

Drought Impacts

The impacts of the drought on the residents, businesses and environmental resources of the Mojave IRWM Region (Region) are increasingly significant as dry conditions persist. The impacts to date and projected future repercussions are described below.

Groundwater basin overdraft history

Mojave Water Agency (MWA) is the Region’s wholesale water supplier and was founded July 21, 1960, due to concerns over declining groundwater levels. The Agency was created for the explicit purpose of doing “any and every act necessary, so that sufficient water may be available for any present or future beneficial use of the lands and inhabitants within the Agency's jurisdiction.”¹ Over the last two decades, groundwater overdraft has been reduced and groundwater levels have stabilized in the East Alto, Centro, Este, and Oeste Subareas (four of the five subareas of the adjudicated Mojave Basin Area). Groundwater levels have stabilized and even begun increasing (~1Ft/year) in the Este and West Alto Subareas. Morongo Area shows high variability in groundwater levels ranging from approximately 1 Ft/year decline to as much as 20 Ft/year increase but is on average stable. In the Baja Subarea, the only subarea where the adjudication has not been fully implemented, groundwater levels have continued to decline 1-2 feet per year.

Essentially all water supplies within MWA are pumped from the local groundwater basins and groundwater levels generally have been declining for the past 50 years or more. Adjudication proceedings were initiated due to concerns that rapid population growth would lead to further overdraft. The resulting Mojave Basin Area Judgment (Judgment) requires that additional surface water be imported to help balance the basins (MWA, 2004).

For management purposes, the MWA generally separates its service area into six management areas, including the five subareas of the adjudicated Mojave Basin Area (Alto, Baja, Centro, Este, and Oeste) and the Morongo Basin/Johnson Valley Area (referred to throughout this document as “Morongo” or the “Morongo Area”). An underlying assumption of the Judgment is that sufficient water will be made available to meet the needs of the Mojave Groundwater Basin in the future from a combination of natural supply, imported water, water conservation, water reuse and transfers of Free Production Allowance (FPA) among parties.

The Warren Valley Basin adjudicated area is located within the Morongo Basin/Johnson Valley Area (“Morongo”) portion of the Mojave Region. Groundwater from the Warren Valley Basin is used to supply the Town of Yucca Valley and its environs. Extractions from the Warren Valley Basin began exceeding supply in the 1950s. The progressively increasing overdraft led to adjudication of the Warren Valley Basin in 1977. In its Warren Valley Judgment, the court appointed the Hi-Desert Water District (HDWD) as Watermaster and ordered it to develop a physical solution for halting overdraft. Objectives identified by the Watermaster Board included managing extraction, importing water supplies, conserving stormwater, encouragement of conservation and reclamation, and protecting groundwater quality. A Basin Management Plan was adopted that called for importing SWP water from MWA through the then-proposed Morongo Basin Pipeline to balance demand and replenish past overdraft.

The entire Morongo Area has limited natural supply, with a large portion of the Area relying on MWA’s ability to provide SWP water through the Morongo Basin Pipeline. The Warren Basin (i.e. Town of Yucca Valley) was the first to experience obvious overdraft issues and relies on imported water and the three associated recharge sites to support the adjudication. Remaining water districts in the Region consisting of Bighorn Desert View Water Agency (BDVWA), County Service Area (CSA) No. 70, and Joshua Basin Water District (JBWD) are at or close to surpassing their natural supply and these agencies plan recharge facilities in the immediate near future to address their own supply issues (MWA 2011).

¹ MWA Law, Chapter 97-1.5, dated July 21, 1960.

One of the main underlying assumptions with the Mojave Region’s two adjudications is relying on imported water to balance demand and replenish past overdraft. Because the Region has been in overdraft, the other assumptions supporting the adjudications such as water conservation are already finely tuned programs (with a few exceptions) in the desert. The drought has caused what little natural supply that entered the groundwater basins via mountain runoff to decrease dramatically as explained below. Therefore, the Region is in desperate need of expanding their water reuse alternatives and cleaning up any possible known water leakages to continue to stop the overdraft conditions from happening again.

Groundwater basin overdraft impacted by drought

The current drought has had significant impacts on the Region's two adjudicated groundwater basins (the Mojave Basin and the Warren Valley Basin) as SWP allocations dropped to 35% in 2013 and a 5% in 2014. SWP water is used in the Region (only in the adjudicated groundwater basins) primarily for direct deliveries to customers of MWA and for groundwater recharge to offset groundwater overdraft. Due to low allocations, in both 2013 and 2014 groundwater production had to draw down banked reserves because the water available from the SWP was insufficient to meet the full need for offsetting overdraft. In addition, MWA’s SWP direct-delivery customers had to switch part of their operations to groundwater production instead of SWP sources, further impacting the groundwater basins. The average demand for SWP water within MWA service area is about 16,000 acre-feet (af) (average of last 5 years); anticipated deliveries in 2014 are about 4,000 af. The shortfall will be met by drawing down groundwater reserves.

SWP water is used for groundwater recharge to offset overdraft. On average, over the last 5 years the Region has needed 12,000 acre-feet per year (afy) of SWP water to offset groundwater overdraft. In 2014 due to the 5% allocation, it is anticipated that approximately 2,000 to 4,000 af of SWP water will be available for groundwater recharge, which is only 16 to 33% of what is actually needed. Additionally, some water users that normally take direct delivery of SWP water have switched partially to groundwater to sustain their needs, further increasing the impact on overdraft. Finally, two power plants within MWA take direct deliveries of SWP water for cooling purposes. Due to the low allocation, one of them will only receive about 15% of what it needs to operate on an annual basis. In 2014, this same power plant was forced to switch to groundwater pumping to meet its needs, which further exacerbates the overdraft conditions of the basin.

For the past three years, local natural inflows to the Mojave Groundwater Basin have been substantially reduced compared to average years. Rainfall in the mountain areas has dropped significantly, thereby reducing the principal source of local water supply to the Region.

Mojave Basin Area. Precipitation in the Mojave River Watershed during 2012-13, measured at Lake Arrowhead, was again below average at about 51 percent of the 60 Year Base Period average. The combined flow of the West Fork Mojave River and Deep Creek during the 2012-13 Water Year was about 14 percent of the 60-year Base Period average (MWA Watermaster 2014). Natural inflows to the Mojave Groundwater Basin primarily occur through surface flows in the Mojave River. Inflows to the Mojave River, measured at USGS stream gauges at the tributaries to the River, average 65,500 afy for the period of record. The last three years, inflows as shown in the table below have been only a fraction of the average.

Water Year	Natural Surface Water Inflows to Mojave GW Basin (af)
Long Term Average*	65,500
2011-12	29,600
2012-13	9,500
2013-14**	11,600

* 60-year Base Period for Mojave Basin Adjudication (1930-1990).

** 2013-14 is an incomplete dataset because it only includes data from Oct 1, 2013 through June 30, 2014 (the water year ends September 30). However, nearly all inflows to the river occur fall through spring, so it is unlikely substantial flows will occur during the remainder of the water year.

Multiple years of severely limited groundwater inflows combined with the recent drastic cuts to SWP allocations, heavy pumping and limited local recharge have left the Mojave Groundwater Basin in a potentially precarious position. These impacts have been identified throughout the Region and specifically in the following areas:

- The Oeste, Western portion of Alto and the Baja Subareas
- Wells in Los Angeles County near the Phelan Piñon Hills Community Services District (CSD) municipal water supply which supplies water to the CSD’s customers in San Bernardino County near Sheep Creek Road and Highway 18
- Wells near the Mojave River in the Daggett area. These wells respond to recharge when it is available but continue to fall immediately following storm events
- Wells in the vicinity of Hinkley but away from the Mojave River system

Continued dry conditions and pumping in depleted areas of the regional system may result in further impacts such as declining yields and water quality problems.

The combination of reduced SWP deliveries and reduced natural inflows to the Basin have increased groundwater overdraft within the Mojave Groundwater Basin. Since mid-2011, the area within the Region that is generally the most responsive/sensitive to droughts has experienced a drop in the water table ranging from a few feet to as much as 40 feet in some parts of the aquifer (see Figure 2-1).

Water Quality Impacts

Arsenic has increasingly become a concern as the drought progresses. Naturally occurring arsenic in groundwater is common in the Alto Subarea, near the Victor Valley Area (which includes the cities of Adelanto, Apple Valley, Hesperia, Victorville and surrounding communities and overlies the Mojave Groundwater Basin). Arsenic is regularly observed in the MWA Groundwater Quality Monitoring Program. Arsenic comes from chemical weathering of igneous and metamorphic rock formations such as those found in the San Bernardino Mountains (which are at the southern edge of the adjudicated Mojave Groundwater Basin). Generally, natural arsenic is found in deeper less-productive aquifer zones.

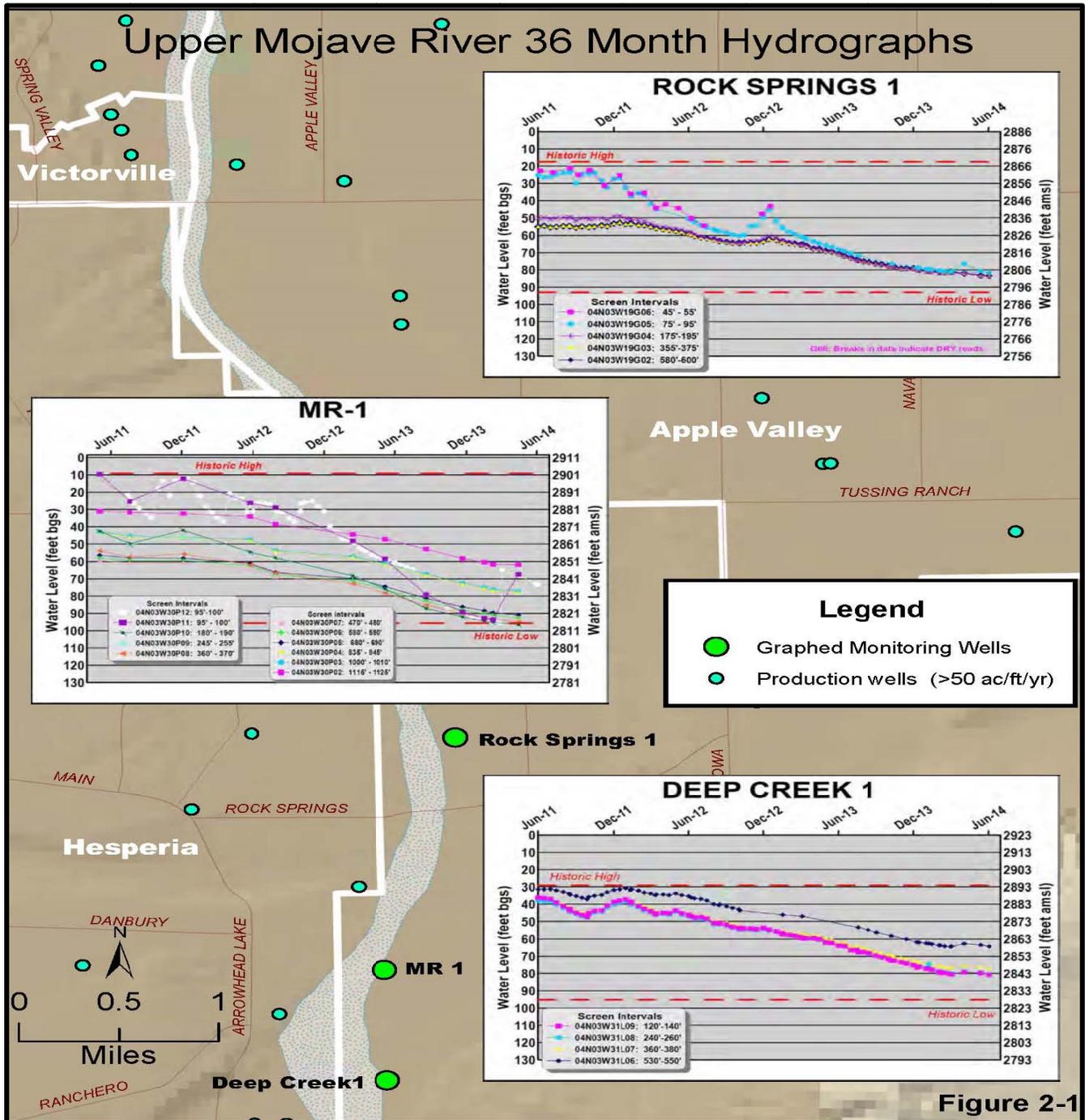
Most production wells in the Victor Valley Area draw water from shallow aquifer zones (generally 400-800 feet below ground surface). This contributes to a groundwater gradient in the aquifer system from deeper aquifer zones upward toward the production zone. The deeper aquifer zone is under pressure relative to the shallow zone and in a drought situation the pressure from the deep zone to the shallow zone increases because without natural recharge, groundwater pumped from the shallow zone causes the shallow zone “pressure” to drop relative to the deeper zone pressure creating a “gradient” from the deep to the shallow zone. By contrast, in a wet year pumping from the shallow zone does not cause such a pressure drop because the aquifer is continuously being recharged and is therefore keeping groundwater levels high. Arsenic generally exists at higher concentrations in the deeper aquifer zones (more than 800 feet below ground surface). As groundwater levels decline to historically low levels under severe drought conditions, the potential for arsenic mobilization from deep un-produced aquifer zones upward to the low pressure zones and into developed-aquifer production zones, increases.

Severe drought conditions, such as those currently being experienced, have led to lower groundwater levels in the Region’s aquifers as there is little to no natural recharge occurring. The low SWP allocations exacerbate the situation as very little artificial recharge supply is available to boost groundwater levels. Under these circumstances, the groundwater gradient from the deep arsenic-containing zones toward shallower production zones grows and increases the potential for migration of arsenic water into the shallow aquifer zones containing the production wells for Victor Valley.

If current drought-related groundwater declines continue arsenic mobilization will occur and treatment for arsenic of a previously potable water supply will become necessary. The increased concentration of arsenic will be widespread due to the geographically pervasive nature of naturally occurring arsenic in deeper aquifer zones in

the Mojave Region of the Mojave Desert. The financial impacts of addressing increased levels of arsenic are addressed in the next section.

Figure 2-1: Upper Mojave River 36 Month Hydrograph Chart



Financial Impacts

This year MWA anticipates selling approximately 4,000 to 8,000 af of SWP water to its customers. This is a substantial reduction due to the drought, compared to normal years when the agency sells around 16,000 afy (average for last 5 years). Because of this reduction in available supply, the drought will significantly reduce the agency's revenues from water sales, creating financial hardship. This will result in a loss of revenue to MWA in 2014 of between \$3.4 million and \$5.1 million (based upon the 2012-13 MWA replacement water rate of \$425/af).

Another financial impact is related to arsenic treatment. If current drought-related groundwater declines continue, arsenic mobilization will occur and treatment will become necessary where it had not been before to ensure safe, potable supplies. Arsenic treatment technologies vary highly in cost. If, for example, Hesperia Water District had to start treating their water supply (~15,000 afy), the installation of arsenic treatment systems would have an initial cost of about \$10 million and ongoing operational costs of approximately \$5 million per year (Jess Brown, Carollo Engineers, Personal Communication, July 1, 2014). Potentially similar costs would be incurred throughout the Region.

At risk of not meeting ecosystem water demands

There are two environmentally sensitive areas in the Mojave Region that are managed by the California Department of Fish and Wildlife: the Upper Mojave Narrows and Camp Cady, and both are home to sensitive riparian habitat that is threatened by groundwater overdraft. The Upper Mojave Narrows is located in the Alto Sub-Basin and is situated between Victorville and Apple Valley. This has historically been a location where the Mojave River has surfaced and a Riparian habitat has been established. Camp Cady is a Department of Fish and Wildlife property that is located near Newberry Springs. Camp Cady was also an area where the Mojave River surfaced and a riparian habitat developed.

The geology along the Mojave River at Camp Cady and the Upper Mojave Narrows causes groundwater to surface and flow year-round, although most of the Mojave River is dry for most of the year. Groundwater overdraft causes surface flows in these areas to be reduced, directly impacting the riparian habitat. As a result of the drought, local storm flows have been reduced resulting in less natural groundwater recharge, and a 5% allocation of SWP water has resulted in insufficient imported water available for mitigation of groundwater overdraft. "Base Flow" (non-storm surface water flow) at the Narrows has decreased about 28% since 2011 due to these conditions (base flow totaled 10,100 af in water year 2010-11, 8,800 af in water year 2011-12 and 7,300 af in water year 2012-13). Projects that reduce groundwater pumping will help alleviate declining base flows in the Narrows, thereby reducing impacts to these sensitive riparian areas.

MWA's aggressive water conservation program, along with key storage projects have so far helped to reduce the impact of other key drought indicators:

At risk of not meeting existing drinking water demands: N/A

At risk of not meeting existing agricultural water demands: N/A

Drinking water MCL violations: N/A

Discharge water TMDL violations: N/A

Water Conservation

Entities within the Mojave Region have been actively planning and implementing conservation programs since long before the drought. The programs are robust and include public outreach and education, technical support and financial incentives. All project proponents seeking funding as part of the 2014 IRWM Plan Drought solicitation have taken drought response actions. Related drought declarations and resolutions are provided in Att2_DG_Impact_2of2.

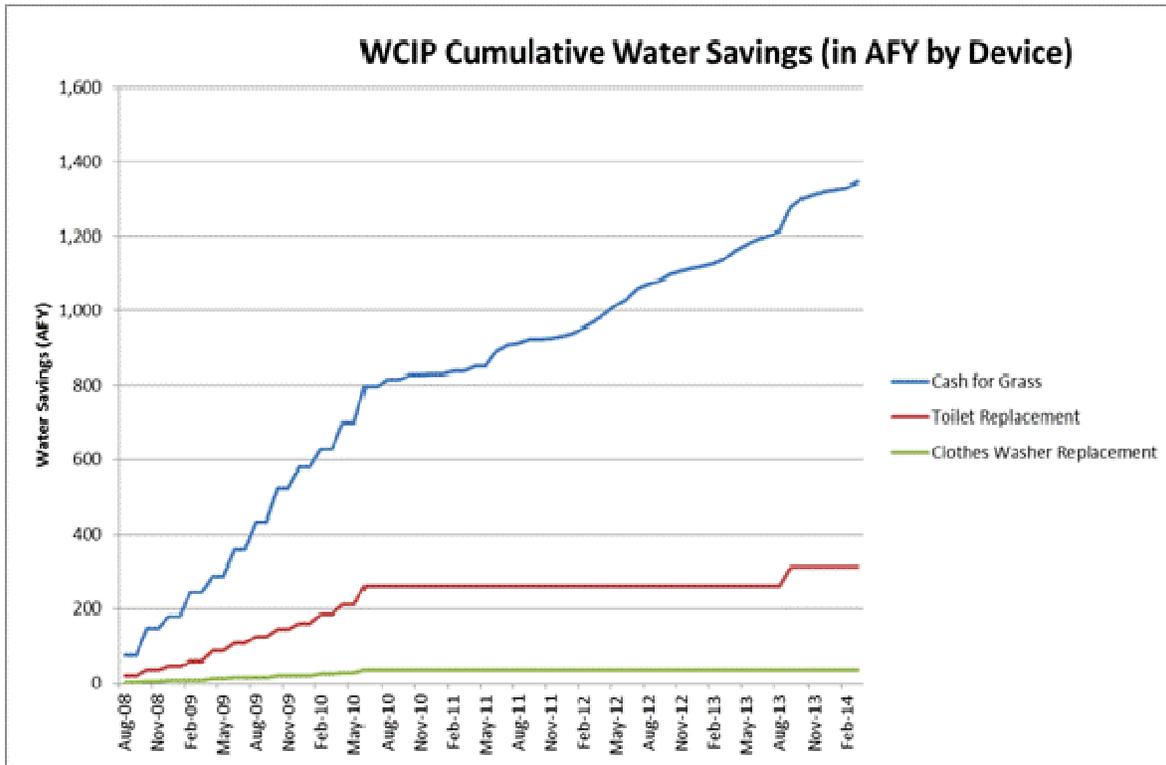
In 2003, Mojave Desert stakeholders, including Hi-Desert Water District (HDWD), Hesperia and MWA, decided that a united regional water conservation program was needed and the Alliance for Water Awareness and Conservation (AWAC) was formed. AWAC receives funding from the California DWR and from MWA to implement water savings measures, including outreach, education and customer incentives. Among other things, AWAC expanded the conservation goals identified in the Regional Water Management Plan (RWMP).

According to the enabling MOU, the purpose of the AWAC is to “provide a vehicle to attract support for a regional water conservation program and coordinate implementation of activities by forming partnerships to obtain common, measurable goals.” Among the Region’s major achievements is a conservation culture that’s been growing steadily over the last decade. AWAC set to change water-use habits and empower local communities with the tools to ensure adequate supplies of water for future generations, and:

- Serve as a network to assist agencies in educating the public on water conservation.
- Provide resources with a consistent message to help agencies meet their respective conservation goals.
- Maintain current gallons per capita per day (gpcd) or lower and continue to position agencies for meeting future conservation needs.
- Exchange ideas between agencies.

Population growth and per-capita municipal production volume data have been tracked and correlated with the implementation of the AWAC regional conservation activities since August 2003. Through aggressive programs, planning and collaboration population growth and demand have successfully been decoupled from historic patterns with per capita use dropping by about 37 percent between 2000 and 2013 from 271 to 172 gpcd. Municipal production fell approximately 9 percent or 8,500 af between 2000 and 2013 while population grew by over 40 percent. Water conservation incentive program activities saved about 1,350 afy since August 2008 (Figure 2-2). The largest portion of the savings is from the turf replacement program (Cash For Grass), followed by toilet and washer replacements. The success of turf replacement to date is the impetus for the proposed Mojave Region CII Turf Replacement Program.

Figure 2-2: Savings from Conservation Incentives



In addition to ongoing conservation efforts, water agencies in the Region have taken actions to both encourage and enforce water conservation in response to the drought. The regional water wholesaler and all project proponents seeking funding as part of the Mojave Region IRWM 2014 Drought Proposal have taken drought response actions. Related drought declarations and resolutions are provided in Att2_DG_Impact_2of2.

Mojave Water Agency

In response to Governor Brown’s drought declaration, the Mojave Water Agency has expanded its efforts to educate and encourage its residents to keep conserving water. In January 2014, MWA issued a press release informing the Region about the drought and calling for enhanced water use efficiency while retail purveyors have been urged to implement their respective drought response plans and conservation ordinances.

Following the drought declaration, MWA's home page (<http://www.mojavewater.org/>, Figure 2-3) was updated to provide information on the current drought situation and links to conservation tips, practices and programs. MWA is working with local municipalities and retail providers to increase promotion of water efficiency with a focus on desert-friendly landscaping and proper irrigation techniques.

As the Region SWP wholesaler, MWA in collaboration with AWAC, has taken the lead in efforts to increase awareness of the drought and promote efficient water use within the service area and provide its retailers with the tools to support these efforts locally.

MWA has undertaken extensive public outreach to achieve conservation goals, making drought presentations to civic groups, retail water agencies, events and schools since January 2014. In addition, MWA is reaching out to water customers through radio interviews print media (articles and/or display advertisements in different local papers) throughout summer and fall of 2014 to encourage public participation in conservation efforts and incentive programs. This outreach is complemented by a regional website and Facebook page hosted by AWAC

Mojave Region Proposition 84 IRWM Drought Grant

Attachment 2 – Drought Impact

where water users can get specific tips to reduce water use (including a "water tip of the day"), learn about desert landscaping and see pictures of "before" and "after" landscaping conversions.

The specific efforts that have been made since the drought started include:

- Over ten school classroom and faculty visits to discuss conservation and the drought
- Visit to the Hispanic High Desert and Helendale Chambers of Commerce
- Numerous public events that feature a drought and conservation focus, particularly landscape use and promotion of the cash for grass program, including: High Desert Water Expo, Cinco de Mayo festival and the Apple Valley Rancho spring fair
- Three drought tolerant plant sales events
- Drought and conservation related radio spots, editorials (including one from MWA Board president), ads in local newspapers and monthly mailers
- Free "ABC's of water" presented by the General Manager of MWA, focusing on the drought and permaculture
- Free Irrigation Controller Programming workshop

MWA through AWAC is also considering expanding its current conservation efforts by providing toilet rebates and developing new outreach tools such as conservation videos and more.

Hesperia Water District

Since the drought declaration the Hesperia Water District's Water Conservation Department has stepped up efforts to minimize water waste throughout the city. These additional efforts include:

- Irrigation Efficiency door hangers distributed to housing tracts containing information on how to check and adjust irrigation timers to reduce the amount of water used in landscaping and prevent water run-off.
- Free water audits to customers with high consumption. These audits involve checking the customer's premises for leaking irrigation and plumbing as well as checking for faulty toilets.
- New bathroom and kitchen sink aerators, which limit the flow of the water to 1.0 gallons per minute, have been added to water conservation kits. Older aerators can use 2.0 gallons per minute or more. The water conservation kit is available to our customers at no charge.
- An afterhours patrolling for water run-off has been added during the summer months in an effort to observe possible irrigation run-off that is not present during the day.
- Summer workshops regarding installation of drip systems and desert adaptive landscaping will be available to the public.
- Participation at the Fall High Desert Home Improvement Show, November 7-9, 2014. Participation at this show will allow our agency to meet with the public during a three day event to discuss ways to save water during fall and winter months. This event is in addition to the spring Home and Garden Show which is held annually in April.

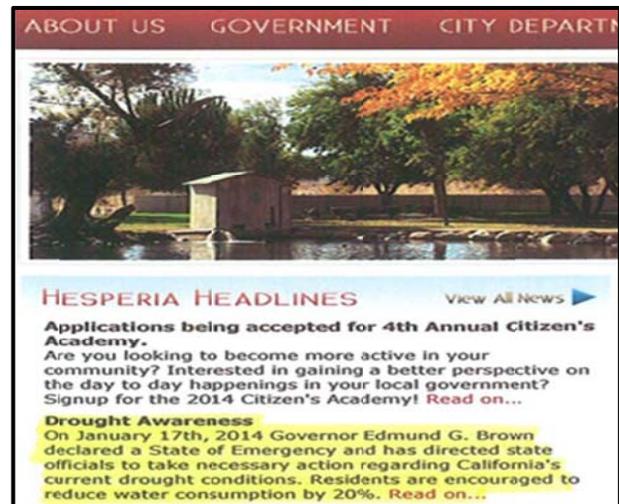
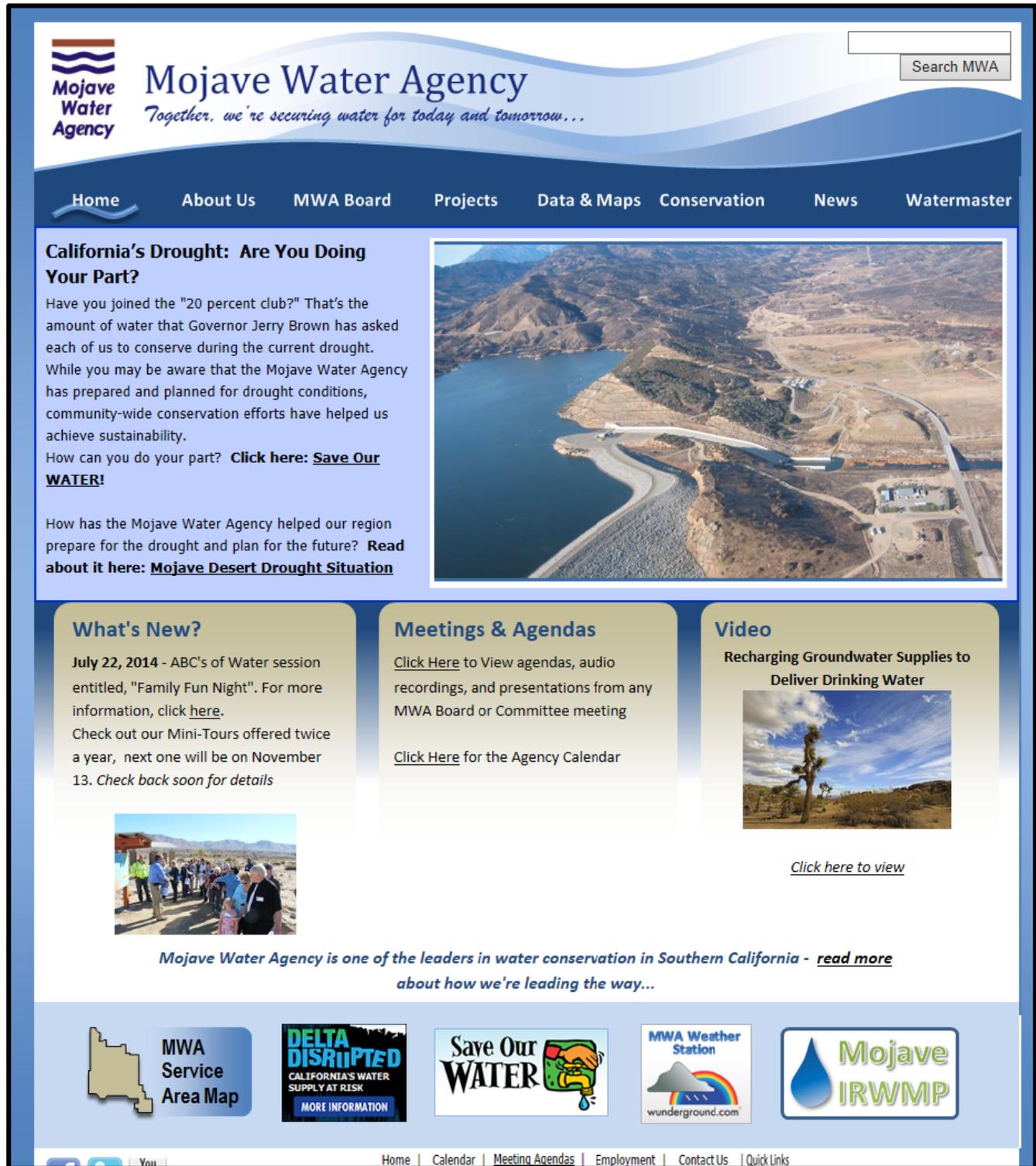


Figure 2-3 MWA Home Page



The screenshot shows the Mojave Water Agency website home page. At the top left is the MWA logo with the tagline "Together, we're securing water for today and tomorrow...". A search bar is located at the top right. A navigation menu includes links for Home, About Us, MWA Board, Projects, Data & Maps, Conservation, News, and Watermaster. The main content area features a large article titled "California's Drought: Are You Doing Your Part?" with an accompanying aerial photograph of a reservoir. Below this are three columns: "What's New?" with a photo of a community event, "Meetings & Agendas" with links to view agendas and the agency calendar, and "Video" with a thumbnail for "Recharging Groundwater Supplies to Deliver Drinking Water". A footer banner reads "Mojave Water Agency is one of the leaders in water conservation in Southern California - read more about how we're leading the way...". The bottom of the page contains several utility icons: "MWA Service Area Map", "DELTA DISRUPTED CALIFORNIA'S WATER SUPPLY AT RISK", "Save Our WATER", "MWA Weather Station", and "Mojave IRWMP". A navigation bar at the very bottom includes links for Home, Calendar, Meeting Agendas, Employment, Contact Us, and Quick Links.

The Hesperia Water District is continuing its partnership with MWA by offering a rebate cash incentive to remove living and maintained lawn and replace it with water-efficient landscaping through the Cash for Grass Program. In view of California's drought situation, the Hesperia Water District chose to accelerate the Cash for Grass Program, starting in February 1st, 2014 rather than April, 2014 as originally planned. The earlier starting date allows customers to both plan and prepare for removal of water-thirsty lawns and the installation of desert low-water use plants.

Hi-Desert Water District

Hi-Desert Water District (HDWD) has been promoting conservation through programs and pricing for over a decade and, as a result, has one of the lowest per capita uses in the Region at under 100 gpcd. On July 16, 2014, HDWD adopted a resolution recognizing the drought, promoting the enforcement prohibitions and encouraging customers to comply with water use restrictions and reduce waste. HDWD is requesting that customers reduce water use by 20% and its customers are eligible for all of the rebates, incentives provided through MWA.

Since the drought declaration, HDWD has increased its efforts to enforce its water waste restrictions which include limitations on irrigation, washdown of hardscape, construction and more. It has expanded its outreach activities and has built a new website dedicated to conservation information and tips and has expanded its focus on water wise landscaping.

HDWD's specific activities in response to the drought conditions include:

- HDWD Board Resolution recognizing the drought and requesting a 20% reduction in use.
- Ongoing media contact focused on providing customers with updated information and encouraging conservation. HDWD has issued three press releases to date: 1) January 23, 2014: informing customers about the Governor's drought declaration and providing tips on how to conserve, 2) February 5, 2014: Water allocation announcement and update on HDWD conservation programs, and 3) April 24, 2014: updating the SWP allocation.
- Providing a link on HDWD's home page to the Governor's drought declaration and conservation tips.
- Developing a new, exclusively conservation-focused microsite for HDWD customers at www.hdwdconserves.com. The website includes information about the drought, rebates, water conservation tips, conservation videos from AWAC, water saving tools, education materials for kids, and information about HDWD's Water Use Restrictions.
- Water wise landscaping tips in HDWD's electronic newsletters.
- Events such as the Family Fun Fair as well as presentations at local schools and Boys and Girls Clubs that focus on the drought and conservation.
- Giveaways such as water wise seed packets and water saver kits which include low flow shower head and faucet nozzles.

