c and 1d are experimental products from the High Plains Regional Climate Center.

On the Web:

For these and other temperature maps, visit:
http://www.wrcc.dri.edu/recent_climate.html and
http://www.hprcc.unl.edu/products/current.html

For information on temperature and precipitation trends, visit:
http://www.cpc.ncep.noaa.gov/trndtext.htm

Figure 1a. Water year '04–'05 (through November 17, 2004) departure from average temperature.

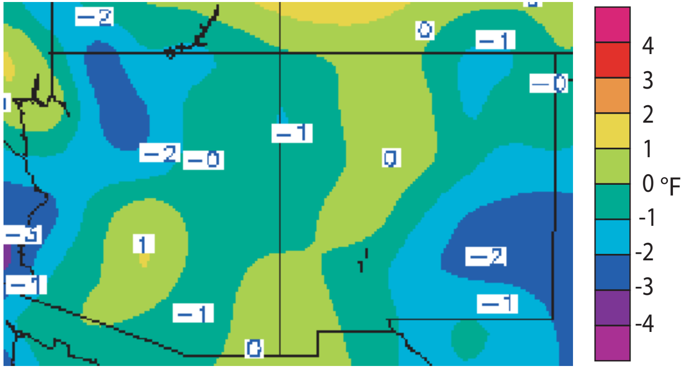


Figure 1b. Water year '04–'05 (through November 17, 2004) average temperature.

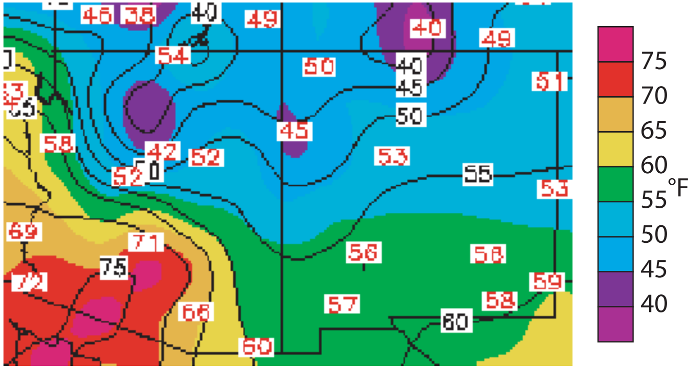


Figure 1c. Previous 30 days (October 19–November 17, 2004) departure from average temperature (interpolated).

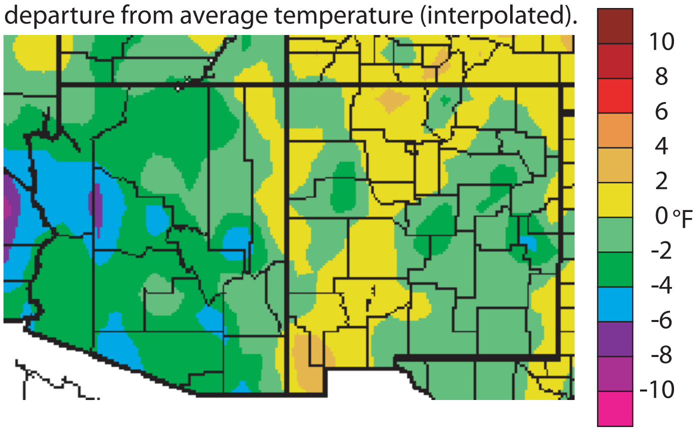
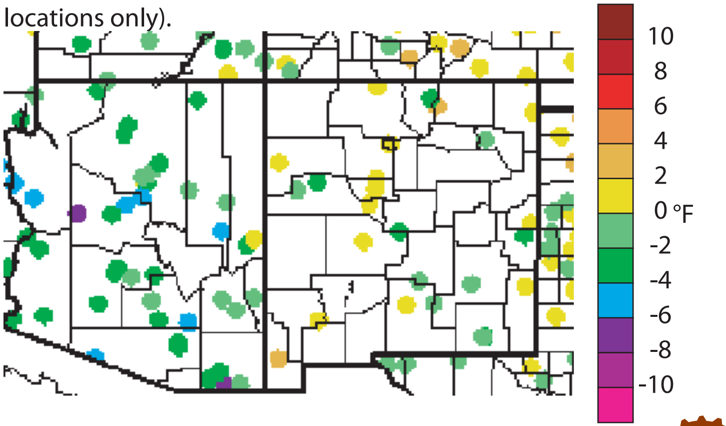


Figure 1d. Previous 30 days (October 19–November 17, 2004, 2004) departure from average temperature (data collection locations only).



Precipitation (through 11/17//04)

Source: High Plains Regional Climate Center

Water year precipitation is much above-average in western Arizona, in eastern New Mexico, and along the central Arizona-New Mexico border (Figures 2a-b). The remainder of the region remains dry, due to large deficits in the first few weeks of the water year. The pattern for the past 30 days (Figures 2c-d) is fairly similar to the water year map. Impacts from several storm systems that brought rain, and high-elevation snow is obvious in western Arizona and southeastern New Mexico. Portions of north-central New Mexico received up to 14 inches of snow [Albuquerque National Weather Service (NWS)].

The pattern of near- to above-average precipitation in New Mexico during October is carrying over into November. Some locations are 1.0–1.4 inches above-average through mid-month (Albuquerque NWS). Areas from Tucson south have had much less precipitation than the rest of Arizona. Tucson was more than 0.5 inches below average in October, despite some late-month storm systems; a similar trend continues in November (Tucson NWS). The above-average precipitation in northwestern Arizona could result in healthier winter vegetation and improved streamflow (*Arizona Republic*, November 12). Parts of the upper Colorado River basin received well-above-average precipitation, which has improved soil moisture. This will increase chances of enhanced runoff and streamflow this winter and spring.

Notes:

The water year begins on October 1 and ends on September 30 of the following year. As of October 1, 2004 we are in the 2005 water year. The water year is a more hydrologically sound measure of climate and hydrological activity than is the standard calendar year.

Average refers to the arithmetic mean of annual data from 1971–2000. Percent of average precipitation is calculated by taking the ratio of current to average precipitation and multiplying by 100.

The continuous color maps (Figures 2a, 2c) are derived by taking measurements at individual meteorological stations and mathematically interpolating (estimating) values between known data points. Interpolation procedures can cause aberrant values in data-sparse regions.

The dots in Figures 2b and 2d show data values for individual meteorological stations.

On the Web:

For these and other precipitation maps, visit:
http://www.hprcc.unl.edu/products/current.html

For National Climatic Data Center monthly precipitation and drought reports for Arizona, New Mexico, and the Southwest region, visit: http://lwf.ncdc.noaa.gov/oa/climate/research/2003/perspectives.html#monthly

Figure 2a. Water year '04–'05 through November 17, 2004 percent of average precipitation (interpolated).

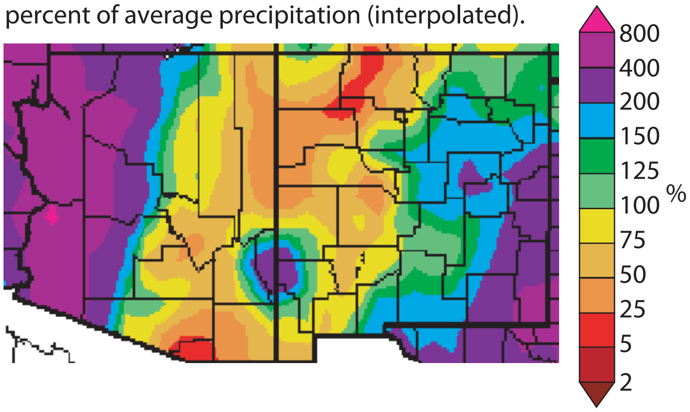


Figure 2b. Water year '04–'05 through November 17, 2004 percent of average precipitation (data collection locations only).

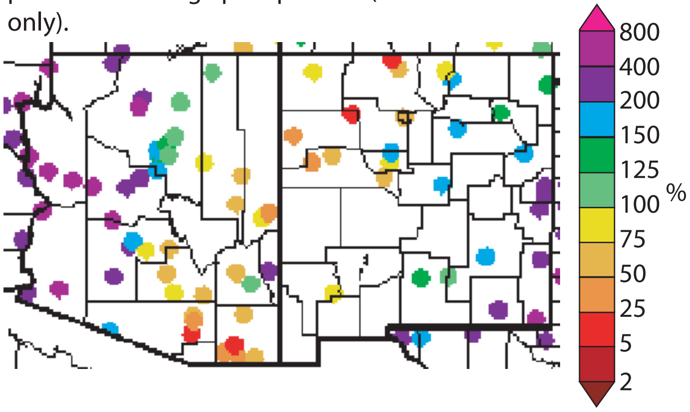


Figure 2c. Previous 30 days (October 19–November 17, 2004) percent of average precipitation (interpolated).

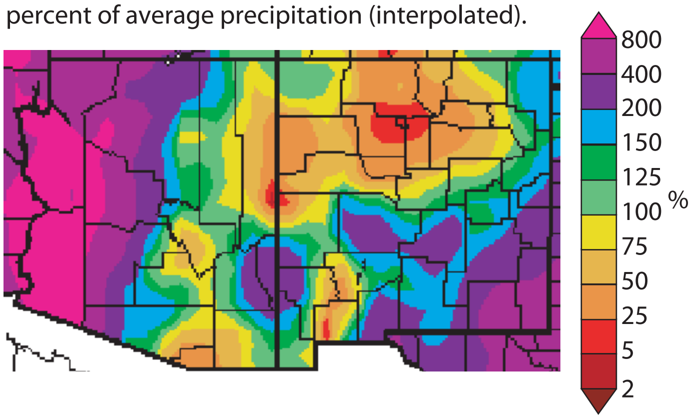
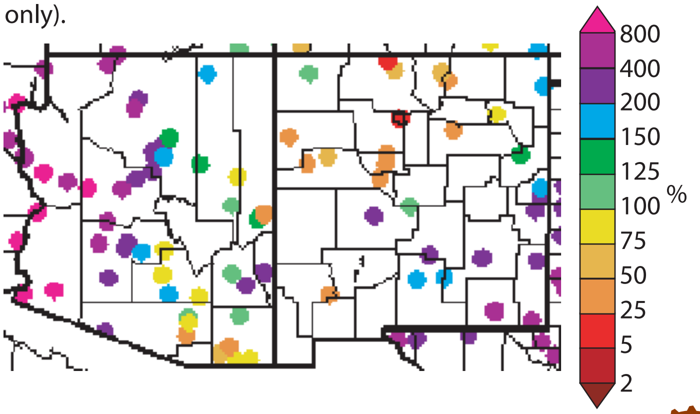


Figure 2d. Previous 30 days (October 19–November 17, 2004) percent of average precipitation (data collection locations only).



U.S. Drought Monitor

(released 11/18/04)

Sources: U.S. Department of Agriculture, National Drought Mitigation Center, National Oceanic and Atmospheric Administration

Drought intensity has eased in areas of the Southwest since October (Figure 3). The eastern edge of the drought region has been pushed westward as a result of beneficial rain in eastern and southeastern New Mexico. The boot heel of the state has also improved from extreme to severe status. Improvements can be seen in the western third of Arizona, which is now predominantly in moderate drought. South-central New Mexico and northwestern Arizona have seen some of the greatest improvement in the United States since late September. Except for parts of northeastern, southeastern, and central Arizona, the Southwest shows significant improvement from one year ago. Despite these changes, many reservoirs remain far below maximum storage (Figures 5 and 6).

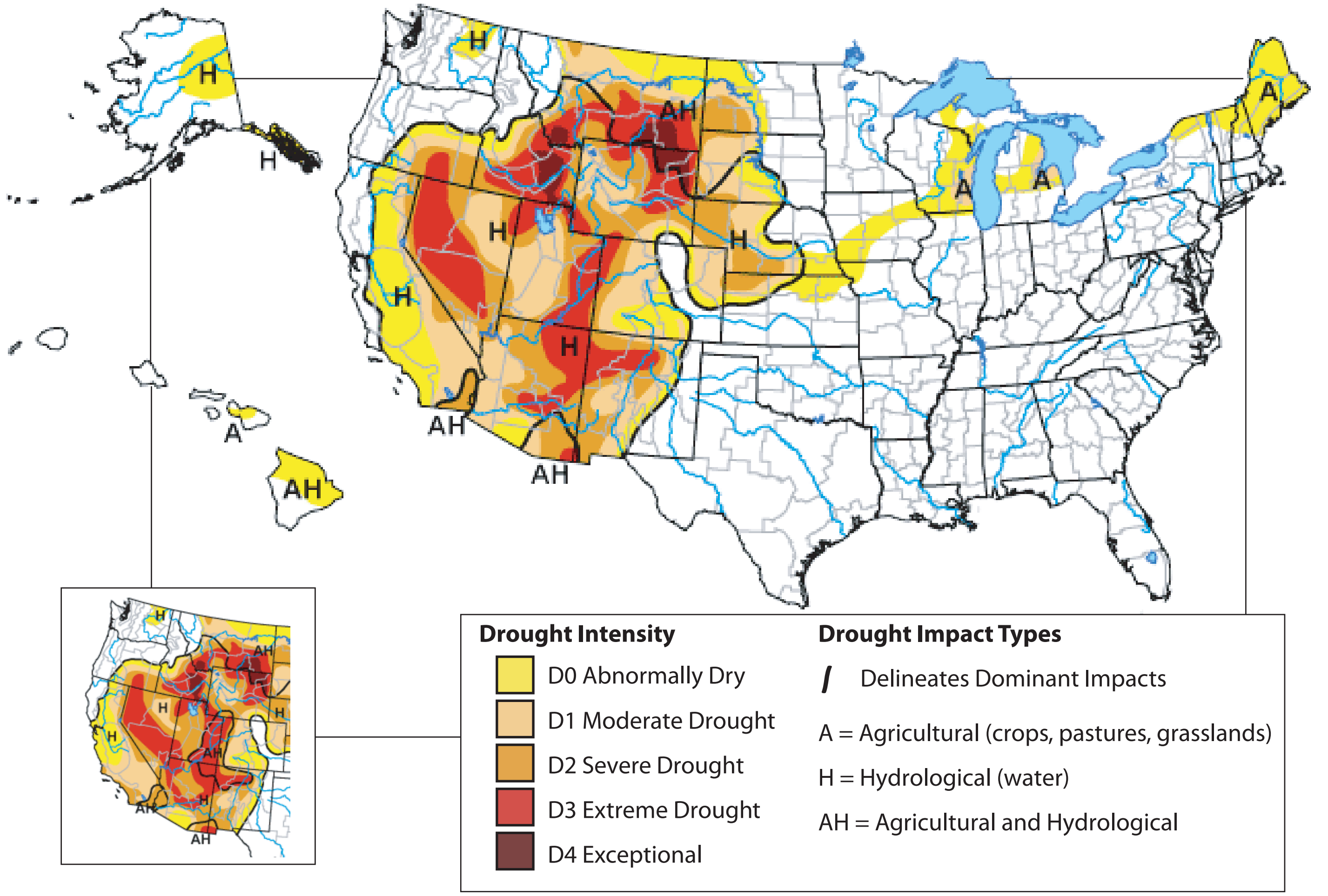
In late October and early November numerous Arizona cities encouraged residents to diminish their water use and increase conservation (*Arizona Republic*, November 11 and *East Valley Tribune*, November 3). At the Arizona Town Hall, federal officials urged the Colorado River states to develop contingency plans for Colorado River shortages (*Tucson Citizen*, November 1). Governor Janet Napolitano echoed this sentiment, and ordered state agencies and universities to cut water use by 5 percent (*U.S. Water News Online*, November 2004).

Notes:

The U.S. Drought Monitor is released weekly (every Thursday) and represents data collected through the previous Tuesday. The inset (lower left) shows the western United States from the previous month's map.

The U.S. Drought Monitor maps are based on expert assessment of variables including (but not limited to) the Palmer Drought Severity Index, soil moisture, streamflow, precipitation, and measures of vegetation stress, as well as reports of drought impacts. It is a joint effort of the several agencies; the authors of this monitor are Richard Heim and Candace Tankersley NCDC/NESDIS/NOAA.

Figure 3. Drought Monitor released November 18, 2004 (full size) and October 21, 2004 (inset, lower left).



On the Web:

The best way to monitor drought trends is to pay a weekly visit to the U.S. Drought Monitor website: http://www.drought.unl.edu/dm/monitor.html

New Mexico Drought Status

(through 10/22/04)

Source: New Mexico Natural Resources Conservation Service

Short-term drought impacts have improved for much of New Mexico over the past several months. Currently, conditions in the extreme eastern portion of the state are considered average for this time of year (Figure 4a). The area of alert status has pushed westward, further indicating the recovery of short-term conditions. Central New Mexico has improved from emergency to warning status. Drought intensity has increased in north-central and northwestern portions of the state. Hydrological drought conditions increased in the northwestern corner, as well as in the San Francisco and Mimbres River Basins (Figure 4b).

Nearly $600,000 in federal drought funding has been granted to New Mexico to allow the U.S. Bureau of Reclamation to lease Pecos River water from “willing parties” to guarantee sufficient water for the threatened Pecos blunt-nose shiner (*Santa Fe New Mexican*, November 6). With critical water problems in some parts of the state, the State Engineer may enforce tighter regulations on new domestic water wells and higher fees for well permits. A court has already demanded restrictions in southwestern New Mexico.(*Arizona Republic*, November 17). Last week, the U.S. House of Representatives approved, a measure to grant 14,000 acre-feet of Central Arizona Project water to New Mexico, plus at least $66 million in federal funding to tackle future water problems (*Santa Fe New Mexican*, November 18).

Notes:

The New Mexico drought status maps are produced monthly by the New Mexico Drought Monitoring Workgroup. When near-normal conditions exist, they are updated quarterly. The maps are based on expert assessment of variables including, but not limited to, precipitation, drought indices, reservoir levels, and streamflow.

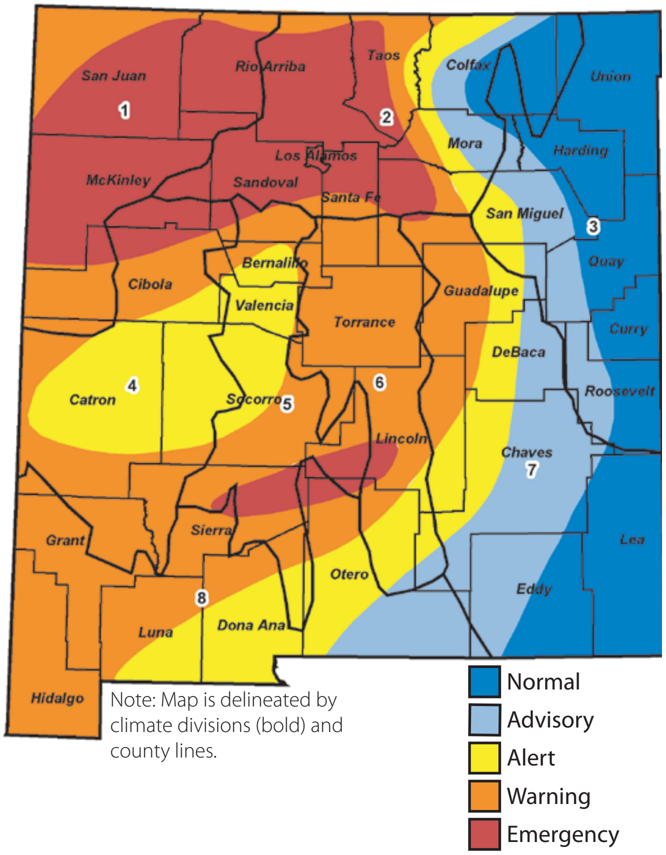
Figure 4a shows short-term or *meteorological* drought conditions. Meteorological drought is defined usually on the basis of the degree of dryness (in comparison to some “normal” or average amount) over a relatively short duration (e.g., months). Figure 4b refers to long-term drought, sometimes known as *hydrological* drought. Hydrological drought is associated with the effects of relatively long periods of precipitation shortfalls (e.g., many months to years) on water supplies (i.e., streamflow, reservoir, and lake levels, groundwater). This map is organized by river basins—the white regions are areas where no major river system is found.

On the Web:

For the most current New Mexico drought status map, visit:
http://www.nm.nrcs.usda.gov/snow/drought/drought.html

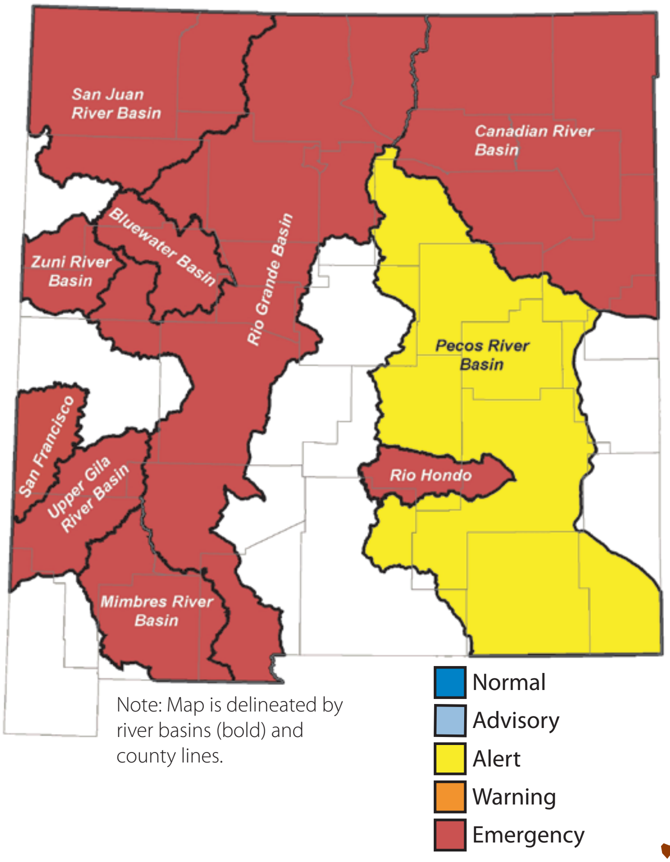
Information on Arizona drought can be found at:
http://www.water.az.gov/gdtf/

Figure 4a. Short-term drought map based on meteorological conditions as of October 22, 2004.



Note: Map is delineated by climate divisions (bold) and county lines.

Figure 4b. Long-term drought map based on hydrological conditions as of October 22, 2004.



Note: Map is delineated by river basins (bold) and county lines.

Arizona Reservoir Levels

(through 10/31/04)

Source: National Water and Climate Center

More than half of Arizona reservoirs remain near or below 50 percent of capacity (Figure 5). Only two showed a decrease in storage over the past month. Lake Mohave dropped nearly 100,000 acre-feet, decreasing the current capacity to 83 percent. Lake Powell levels slumped slightly by 21,000 acre-feet. Show Low Lake, Lyman Reservoir, and the Salt River System all remained steady, while storage increased slightly elsewhere. The largest increase occurred at Lake Havasu, which is now at 99 percent of capacity.

The U.S. Bureau of Reclamation (USBR) is releasing water from the Glen Canyon Dam as of the publication of this issue. Extra flow is planned to occur over 90 hours from November 21–25 (*L.A. Times*, November 10, and *Arizona Republic*, November 13). The goal is to agitate about 880,000 tons of sediment from behind the dam and redistribute it downstream "to enlarge existing beaches and sandbars, create new ones, and distribute sediment into drainage channels" (USBR, November 19). The release uses water from the water year budget, so it will not change the total discharge during the 2005 Water Year (*Salt Lake Tribune*, November 15).

A public meeting concerning long-range operating criteria for Colorado River reservoirs was held on November 19. Several changes have been proposed due to amendments to federal laws, outdated language in the current text, and outdated operating experience descriptions (*Federal Register*, November 3). Input will be accepted until December 6. See http://www.setonresourcecenter.com/register/2004/Nov/03/64096A.pdf for contact information.

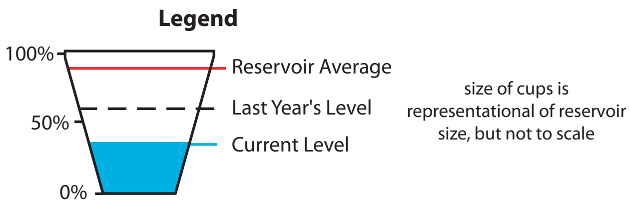
Notes:

The map gives a representation of current storage levels for reservoirs in Arizona. Reservoir locations are numbered within the blue circles on the map, corresponding to the reservoirs listed in the table. The cup next to each reservoir shows the current storage level (blue fill) as a percent of total capacity. Note that while the size of each cup varies with the size of the reservoir, these are representational and not to scale. Each cup also represents last year's storage level (red line) and the 1971–2000 reservoir average (dotted line).

The table details more exactly the current capacity level (listed as a percent of maximum storage). Current and maximum storage levels are given in thousands of acre-feet for each reservoir.

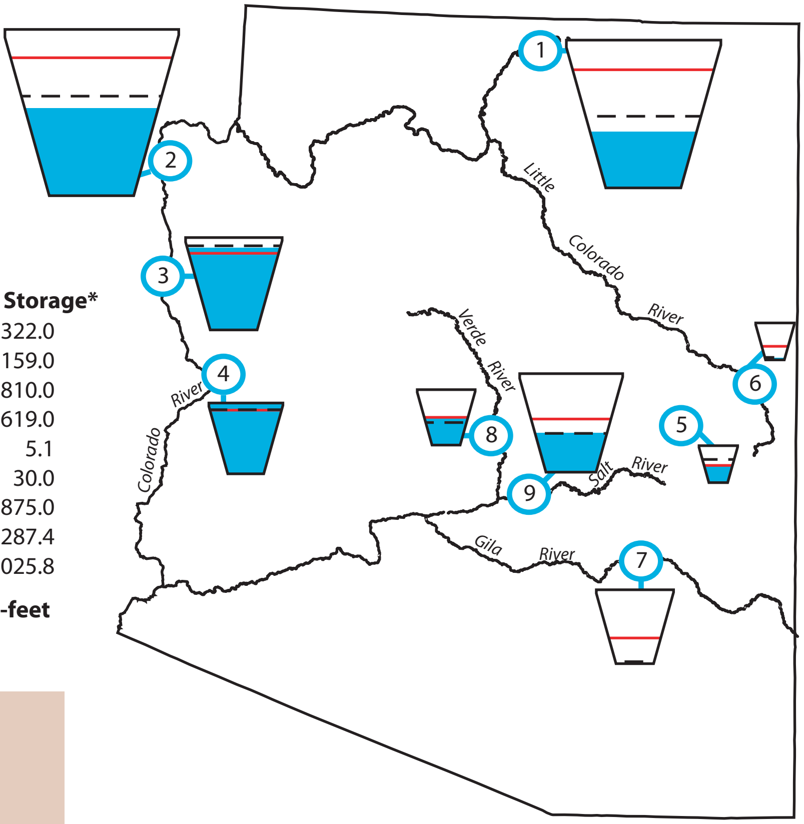
These data are based on reservoir reports updated monthly by the National Water and Climate Center of the U.S. Department of Agriculture's Natural Resource Conservation Service. For additional information, contact Tom Pagano at the National Water Climate Center (tpagano@wcc.nrcs.usda.gov; 503-414-3010) or Larry Martinez, Natural Resource Conservation Service, 3003 N. Central Ave, Suite 800, Phoenix, Arizona 85012-

Figure 5. Arizona reservoir levels for October 2004 as a percent of capacity. The map also depicts the average level and last year's storage for each reservoir, while the table lists current and maximum storage levels.



Reservoir Name	Capacity Level	Current Storage*	Max Storage*
1. Lake Powell	38%	9,148.0	24,322.0
2. Lake Mead	54%	14,094.0	26,159.0
3. Lake Mohave	83%	1,509.1	1,810.0
4. Lake Havasu	99%	611.4	619.0
5. Show Low Lake	47%	2.4	5.1
6. Lyman Reservoir	6%	1.8	30.0
7. San Carlos	2%	17.2	875.0
8. Verde River System	51%	146.6	287.4
9. Salt River System	40%	806.9	2,025.8

*** thousands of acre-feet**



On the Web:

Portions of the information provided in this figure can be accessed at the NRCS website:
http://www.wcc.nrcs.usda.gov/wsf/reservoir/resv_rpt.html

New Mexico Reservoir Levels

(through 10/31/04)

Source: National Water and Climate Center

All reservoirs in New Mexico shown in Figure 6 are below 65 percent of capacity, with 11 of the 13 at less than 30 percent. *The Albuquerque Journal* (November 1) reports that the Rio Grande Compact, which presides over the distribution of Rio Grande water between New Mexico, Colorado, and Texas, is complicating the replenishment of reservoirs on the Rio Grande and Rio Chama. The Compact prohibits storage in upstream reservoirs when Elephant Butte is low. According to the same article, the low level of the Navajo Reservoir has forced officials to decrease flow on the San Juan River for the upcoming winter to conserve water. State Engineer John D'Antonio says that basins and headwaters in New Mexico and surrounding states must have 4–5 years with above-average snowpack for the state's reservoirs to recover (*Albuquerque Journal*, November 1). Recent storm systems that brought rain and high-elevation snowfall (up to 14 inches of snow in some locations) are a good start, but the impact of the current El Niño is uncertain during the remainder of the fall and upcoming winter.

New management laws have been proposed that will require acquisition of a state permit to build livestock dams, ban the use of livestock dams for fish or aesthetic purposes, requires newspaper publication of changes to water rights, and prompt notification to the state about changes in water rights ownership (*Santa Fe New Mexican*, November 7). The State Engineer's Office is accepting public comments on the proposed regulations, which can be viewed at http://www.ose.state.nm.us.

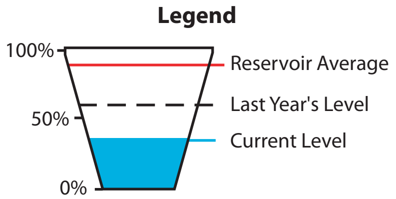
Notes:

The map gives a representation of current storage levels for reservoirs in New Mexico. Reservoir locations are numbered within the blue circles on the map, corresponding to the reservoirs listed in the table. The cup next to each reservoir shows the current storage level (blue fill) as a percent of total capacity. Note that while the size of each cup varies with the size of the reservoir, these are representational and not to scale. Each cup also represents last year's storage level (red line) and the 1971–2000 reservoir average (dotted line).

The table details more exactly the current capacity level (listed as a percent of maximum storage). Current and maximum storage levels are given in thousands of acre-feet for each reservoir.

These data are based on reservoir reports updated monthly by the National Water and Climate Center of the U.S. Department of Agriculture's Natural Resource Conservation Service. For additional information, contact Tom Pagano at the National Water Climate Center (tpagano@wcc.nrcs.usda.gov; 503-414-3010) or Dan Murray, NRCS, USDA, 6200 Jefferson NE, Albuquerque, NM 87109; 505-761-4436; Dan.Murray@nm.usda.gov).

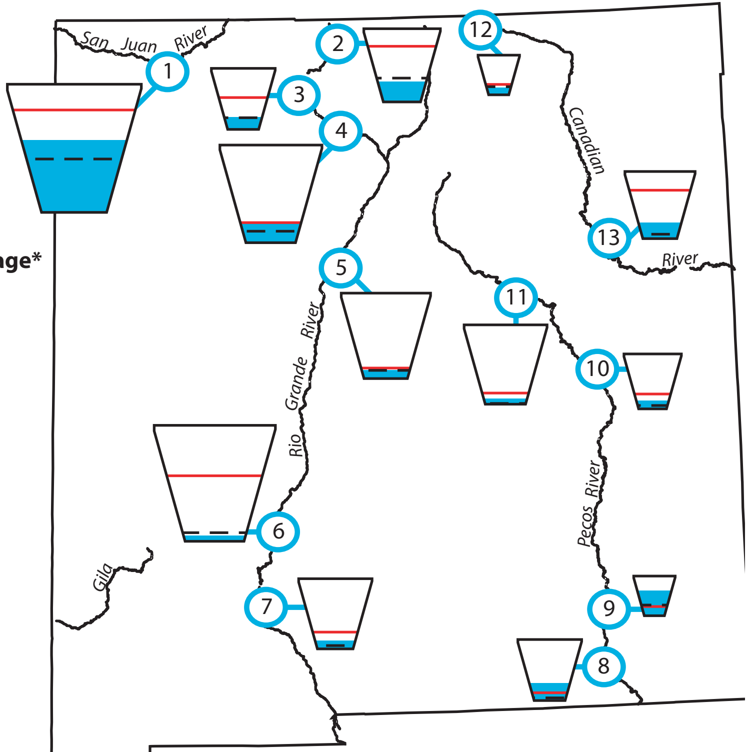
Figure 6. New Mexico reservoir levels for October 2004 as a percent of capacity. The map also depicts the average level and last year's storage for each reservoir, while the table lists current and maximum storage levels.



size of cups is representational of reservoir size, but not to scale

Reservoir Name	Capacity Level	Current Storage*	Max Storage*
1. Navajo	56%	946.5	1,696.0
2. Heron	28%	111.2	400.0
3. El Vado	20%	37.1	186.3
4. Abiquiu	21%	114.5	554.5
5. Cochiti	10%	49.2	502.3
6. Elephant Butte	5%	109.0	2,065.0
7. Caballo	6%	19.0	331.5
8. Brantley	29%	42.1	147.5
9. Lake Avalon	63%	3.8	6.0
10. Sumner	15%	15.4	102.0
11. Santa Rosa	7%	29.3	447.0
12. Costilla	18%	2.8	16.0
13. Conchas	24%	61.8	254.0

*** thousands of acre-feet**



On the Web:

Portions of the information provided in this figure can be accessed at the NRCS website:
http://www.wcc.nrcs.usda.gov/wsf/reservoir/resv_rpt.html

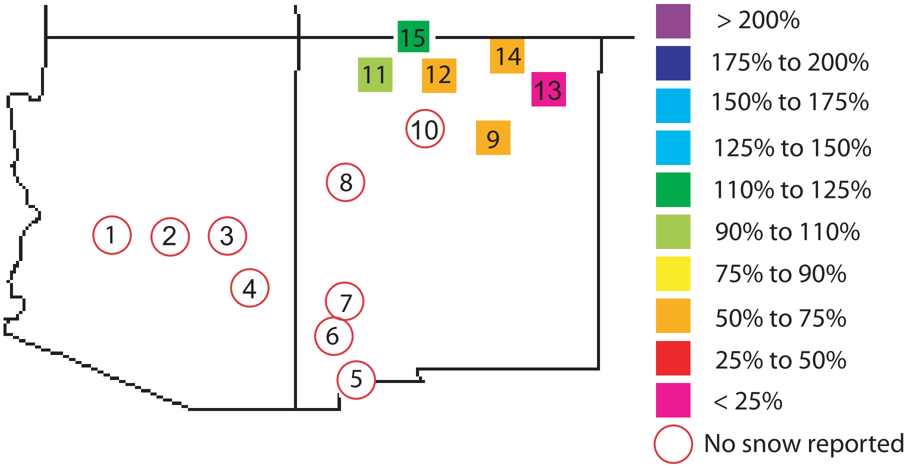
Southwest Snowpack

(updated 11/18/04)

Source: National Water and Climate Center, Western Regional Climate Center

Snowpack telemetry (SNOTEL) sites in northern New Mexico have reported snow water content values ranging from less than 25 percent of average in the Cimarron River Basin to 110–125 percent of average in the San Juan River Headwaters (Figure 7). SNOTEL sites in other parts of New Mexico and in Arizona did not report snow as of November 18, but the National Weather Service (NWS) reports that snow has fallen elsewhere. For example, the North Rim of the Grand Canyon had snow depths up to 18 inches in late October (Phoenix NWS), while high-elevation locations in the central and south-central New Mexico mountains, including Ruidoso and Cloudcroft, reported up to 14 inches of snow in mid-November (Albuquerque NWS). These snowfall amounts can ease the dry conditions, but additional snowpack is necessary to improve streamflow and reservoir levels.

Figure 7. Average snow water content (SWC) in percent of average for available monitoring sites as of November 18, 2004.



Arizona Basins
1 Verde River Basin
2 Central Mogollon Rim
3 Little Colorado - Southern Headwaters
4 Salt River Basin

New Mexico Basins
5 Mimbres River Basin
6 San Francisco River Basin
7 Gila River Basin
8 Zuni/Bluewater River Basin
9 Pecos River
10 Jemez River Basin
11 San Miguel, Dolores, Animas, and San Juan River Basins
12 Rio Chama River Basin
13 Cimarron River Basin
14 Sangre de Cristo Mountain Range Basin
15 San Juan River Headwaters

On the Web:

For color maps of SNOTEL basin snow water content, visit: http://www.wrcc.dri.edu/snotelanom/basinswe.html

For a numeric version of the map, visit: http://www.wrcc.dri.edu/snotelanom/basinswen.html

For a list of river basin snow water content and precipitation, visit: http://www.wrcc.dri.edu/snotelanom/snotelbasin

Notes:

Snowpack telemetry (SNOTEL) sites are automated stations that measure snowpack depth, temperature, precipitation, soil moisture content, and soil saturation. A parameter called snow water content (SWC) or snow water equivalent (SWE) is calculated from this information. SWC refers to the depth of water that would result by melting the snowpack at the SNOTEL site and is important in estimating runoff and streamflow. It depends mainly on the density of the snow. Given two snow samples of the same depth, heavy, wet snow will yield a greater SWC than light, powdery snow.

Figure 7 shows the SWC for selected river basins, based on SNOTEL sites in or near the basins, compared to the 1971–2000 average values. The number of SNOTEL sites varies by basin. Basins with more than one site are represented as an average of the sites. Individual sites do not always report data due to lack of snow or instrument error.

Temperature Outlook

(December 2004–May 2005)

Source: NOAA Climate Prediction Center

Virtually the entire West is predicted to have increased chances of above-average temperatures from December 2004–May 2005, although the area and percentages vary (Figures 8a-d). The probabilities for above-average temperatures are remarkably high in parts of Arizona, southeastern California, and southern Nevada for January–May 2005. New Mexico is mostly split between no forecasted anomalies and increased chances of above-average temperatures through May 2005. However, from March–May 2005 the extreme eastern edge of New Mexico shows increased chances for below-average temperatures. Through early spring, the forecasts are based on the high level of agreement in forecast models, while the late spring outlooks only reflect trends toward warmer conditions. As in recent months, the International Research Institute for Climate Prediction forecasts (not shown) are similar to Figures 8a-d.

Notes:

These outlooks predict the likelihood (chance) of above-average, average, and below-average temperature, but not the magnitude of such variation. The numbers on the maps do not refer to degrees of temperature.

The NOAA-CPC outlooks are a 3-category forecast. As a starting point, the 1971–2000 climate record is divided into 3 categories, each with a 33.3 percent chance of occurring (i.e., equal chances, EC). The forecast indicates the likelihood of one of the extremes—above-average (A) or below-average (B)—with a corresponding adjustment to the other extreme category; the "average" category is preserved at 33.3 likelihood, unless the forecast is very strong.

Thus, using the NOAA-CPC temperature outlook, areas with light brown shading display a 33.3–39.9 percent chance of above-average, a 33.3 percent chance of average, and a 26.7–33.3 percent chance of below-average temperature. A shade darker brown indicates a 40.0–50.0 percent chance of above-average, a 33.3 percent chance of average, and a 16.7–26.6 percent chance of below-average temperature, and so on.

Equal Chances (EC) indicates areas where the reliability (i.e., 'skill') of the forecast is poor; areas labeled EC suggest an equal likelihood of above-average, average, and below-average conditions, as a "default option" when forecast skill is poor.

Figure 8a. Long-lead national temperature forecast for December 2004–February 2005.

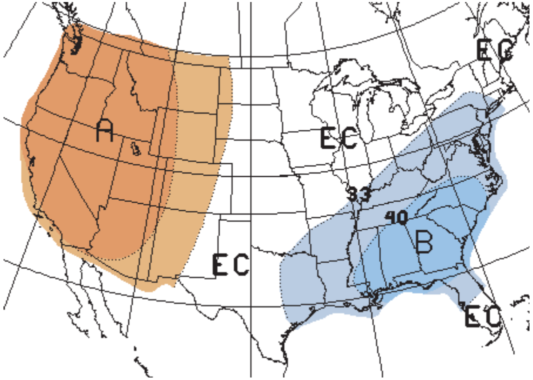


Figure 8b. Long-lead national temperature forecast for January–March 2005.

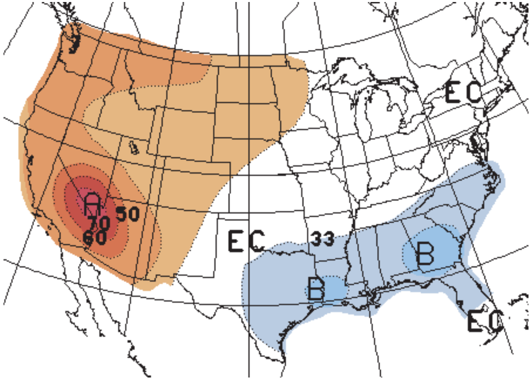


Figure 8c. Long-lead national temperature forecast for February–April 2005.

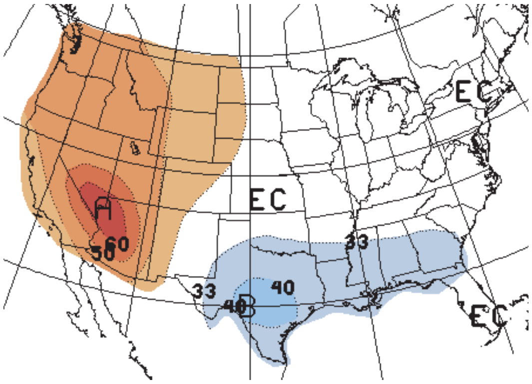
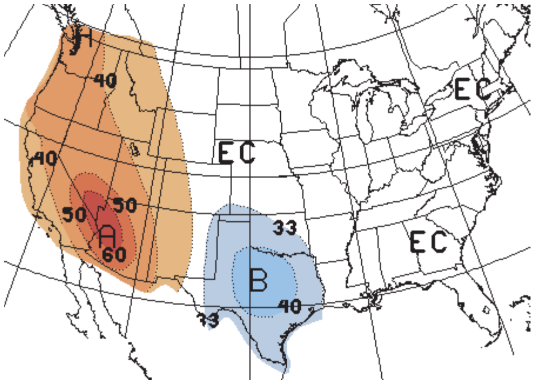


Figure 8d. Long-lead national temperature forecast for March–May 2005.



A= Above
- 🟥 70.0–79.9%
- 🟥 60.0–69.9%
- 🟧 50.0–59.9%
- 🟧 40.0–49.9%
- 🟧 33.3–39.9%

B= Below
- 🟦 33.3–39.9%
- 🟦 40.0–49.9%

EC= Equal chances. No forecasted anomalies.

On the Web:

For more information on CPC forecasts, visit:
http://www.cpc.ncep.noaa.gov/products/predictions/multi_season/13_seasonal_outlooks/color/churchill.html
(note that this website has many graphics and may load slowly on your computer)

For IRI forecasts, visit:
http://iri.columbia.edu/climate/forecast/net_asmt/

Precipitation Outlook

(December 2004–May 2005)

Source: NOAA Climate Prediction Center

The long-lead precipitation forecasts from the NOAA-CPC basically show a north-south split in the United States from December 2004–May 2005 (Figures 9a-d). New Mexico is forecast to have increased chances of wetter-than-average conditions throughout the period, while the same is not expected in Arizona until January–May 2005 (Figures 9b-d). These forecasts reflect the influence of weak El Niño conditions. If these predictions are realized, short-term drought intensity will decrease, although long-term precipitation deficits will likely persist. Experimental forecasts from the Climate Diagnostics Center favor slightly increased chances of wetter-than-average conditions over most of the Southwest (CDC website). If El Niño weakens, these forecasts point to a dry winter and early spring in northwestern New Mexico, which is already in extreme drought.

Notes:

These outlooks predict the likelihood (chance) of above-average, average, and below-average precipitation, but not the magnitude of such variation. The numbers on the maps do not refer to inches of precipitation.

The NOAA-CPC outlooks are a 3-category forecast. As a starting point, the 1971–2000 climate record is divided into 3 categories, each with a 33.3 percent chance of occurring (i.e., equal chances, EC). The forecast indicates the likelihood of one of the extremes—above-average (A) or below-average (B)—with a corresponding adjustment to the other extreme category; the "average" category is preserved at 33.3 likelihood, unless the forecast is very strong.

Thus, using the NOAA-CPC precipitation outlook, areas with light green shading display a 33.3–39.9 percent chance of above-average, a 33.3 percent chance of average, and a 26.7–33.3 percent chance of below-average precipitation. A shade darker green indicates a 40.0–50.0 percent chance of above-average, a 33.3 percent chance of average, and a 16.7–26.6 percent chance of below-average precipitation, and so on.

Equal Chances (EC) indicates areas where the reliability (i.e., 'skill') of the forecast is poor; areas labeled EC suggest an equal likelihood of above-average, average, and below-average conditions, as a "default option" when forecast skill is poor.

Figure 9a. Long-lead national precipitation forecast for December 2004–February 2005.

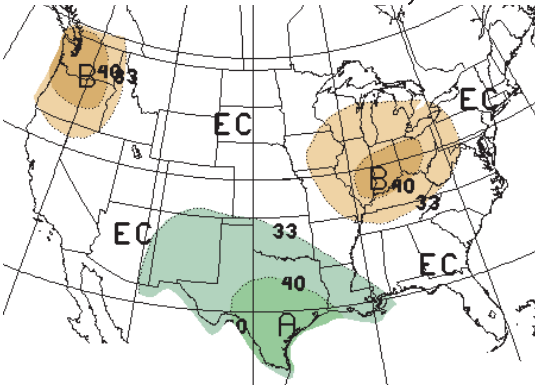


Figure 9b. Long-lead national precipitation forecast for January–March 2005.

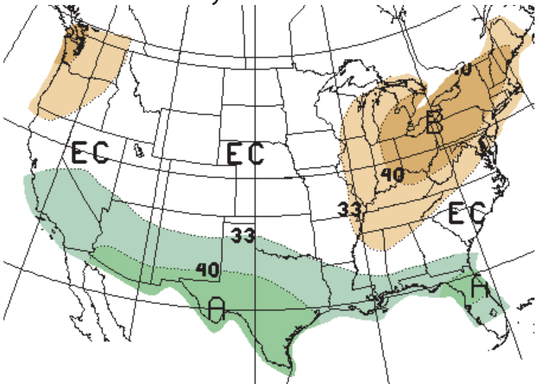


Figure 9c. Long-lead national precipitation forecast for February–April 2005.

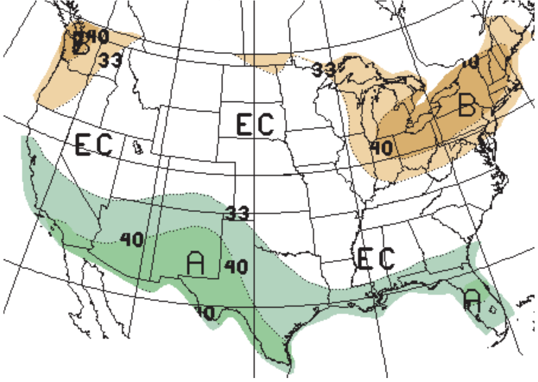
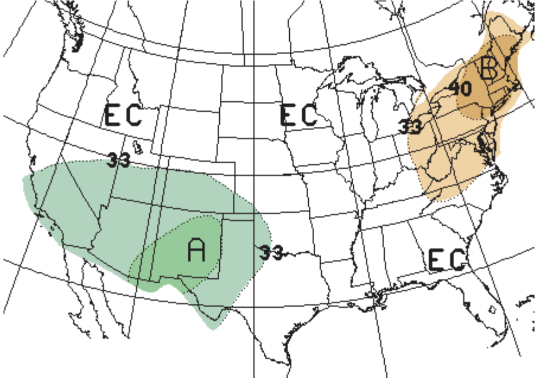


Figure 9d. Long-lead national precipitation forecast for March–May 2005.



A= Above
🟩 40.0–49.9%
🟩 33.3–39.9%

B= Below
🟧 33.3–39.9%
🟫 40.0–49.9%

EC= Equal chances. No forecasted anomalies.

On the Web:

For more information on CPC forecasts, visit:
http://www.cpc.ncep.noaa.gov/products/predictions/multi_season/13_seasonal_outlooks/color/churchill.html
(note that this website has many graphics and may load slowly on your computer)

For IRI forecasts, visit:
http://iri.columbia.edu/climate/forecast/net_asmt/

Seasonal Drought Outlook

(through February 2005)

Sources: NOAA Climate Prediction Center

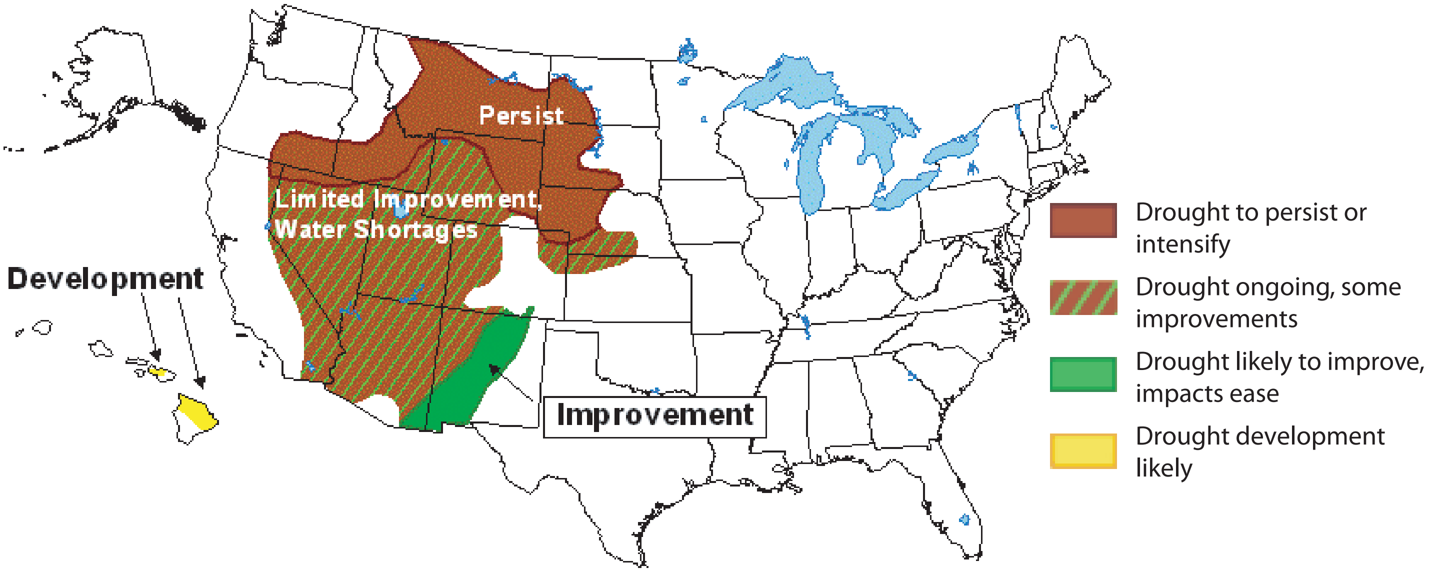
According to the NOAA-Climate Prediction Center (CPC), much of the western United States should see at least limited improvement in drought status through February 2005 (Figure 10). The only exception is in the northern Rocky Mountains and the northwestern Great Plains, where the dry conditions are expected to persist. Conditions are most likely to improve from north-central New Mexico to extreme southeastern Arizona. This is due in part to the continuing weak El Niño, which the International Research Institute for Climate Prediction (IRI) and NOAA forecast to continue into early to mid-spring (see Figures 12a and 12b). Along with the uncertain impact of the current and forecasted El Niño, weather and climate experts warn that just one winter of above-average precipitation will not adequately replenish groundwater and reservoirs. David Runyan of the Phoenix National Weather Service says that at least 2–3 years of wetter-than-average years would be necessary (*East Valley Tribune*, November 3).

Governor Bill Richardson of New Mexico and Governor Janet Napolitano of Arizona have recently been discussing water issues in their respective states. Governor Richardson has deemed water projects a top priority during the next legislative session, which begins in January (*Santa Fe New Mexican*, November 11). A currently unknown portion of the approximately $340 million of capital outlay money will be set aside for water supply issues. Governor Napolitano has asked rural areas to prepare plans of projected water needs (*Eastern Arizona Courier*, October 25). If they fail to do so, the state will develop plans for them. The recently completed Arizona Drought Preparedness Plan proposes that every city develop a drought plan (KVOA TV, November 11). At the 85th Arizona Town Hall held earlier this month, Napolitano called for a "virtual water university," which would bring together programs from the three state universities, to make Arizona a world leader in drought and arid land studies (*U.S. Water News*, November 2004, and *Payson Roundup*, November 9).

Notes:

The delineated areas in the Seasonal Drought Outlook (Figure 10) are defined subjectively and are based on expert assessment of numerous indicators, including outputs of short- and long-term forecasting models.

Figure 10. Seasonal drought outlook through February 2005 (release date November 18, 2004).



On the Web:

For more information, visit:
http://www.drought.noaa.gov/

Wildland Fire Outlook

Sources: National Interagency Coordination Center, Southwest Coordination Center

The NICC wildland fire outlook shows no areas of above-average large fire potential (Figure 11a). The Southwest is considered to have average large fire potential. According to NICC, any large fires that ignite would be short-lived. Prescribed fire activity was hampered during the first part of November by a series of storm systems. Similar issues are expected during the remainder of November.

The 2004 fire season was a below-average fire year for the entire United States, except Alaska (*National Fire News*, November 1). NICC attributed the lower-than-expected severity to fewer dry thunderstorms and high rates of success in initial attack. Wildland fire activity decreases quickly at the end of the year, thus the nationwide fire statistics as of October 22—7,912, 571 acres burned, over $500 million in suppression costs, and 1,084 structures destroyed—are not expected to change dramatically.

Notes:

The National Interagency Fire Center produces monthly wildland fire outlooks. These predictions (Figure 11a) consider climate forecasts and surface fuel conditions to assess fire potential for fires greater than 100 acres. They are subjective assessments based on a synthesis of regional fire danger outlooks.

The Southwest Area Wildland Fire Operations produces monthly fuel conditions and outlooks. Fuels are any live or dead vegetation that are capable of burning. Fuel moisture is the ratio of the weight of the water contained in the fuel to its dry weight, expressed as a percentage. Monitoring live fuel moisture aids in the prediction of fire behavior and is an important tool for managing prescribed fires. It is affected largely by the availability of soil moisture. The top of Figure 11b indicates the current condition and amount of growth of fine (small) fuels. The middle of the figure shows live fuel moisture level as percent of average conditions.

Dead fuel moisture is regulated by the environmental conditions to which the dead fuel is exposed, such as temperature, humidity, and wind speed. It is classed by timelag. A fuel's timelag is proportional to its diameter and is loosely defined as the time it takes a fuel particle to reach 2/3 of its way to equilibrium with its local environment. Plants or portions of plants with diameters of 3-8 inches are classified as 1000-hour fuels. 1000-hour dead fuel moisture is calculated from weekly average values of day length, hours of rain, and daily temperature and humidity ranges, which define local environmental conditions. The bottom segment of Figure 11b indicates the percent of average moisture for dead 1000-hour fuels compared to long-term averages (top row), as well as the average range for the time of year (bottom row).

On the Web:

National Wildland Fire Outlook web page:
http://www.nifc.gov/news/nicc.html

Southwest Area Wildland Fire Operations (SWCC) web page:
http://www.fs.fed.us/r3/fire/

Figure 11a. National wildland fire potential for fires greater than 100 acres (valid November 1–30, 2004).

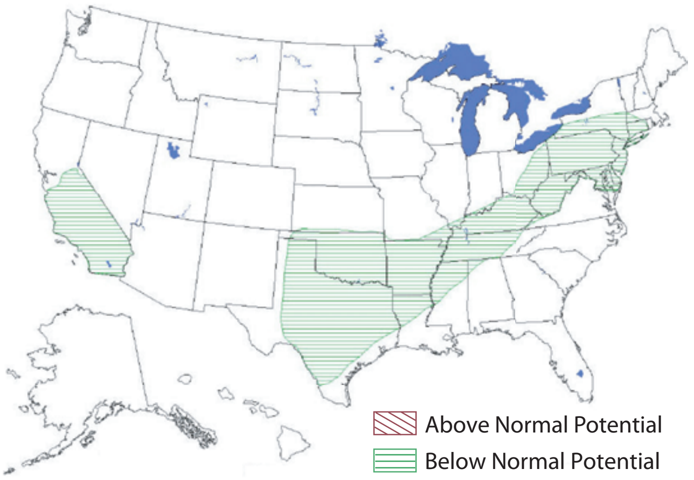


Figure 11b. Current fine fuel condition, live fuel moisture, and average dead fuel moisture status in the Southwest.

Current Fine Fuels						
Grass Stage	Green		Cured	x		
New Growth	Sparse		Normal	x	Above Normal	

Live Fuel Moisture	Percent of Average
Ponderosa Pine	110–138
Douglas Fir	119–190
Piñon	80–130
Juniper	80–112
Sagebrush	90–110

Dead Fuel Mositure	Percent of Average
1000-hour dead fuel moisture	12–22
Average 1000-hour fuel moisture for this time of year	12–18

El Niño Status and Forecast

Sources: NOAA Climate Prediction Center, International Research Institute for Climate Prediction

The Southern Oscillation Index continues to increase slightly, but remains indicative of a weak El Niño (Figure 12b). For winter 2004–spring 2005, the ENSO forecast from the International Research Institute for Climate Prediction (IRI) predicts a much higher than average probability of an El Niño episode (Figure 12a). High probabilities for El Niño continue until April–June 2005, when neutral conditions and El Niño conditions each have a nearly equal chance of incidence. Higher probabilities for neutral conditions then persist through August–October. Based on the latest trends in oceanic and atmospheric patterns in the tropical Pacific Ocean and on many of their model forecasts, the NOAA-Climate Prediction Center (CPC) also expects El Niño conditions to continue into the early part of 2005.

With current conditions still representative of only a weak El Niño, forecasters are hesitant to make a declaration about wet, average, or dry conditions until a clearer ENSO picture develops. David Runyan of the Phoenix National Weather Service says that an above-average precipitation year is very possible (*East Valley Tribune*, November 3). Runyan and others continue to remind the public that more than one year of wetter-than-average conditions is necessary to help ground water recover. With the low reservoir levels around the Southwest, it will likely be longer before they improve significantly. Case in point, after the 1950s drought Lake Mead did not reach capacity for nearly 25 years (see page 19). Climate experts also hesitate to attribute the recent winter-like storms to El Niño (*Arizona Republic*, November 6).

Notes:

Figure 12a shows the International Research Institute for Climate Prediction (IRI) probabilistic El Niño-Southern Oscillation (ENSO) forecast for overlapping three month seasons. The forecast expresses the probabilities (chances) of the occurrence of three ocean conditions in the ENSO-sensitive Niño 3.4 region, as follows: El Niño, defined as the warmest 25 percent of Niño 3.4 sea-surface temperatures (SSTs) during the three month period in question; La Niña conditions, the coolest 25 percent of Niño 3.4 SSTs; and neutral conditions where SSTs fall within the remaining 50 percent of observations. The IRI probabilistic ENSO forecast is a subjective assessment of current model forecasts of Niño 3.4 SSTs that are made monthly. The forecast takes into account the indications of the individual forecast models (including expert knowledge of model skill), an average of the models, and other factors.

Figure 12b shows the standardized three month running average values of the Southern Oscillation Index (SOI) from January 1980 through September 2004. The SOI measures the atmospheric response to SST changes across the Pacific Ocean Basin. The SOI is strongly associated with climate effects in the Southwest. Values greater than 0.5 represent La Niña conditions, which are frequently associated with dry winters and sometimes with wet summers. Values less than -0.5 represent El Niño conditions, which are often associated with wet winters.

On the Web:

For a technical discussion of current El Niño conditions, visit:
http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/enso_advisory/

For more information about El Niño and to access graphics similar to the figures on this page, visit:
http://iri.columbia.edu/climate/ENSO/

Figure 12a. IRI probabilistic ENSO forecast for El Niño 3.4 monitoring region (released November 18, 2004). Colored lines represent average historical probability of El Niño, La Niña, and neutral.

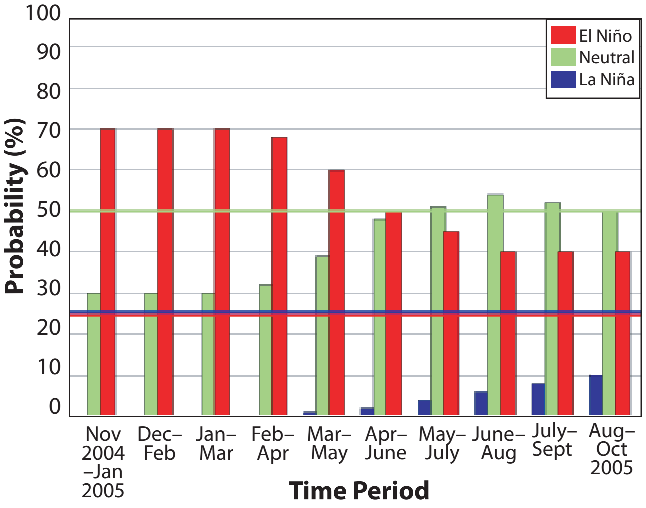
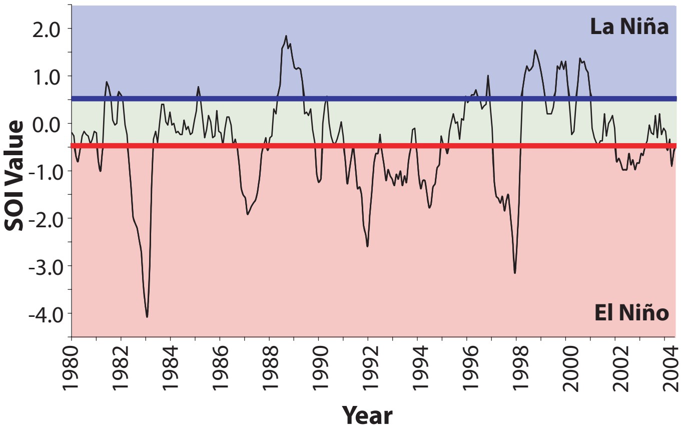


Figure 12b. The standardized values of the Southern Oscillation Index from January 1980–October 2004. La Niña/El Niño occurs when values are greater than 0.5 (blue) or less than -0.5 (red) respectively. Values between these thresholds are relatively neutral (green).



Temperature Verification

(August–October 2004)

Source: NOAA Climate Prediction Center

The NOAA-Climate Prediction Center long-lead forecast for August–October called for increased chances of below-average temperatures for the northern Great Plains and increased chances of above-average temperatures for much of the West and Florida (Figure 13a). The Southwest, most notably Arizona, had the greatest probabilities. Arizona and New Mexico generally had below-average conditions (Figure 13b) due to a series of winter-like storm systems. Temperatures in west-central and east-central Arizona were 3–5 degrees cooler than the 1971–2000 average. Extreme southeastern and southwestern New Mexico and extreme northeastern Arizona were warmer-than-average. Most of the remainder of the United States experienced average to slightly warmer-than-average conditions. Northeastern Texas and north-central Washington state had departures of 4–5 degrees F above average. The forecast models performed well in Florida, the Dakotas, and the northwestern United States, but they did not indicate the warmer-than-average temperatures in the western Great Lakes or along the Gulf Coast.

Notes:

Figure 13a shows the NOAA Climate Prediction Center (CPC) temperature outlook for the months August–October 2004. This forecast was made in July 2004.

The August–October 2004 NOAA CPC outlook predicts the likelihood (chance) of above-average, average, and below-average temperature, but not the magnitude of such variation. The numbers on the maps do not refer to degrees of temperature. Care should be exercised when comparing the forecast (probability) map with the observed temperature maps described below.

Using past climate as a guide to average conditions and dividing the past record into 3 categories, there is a 33.3 percent chance of above-average, a 33.3 percent chance of average, and a 33.3 percent chance of below-average temperature. Thus, using the NOAA CPC likelihood forecast, in areas with light brown shading there is a 33.3–39.9 percent chance of above-average, a 33.3 percent chance of average, and a 26.7–33.3 percent chance of below-average precipitation. Equal Chances (EC) indicates areas where reliability (i.e., the skill) of the forecast is poor and no prediction is offered.

Figure 13b shows the observed departure of temperature (°F) from the average for August–October 2004.

In all of the figures on this page, the term average refers to the 1971–2000 average. This practice is standard in the field of climatology.

Figure 13a. Long-lead U.S. temperature forecast for August–October 2004 (issued July 2004).

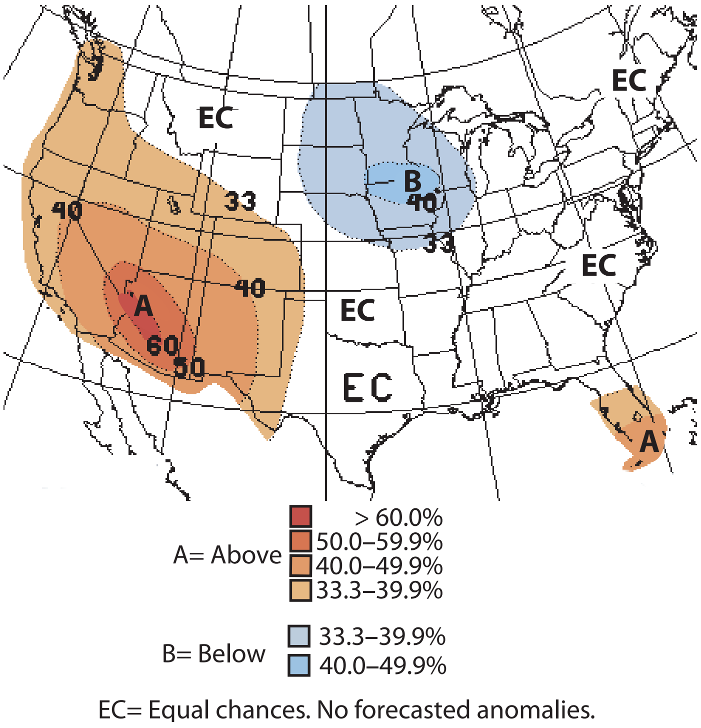
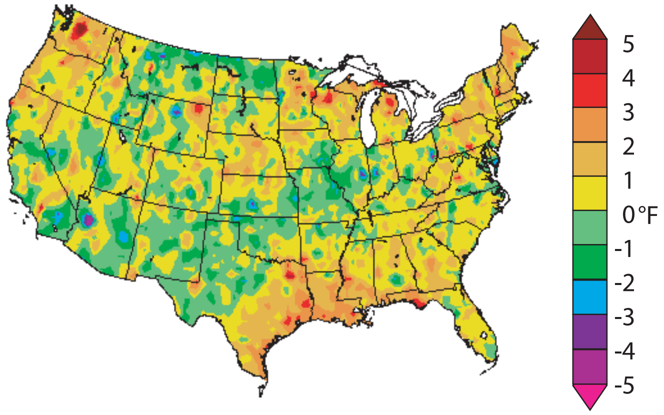


Figure 13b. Average temperature departure (in degrees F) for August–October 2004.



On the Web:

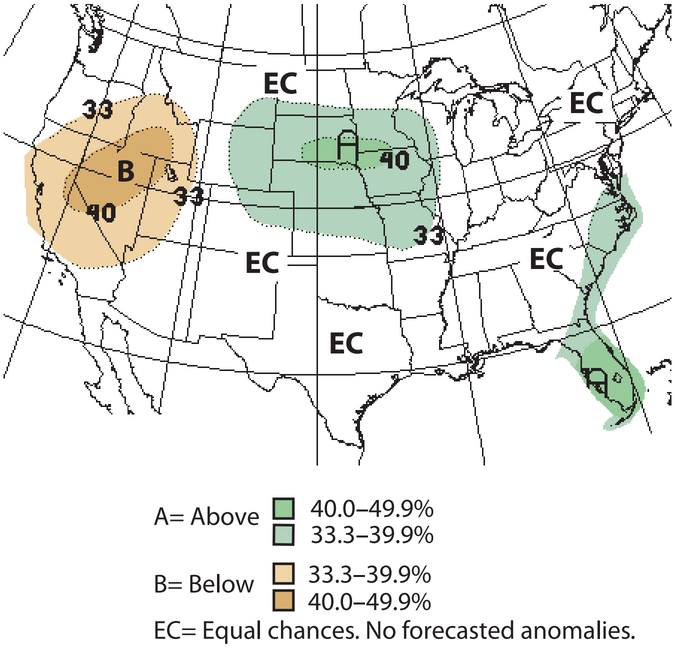
For more information on CPC forecasts, visit:
http://www.cpc.ncep.noaa.gov/products/predictions/multi_season/13_seasonal_outlooks/color/churchill.html

Precipitation Verification
(August–October 2004)

Source: NOAA Climate Prediction Center

The NOAA-CPC precipitation forecasts indicated increased chances of above-average precipitation from Florida to Virginia and in the northern Great Plains for August–October (Figure 14a). The central West Coast and Intermountain West were forecast to have increased chances of below-average precipitation. Judgment was withheld elsewhere. Much of the East Coast did experience wetter-than-average conditions, most notably in Florida, as several hurricanes and tropical storms affected the region (Figure 14b). The West had much variability in precipitation. The most prominent wet areas were northwestern Arizona, extreme southeastern New Mexico, Nevada, and the California coast. These areas were impacted by a series of winter-like storm systems, which dropped unseasonably high snowfall in the Sierra Nevadas. The Plains states showed a large range in precipitation, from 25-50 percent of average in Nebraska and Kansas to more than 200 percent of average in South Dakota and west-central Minnesota. The long-range forecasts performed best in the East and portions of the northern Great Plains, but missed the above-average precipitation in the West.

Figure 14a. Long-lead U.S. precipitation forecast for August–October 2004 (issued July 2004).



Notes:

Figure 14a shows the NOAA Climate Prediction Center (CPC) precipitation outlook for the months August–October 2004. This forecast was made in July 2004.

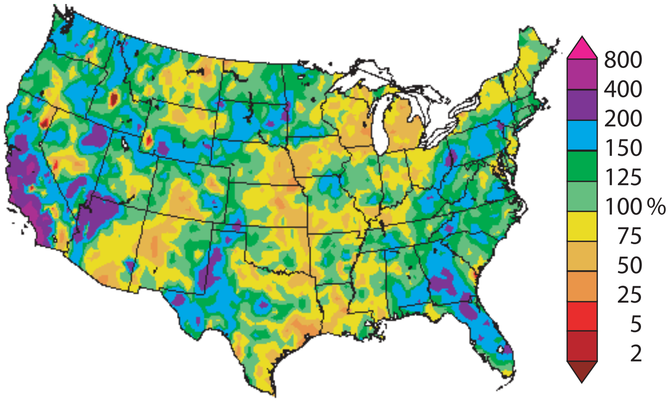
The August–October 2004 NOAA CPC outlook predicts the likelihood (chance) of above-average, average, and below-average precipitation, but not the magnitude of such variation. The numbers on the maps do not refer to inches of precipitation. Care should be exercised when comparing the forecast (probability) map with the observed precipitation maps described below.

Using past climate as a guide to average conditions and dividing the past record into 3 categories, there is a 33.3 percent chance of above-average, a 33.3 percent chance of average, and a 33.3 percent chance of below-average precipitation. Thus, using the NOAA CPC likelihood forecast, in areas with light brown shading there is a 33.3–39.9 percent chance of above-average, a 33.3 percent chance of average, and a 26.7–33.3 percent chance of below-average precipitation. Equal Chances (EC) indicates areas where reliability (i.e., the skill) of the forecast is poor and no prediction is offered.

Figure 14b shows the observed percent of average precipitation observed August–October 2004.

In all of the figures on this page, the term average refers to the 1971–2000 average. This practice is standard in the field of climatology.

Figure 14b. Percent of average precipitation observed from August–October 2004.



On the Web:

For more information on CPC forecasts, visit:
http://www.cpc.ncep.noaa.gov/products/predictions/multi_season/13_seasonal_outlooks/color/churchill.html

USBR Lower Colorado Region

Source: U.S. Bureau of Reclamation

The October issue of the Southwest Climate Outlook introduced the web pages for the Upper Colorado Region of the U.S. Bureau of Reclamation. This month we spotlight the Lower Colorado Region web pages, which offer historical, current, and projected operations information at Lake Mead, Lake Mohave, and Lake Havasu. Figure 15a shows high and low elevations of Lake Mead. The initial increase depicts the filling of the reservoir. The low levels in the 1950s and 1960s show the effect of persistent drought on reservoir elevation. The lake did not recover completely from long-term drought until the early 1980s. Similar delayed responses can be seen in the early 1990s, due to the late 1980s drought, and after 2000, due to the current drought. Figure 15b is Colorado River streamflow below Hoover Dam. Each spike is indicative of increased flow due to spring snowmelt. The series of very high spikes before 1935 shows unregulated Colorado River flow prior to the construction of Hoover Dam. Other longer-term variations relate to the filling of Lake Powell and climate conditions.

Figure 15a. High and low elevation at Lake Mead from 1935–2003.

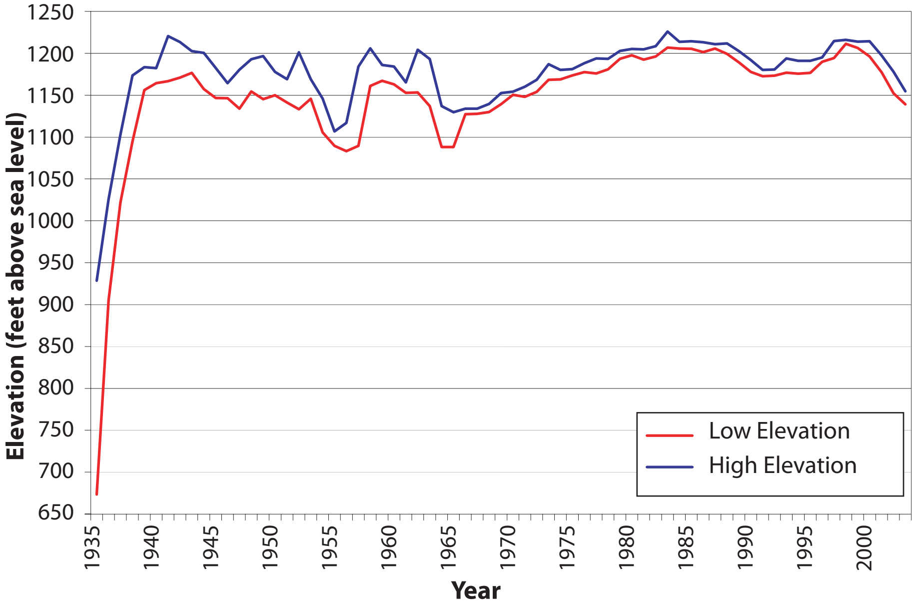
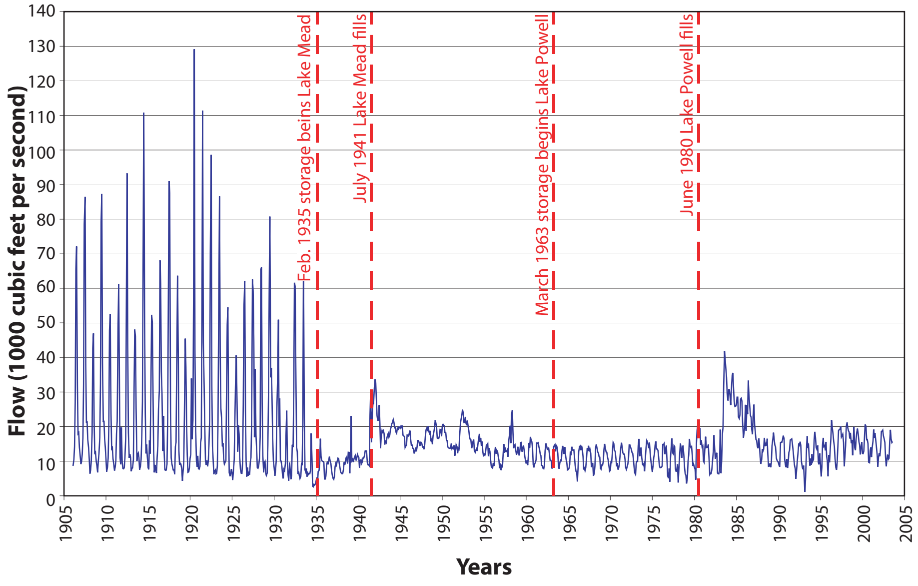


Figure 15b. Flow below Hoover Dam from 1906–2003.



Notes:

The Lower Colorado Region (LCR) of the U.S. Bureau of Reclamation manages water use on the last 688 miles of the Colorado River within the United States. Some of their projects include the Central Arizona Project, the All-American Canal, and the Hoover Dam. The region serves portions of Arizona, California, Nevada, New Mexico, and Utah.

Historical data is available from the LCR website in both tabular and graphical formats. Tabular data includes monthly reservoir levels since construction of the dams (Lake Mead/Hoover Dam – February 1935, Lake Mohave/Davis Dam – January 1950, and Lake Havasu/Parker Dam – July 1938). Daily data, including power generation, are available for 2001 to the present.

To view graphs similar to Figures 15a and 15b select the "Water Operations" link on the lefthand side of the main page. On the Water Operations page under the "Current Conditions" menu, hourly elevation and flow data for reservoirs and water gauges are available for the past four days. Month-to-date elevation, storage, release, and generated power can be accessed by selecting the "Mead, Mohave, Havasu" link.

Projected reservoir elevations at midnight and average water release at the dams are provided for each day of the current week and as an average value for the subsequent two weeks. Daily elevation and water release at each dam are also available through the end of the year. In addition, projected monthly operations are posted for the next two years.

On the Web:

USBR Lower Colorado webpage:
http://www.usbr.gov/lc/

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http://www.usbr.gov