



**REGIONAL WASTEWATER RECLAMATION DEPARTMENT**

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**TO:** Jackson Jenkins, Director  
**FROM:** Kathleen M. Chavez, Water Policy Manager   
**SUBJECT:** **Drought Management Plan Review, Vulnerability  
Conclusions and Recommendations**

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Pima County has had in place a Drought Response Plan and Water Wasting Ordinance since 2006. The year following its adoption, Pima County issued a Drought Stage One declaration in conjunction with the City of Tucson. This declaration has remained in place since then and its response measure is voluntary reduction in water use.

During this time, Pima County's local drought impact group (LDIG), functioning as the drought monitoring committee established in the ordinance, has met regularly to monitor the status of drought in Pima County and to assess the drought impacts.

When Pima County adopted the Drought Response Plan, an emphasis was placed on water use impacts. However, drought has impacts to many sectors and therefore, an assessment of Pima County's vulnerability to drought was conducted. The attached report assesses Pima County's vulnerability to drought across several sectors.

Drought Vulnerability

In reviewing the vulnerabilities of Pima County to local drought conditions, a key vulnerability begins with the junior priority right to Colorado River water Arizona holds and implications for CAP delivery to the County's water providers. Summarizing the Bureau of Reclamation's Basin Study provides scenarios and certain future expectations for water policy planning.

- The Colorado River faces increased demand and reduced supply; the system is over-allocated and highly variable. Lower Basin states' demand for Colorado River water will exceed the 7.5 million acre-feet (maf) a year allocation in all scenarios.
- Reservoirs have and will continue to be used to meet demand that exceeds supply. Reservoir levels will continue to decrease without changing snowpack trends. Lake Mead is forecast to decline an additional eight feet due to the Bureau of Reclamation's reduced Lake Powell release, curtailed from 8.23 maf to 7.48 maf. Lower Basin delivery shortages could occur in 2016 or 2017, triggering an escalation of the City of Tucson's drought plan to Stage 2.
- Banking and recharge infrastructure will help forestall mandatory water use restrictions, as it has in southern California. Greater cooperation between federal, state and local governments and tribes will be required to plan for additional infrastructure of significant expense.
- Complete elimination of Colorado Basin vulnerability is not likely but employment of augmentation, re-use and conservation strategies, to include water transfers, has the potential to reduce vulnerability by as much as 50%. Vulnerability will remain present because of the hydrologic conditions driving it; two specific conditions are deemed as critical vulnerability events- long term mean natural flow at Lee's Ferry below the historical average of 15 maf and droughts lasting eight years or longer. These two trigger points could be included in drought response planning.

- Historical records indicate the current drought could continue and increase in severity. University of Arizona researchers expect drought to become more frequent, more severe and hotter with longer and hotter heat waves. The same research assumes decreased water availability and quality.
- CAP water availability has changed as more municipal and industrial allotments are maximized; excess water is unavailable despite requests for this allocation pool. Purchase of long term storage credits will become increasingly important and more competitive at a time when water for recharge and banking will become less available. Emerging water credit markets will become more influential.
- Water and energy prices will increase, cascading into economic sectors. Industries will increasingly consider water supply costs and local government resource planning when making decisions to base operations.
- Agriculture and ranching will decline in the County from rising costs and as land is converted to development with possible impacts to land use planning. Eventual increased enrollment in the Central Arizona Groundwater Replenishment District, of which a significant amount of development in the County utilizes for assured water supply, will require new water leases or the purchase of credits, such as the 100,000 acre-feet of long term storage credits recently purchased from the City of Tucson.
- Effluent will be a vital resource, as the only water source to increase with population, for generating long term storage credits or for reclaimed use to reduce groundwater withdrawal. Competing interests for the use of effluent will intensify. Future effluent discussion will include more indirect and direct re-use strategies.

#### Conclusions

Considering these possibilities in conjunction with County vulnerability will help in evaluating recommendations. To restate conclusions of vulnerability assessment;

1. County owned and maintained open space and riparian habitat is the most vulnerable county asset. The County's long term planning programs associated with these lands are also a significant asset. A drought management plan for the county should protect these investments by prioritizing adaptive management strategies and resources for these sectors.
2. Agriculture and ranching are not dominant economic drivers in Pima County however are valued as a distinct regional cultural heritage. Ranching is most beneficial to the county as a land management and habitat maintenance tool.
3. Birding and wildlife watching, combined with other outdoor recreation and tourism, are dominant economic drivers for the county. Birding offers economic benefits comparable to the region's largest copper mine. The county's habitat programs are benefiting these economic sectors.
4. Tourism is multi-faceted and duplicative in other sectors and sub-sectors. Of the drought sensitive industries considered in this narrative, it is the most dominant economic driver. Outdoor activities associated with the natural environment are the most popular county attractions.
5. Socio-economic impacts are second and third order impacts easily obscured. Collecting reports on all order of impact is an important function of Pima County's LDIG.

Revisiting the Pima County Drought Management Plan from 2006, specific goals adopted at that time were:

- Reduce water shortage impacts and hardships
- Reduce conflicts between water users
- Improve coordination of county departments and governments
- Improve procedures for monitoring and assessment
- Improve response to shortage
- Improve information sharing with the public
- Improve resource allocation

Additionally, consideration of mitigation actions sought answers to the following;

- o Can the cause be mitigated?
- o Can the cause be modified?
- o If neither is possible, must the impact be accepted as a drought-related risk to the County?
- o What is the cost/benefit ratio of mitigation actions identified?
- o What actions are feasible and appropriate?
- o What actions are environmentally sensitive?
- o Do the actions address the right combination of causes to adequately reduce the relevant impact?
- o Do the actions address short and long term solutions?
- o Do the actions fairly represent the needs of affected individuals, groups and sectors?

Recommendations

Taking into account future expectations and reviewing the County’s exposure and vulnerability in context of Drought Management Plan goals, suggested changes to the County’s drought ordinance, department activities and LDIG include;

1. Revise drought stage and trigger events (Table 8.70.050) to more accurately reflect and communicate current conditions, improve coordination with other jurisdictional declarations, correct front loading of response measures, provide more flexibility and buffer against oscillating changes of status. Include some exceptions for rainwater harvesting systems to incentivize use. Provide a range of status condition allowing discretion in stage declaration and distinction, for example of a recent and limited Severe finding versus a prolonged Severe finding with more pronounced impacts. A draft ordinance is included in the report

**Current Table 8.70.050**

<b>Indicator</b>	<b>Arizona Drought Monitor Report Based on Findings Related to Pima County</b>
<b>Stage 1 Alert</b>	<b>Abnormally Dry</b>
<b>Stage 2 Warning</b>	<b>Moderate</b>
<b>Stage 3 Emergency</b>	<b>Severe</b>
<b>Stage 4 Crisis</b>	<b>Extreme</b>

**Suggested Revised Table 8.70.050**

<b>Indicator</b>	<b>Arizona Drought Monitor Report Based on Findings Related to Pima County</b>
<b>Stage 1 Alert</b>	<b>Moderate-Severe</b>
<b>Stage 2 Warning</b>	<b>Severe-Extreme</b>
<b>Stage 3 Emergency</b>	<b>Extreme-Exceptional</b>
<b>Stage 4 Crisis</b>	<b>Exceptional</b>

2. Consider appropriate levels of duplication with the City of Tucson and other providers to encourage cooperation and prevent disparate enforcement
3. Cooperation and consolidation of effort is necessary. LDIG, as a component of the ADPP, is designed to augment the response plan (ordinance) as a repository of assessment information and as a recommendation body. Formalize decision making process within LDIG to coordinate new declarations with water providers. Table 8.70.050 serves as a guideline for drought declaration; LDIG analysis and report to the County Administrator is integral to providing context of drought status

4. Increase public education and information collection and dissemination with drought sensitive sectors. Conduct a review of department procedures for receiving and responding to violations of the drought and water wasting ordinance
5. Designate a Drought Liaison within relevant County departments responsible for information sharing of drought impacts and other pertinent data with LDIG
6. Continue implementation of the Sustainability Action Plan for County Operations (SAPCO), Water and Wastewater Infrastructure, Supply and Planning (WISP) Study and Action Plan and Water Resource Asset Management Plan (WRAMP)
7. Consider purchase of wells near groundwater dependent ecosystem areas and permanently retire the groundwater rights associated with them
8. Continue refinement of the County's Strategic Plan for Use of Reclaimed and similar strategy and criteria for use or transaction of accrued Long Term Storage Credits
9. Initiate a process to identify data and information gaps and assess changing vulnerability over time to provide LDIG improved analysis.

Next Steps

LDIG has reviewed the draft Vulnerability Assessment in Drought Mitigation Report. It is recommended that the final report and attached draft ordinance be presented to LDIG for review and comment at their next regularly scheduled meeting May 12. Following their review, it is recommended the final Drought Vulnerability Report and Ordinance be forwarded to the Board of Supervisors for review and approval.

Should you have any questions, I am available at your convenience.

Enclosures:        Vulnerability Assessment in Drought Mitigation Report  
                         Draft Drought Response Plan and Water Wasting Ordinance Chapter 8.70

# Vulnerability Assessment

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## In Drought Mitigation



**Pima County**  
**Regional Wastewater Reclamation Department**  
**Water Resources Unit**

April 2014

## Vulnerability Assessment in Drought Mitigation

Arizona is one of twelve states with a mitigation based drought plan. Disaster management, and corresponding research, has evolved over the years from short-term crisis response to more long range, proactive risk management planning for expected impacts, or mitigation. The goal of mitigation is to reduce vulnerability to a range of identified risks ahead of time.

Vulnerability, in its research definition, is composed of three characteristics: Exposure, Sensitivity and Adaptive Capacity.<sup>1</sup> Exposure is the probability of a certain area to experience a hazard- drought- and to what magnitude and duration. Drought maps produced by the US Drought Monitor and the Arizona Monitoring Technical Committee record current and past drought exposure. Sensitivity is somewhat self-explanatory, as the degree to which a system or sector can be altered or will respond after exposure. Adaptive capacity refers to a system's ability to adjust and mitigate primary and secondary impacts. Important to adaptive capacity is the ability to collect reporting on all order of impacts across many sectors, a key function of drought impact assessment groups, such as Pima County's Local Drought Impact Group (LDIG).

In reviewing planning practices, Colorado's Hazard Mitigation and Drought Response Plan is mentioned in multiple studies as an example of an effective plan. The 2013 update, approved in September, includes a revised vulnerability assessment and tools to rank individual counties within different sectors. Applied to their drought planning process, vulnerability is a determination after "assessing the threat from potential drought hazards to various sectors across social, economic, environmental, and political fields." A vulnerability assessment is defined as a "process of identifying, quantifying, and prioritizing (or scoring) the vulnerabilities in a system."<sup>2</sup>

A similar vulnerability assessment of Pima County would help inform the drought update process by reviewing the county's historical exposure, listing the natural resource and environmental, economic, social, and municipal sectors deemed sensitive, determining the size and relative importance of those sectors to the county, and exploring the county's adaptive capacity to mitigate impacts, primary and secondary, to these sectors, which include:

1. County Assets- County land, parks, planning, recreational areas, water rights and wells.
2. Economic Sectors- Agriculture and Ranching; Energy and Mining; Hunting, Fishing and Other Outdoor Recreation; Tourism and Sports; and Forestry and Logging.
3. Municipal and Industrial (M&I); Private wells.
4. Environment.

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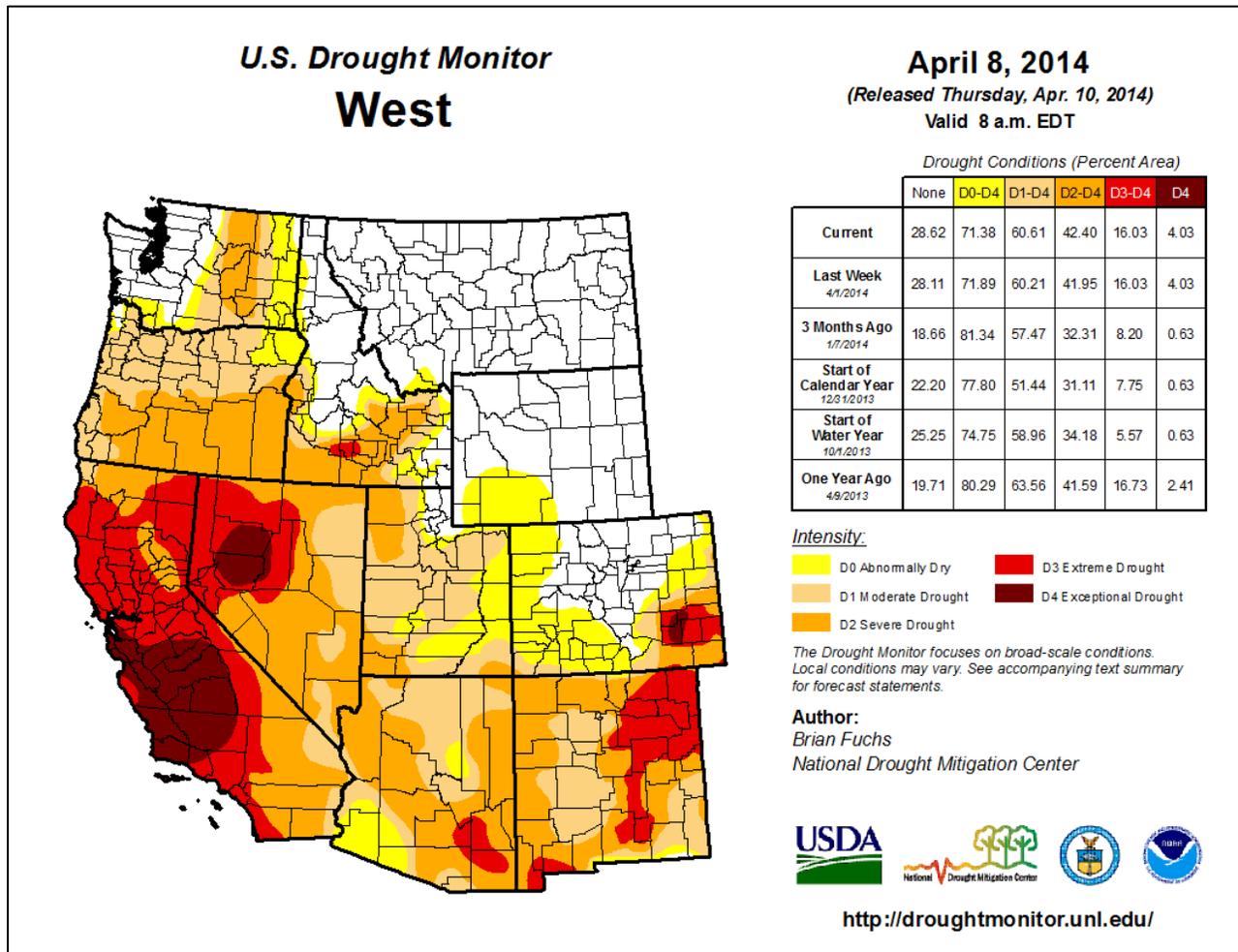
<sup>1</sup>McCarthy, Canziani, Leary, Dokken, White; *Climate Change 2001: Impacts, Adaptation and Vulnerability*. Cambridge University Press, 2001.

<sup>2</sup>Colorado Drought Mitigation and Response Plan, Annex B. 2013

Exposure

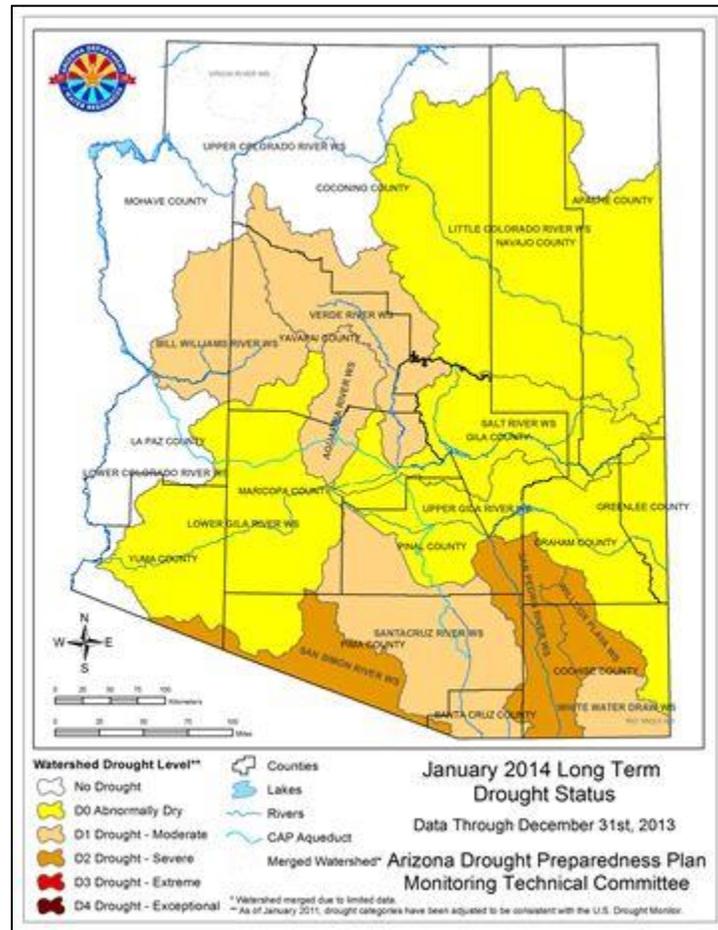
According to the US Drought Monitor Pima County exposure as of April 2014 is Extreme drought in the northeast corner of the county, radiating to Severe and Moderate drought throughout most of the county with Abnormally Dry condition along the western border (see figure 1).

**Figure 1-US Drought Monitor**



The Arizona Department of Water Resources’ (ADWR) Arizona Monitoring Technical Committee long-term maps indicate an improvement to Moderate drought in the Santa Cruz watershed, the San Simon area in Severe. The portion of the Lower Gila watershed within the county continued in Abnormally Dry status (see figure 2).

**Figure 2-ADWR Long Term Drought Status Map**



As chronicled in a previous memo<sup>3</sup>, Pima County has reported a predominance of Severe drought with oscillating pockets of Moderate finding from January to July 2012 and then a reversal- Moderate drought with pockets of Severe from August 2012 to March 2013. April, May and June, prior to this year’s monsoon, recorded Severe drought in entirety, followed by some sustained Severe with Moderate and Abnormally Dry easing following monsoon activity in July and August.

A cursory review of previous years’ drought maps show no discernible pattern given the highly variable seasonal precipitation. Summer monsoons have eased drought conditions in some years but then are absent in others, where the only relief came from winter storms. However, in the last eight years, no drought in entirety has only been recorded in May and June of 2010 and September and October of 2008. Pima County’s exposure to drought could be defined as sustained and variable.

<sup>3</sup> Water Resources Unit Memo. Drought Ordinance Review. June 24, 2013.

## Sensitivity

The Colorado Drought Mitigation and Response Plan assesses vulnerability by cataloging assets and resources in systems across sectors that are sensitive to drought exposure, then identifies the threats to each resource, assigning a quantifiable value and/or rank order to those resources. Quantifying the magnitude of possible impact allows prioritization of sectors and mitigation. Assigning a “score” of sensitivity, as the Colorado Plan does with each county, is beyond the scope of this paper. The effort here is to define sectors within the county to further understand the magnitude of impact possible and discuss the economic and social importance of those sectors to the county.

## County Assets

### County Critical and Riparian Habitat

As part of Pima County’s Sonoran Desert Conservation Plan (SDCP) and the Critical Habitat and Biological Corridors and Riparian Protection components, the county’s effort in defining critical habitat for Priority Vulnerable Species has led to the acquisition and management of numerous creek, canyon and wash parcels. Priority habitats and corridors include specific sites deemed as critical habitat or Priority Riparian Resources:

- Arivaca, Bear, Cienega, Rincon, Sabino, Tanque Verde Creeks.
- Bear, Brown, Cochie, Davidson, Edgar, Gardner, Madera Sutherland, Wakefield Canyons.
- Agua Caliente, Agua Verde, Black, Brawley, Canada del Oro, La Milagrosa, Sopori/Papalote, Sutherland Washes.
- Tumamoc Hill, Happy Valley, Los Morteros, Madera Highlands and Elephant Head Pineapple Cactus Mitigation lands.

Priority Habitats
<ul style="list-style-type: none"><li>• Altar Valley</li><li>• Baboquivari Mountains</li><li>• Cienega Creek</li><li>• Eastern Tucson Riparian Complex</li><li>• Organ Pipe/Goldwater Complex</li><li>• Sabino Canyon</li><li>• San Pedro River</li><li>• Santa Rita Mountains</li><li>• Silverbell Mountains</li><li>• Tortolita Mountains</li><li>• Tucson Mountains</li></ul>

- Bingham Cienega, Cienega Creek and Sweetwater Natural Preserves.
- Colossal Cave, Tortolita and Tucson Mountain Parks.

This inventory, combined with county ranches, form conceptual reserves- Tortolita, San Pedro Valley, Northern Altar Valley, Upper Santa Cruz and Southern Altar Valley Reserves.

## County Ranches

Ranching has been deemed compatible with the SDCP and contributes to the open space strategy of the county by defining the urban boundary and preserving sensitive wildlife habitat, corridors and water resources. Maintenance of traditional ranching and agriculture industry, heritage and cultural resources, historic sites such as Canoa Ranch, are also goals of the Ranch Conservation component of SDCP. Assisting ranchers and retaining them as land stewards by entering into cooperative management agreements following purchase allows for continued traditional land use, preventing conversion to development. Ranching has historically occurred in biologically rich and riparian areas, making ranch sites suitable for habitat and species conservation.

There are 16 county ranches<sup>i</sup>, all but one working and grazing cattle. Biological value of these lands varies but includes a mixture of Important Riparian Area, Biological Core, Special Species Management Area and Multiple Use designations per the Conservation Land System (CLS). Two, the Bar V and Sopori, are mentioned as shallow groundwater areas. The Bar V has perennial and intermittent stream flow while the Six Bar Ranch has intermittent streams and springs. Sopori Ranch has the benefit of irrigated pasture land, allowing reduced livestock dependence on native forage. Cattle operation is reduced at most ranches, herd inventory held at less than permitted capacity to reflect drought conditions.

## County Planning

County owned and managed land is vulnerable to drought impacts as are the county's conservation plans. The planning associated with and dependent upon the land is a vital county asset and impact assessment and adaptive capacity of each must be taken in to consideration.

1. Sonoran Desert Conservation Plan (SDCP)
2. Conservation Land System (CLS)
3. Multi Species Conservation Plan (MSCP) & Section 10 Permit
4. Pima Prospers (Comprehensive Plan Update)

The biological goal of the SDCP, the critical habitat component, is long-term survival of indigenous plant and animal species by "maintaining or improving habitat conditions and ecosystem functions necessary" for each. Complementing land acquisition, the SDCP represents "long-term investment in research, monitoring and adaptive management to ensure the sustained bio-diversity of our region."<sup>4</sup>

The CLS is a guide to the county's land acquisition program by way of categorizing and prioritizing biologically important lands, or Habitat Protection Priorities. The CLS is informed by listing Priority Vulnerable Species, defining biological standards and extensive mapping representing "the ultimate

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<sup>4</sup>Protecting Our Land, Water and Heritage: Pima County's Voter-Supported Conservation Efforts.

expression of those lands where conservation is fundamental and necessary to achieve the Plan's biological goals."<sup>5</sup>

The MSCP is the county's response and responsibility in meeting Endangered Species Act (ESA) requirements and receiving a Section 10 permit from the US Fish and Wildlife Service, which will allow certain disturbance of ESA protected species provided mitigation and conservation measures are in place to compensate. The MSCP "will institutionalize many SDCP principles" at the federal level by recording SDCP open space lands as mitigation acreage- an estimated 116,000 acres will be needed for Section 10 compliance as well as continued program and ecological monitoring.

*"The County is responsible for management of County owned and leased mitigation lands to ensure that the natural and cultural resource values for which they were secured persists over time. How the County manages these lands for the benefit of natural (especially biological) resources has a direct and critical relationship to the MSCP and, ultimately, the County's receipt of the Section 10 permit."*<sup>6</sup>

The MSCP is a way to streamline and provide more certainty for public and private sector development in complying with ESA. These plans, the SDCP, CLS and MSCP, converge with the county's Comprehensive Plan, and current update, Pima Prospers, to represent the county's land use, economic and environmental development strategy- integrating natural and cultural resource protection and land use and infrastructure planning.

#### County Parks and Recreation

Pima County Natural Resources, Parks and Recreation maintains 42 parks, associated ball fields, 10 pools, one golf course and 22 trail heads<sup>ii</sup> as well as other community recreational resources less sensitive to drought. Obviously, large turf areas require significant irrigation and are very drought sensitive. With the implementation of new software, EnergyCap, water use and demand is being tracked at all county water meters allowing benchmarking and informing better management decision-making.

The Loop, recognized locally and nationally as a regional asset, is a 131 mile shared use path connecting the county's river parks and greenways as well as surrounding communities and other county venues. Reclaimed infrastructure serves most of the river park system; to the extent possible, park irrigation is served by the county's share of effluent.

#### County Riparian Restoration and Flood Control Projects

Pima County Regional Flood Control District performs its legally required function of installing structural flood control infrastructure across jurisdictional boundaries with bond funds and state and federal resources. Where possible, RFCD supports riparian restoration projects in wash corridors and floodplains. The Floodprone Land Acquisition Program (FLAP) has acquired more than 7,000 acres of land susceptible to flooding in a proactive mitigation effort to reduce development risk in vulnerable

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<sup>5</sup>Ibid.

<sup>6</sup>Pima County's Multi-Species Conservation Plan: Balancing Development and Habitat Conservation. Nov 2012.

floodplain. RFCD owns valuable wildlife habitat with significant ecological value<sup>7</sup>. Completed and pending projects include:

1. Cienega Bottomlands Restoration Project
2. Cortaro Mesquite Bosque Construction Project
3. Kino Environmental Restoration Project (KERP)
4. Pantano Jungle Restoration Project
5. Rillito River/Swan Wetlands Ecosystem Restoration Project
6. Lower Santa Cruz River Living River Project
7. Big Wash Rehabilitation
8. Paseo de las Iglesias Phase I
9. Arroyo Chico Multi-Use Project
10. Avra Riparian Restoration and Groundwater Replenishment Project
11. El Rio Medio
12. Tres Rios del Norte

Additionally, RFCD participates in effluent recharge projects that recharge the aquifer earning the county valuable water credits at Underground Storage Facilities such as:

1. Marana High Plains Effluent Recharge Project (MHPERP)-managed by RFCD
2. Lower Santa Cruz River Managed Recharge Project (LSCMRP) –managed by a joint cooperative that includes RFCD

RFCD also maintains the county's river park system along the urban and wash periphery, connected by The Loop:

1. Cañada del Oro River Park
2. Harrison Greenway
3. Julian Wash Greenway
4. Pantano River Park
5. Rillito River Park
6. Santa Cruz River Park

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<sup>7</sup>WRRC, Riparian Restoration Efforts in the Santa Cruz River Basin. Fabre, Cayla. Mar 2009.

### County Water Rights

Pima County Regional Wastewater Reclamation Department (RWRD) treats wastewater and produces effluent, a water source that increases with population growth and will play an increasingly important role in future water planning. Through several inter-governmental agreements, regional sharing of effluent has equated to the county receiving a 10% share of Metro area effluent and ownership of non-Metro area production. Long Term Storage Credits (LTSC) are accrued by storing effluent at the county's permitted recharge facilities. In addition, land acquisition has included certain water rights, giving the county a water portfolio of approximately 15,000 acre-feet (af). Water is withdrawn from 578 county wells; 91 non-exempt, 300 exempt (mostly water quality monitoring) and 187 other wells used for dewatering, water quality and industrial use. Compliance, maintenance and reporting tasks are the responsibility of the county department assigned to the well. The county shares 10,000 af of effluent with the City of Tucson as the Conservation Effluent Pool, to be utilized in future agreed-upon environmental restoration projects.

Total County Effluent Production	65,389 af
County Share from Metropolitan Area Facilities	3,319 af
County Share from Non-Metropolitan Area Facilities	3,993 af
Accrued Long Term Storage Credits (LTSC)	7,573 af
Irrigation Grandfathered Rights (IGR)	4,216 af
Type 1 Non-Irrigation Rights	2,566 af
Type 2 Non-Irrigation Rights	994 af

### Other County Venues

Other county affiliated tourist and community attractions include the Kino Veterans Memorial Stadium, Arizona-Sonoran Desert Museum, Pima Air & Space Museum, Pima County Fairgrounds, Titan Missile Museum, Old Tucson Studios, and various motorsports tracks.

### Agricultural and Ranching Economic Sector

A 2007 census of the agricultural industry in Pima County conducted by the US Department of Agriculture (USDA), National Agricultural Statistics Service (NASS) surveyed the operation of farms, market activity and production within the county.

The market value of products sold from the 622 operating farms totaled \$67.5 million, with \$49.4 million, or 73%, in crop sales and \$18.1 mil, or 27%, in livestock sales. The average market share per farm was \$108,521. There were 71,160 irrigated farm acres in 2007, a decline of 10% from 2002.

The 2011-2007 USDA NASS annual statistics bulletins augment information provided since the 2007 census- the 2012 Census of Agriculture is expected in early 2014. Market cash receipts in 2011 were \$64.4 million (72%) in crop sales and \$24.9 million (28%) in livestock sales for a total of \$89.3 mil, an increase (25% ) from combined 2010 crop sales of \$52.1 million (73%) and livestock sales of \$19.5 million (27%), or \$71.6 million.

Most recent data from 2011 and 2010 detail 10,000 harvested acres of upland cotton generating 1,392 pounds per acre for a total production of 29,000 bales. Examining other crops, 4,400 harvested acres of durum wheat produced 396,000 bushels and 2,000 harvested acres of alfalfa hay produced 19,000 tons.

### Number of Farms

In quantifying the number of farms within the county, the census included the North American Industry Classification System (NAICS) code 112990; All Other Animal Production. This class, the second largest represented in terms of number, describes specialty and miscellaneous activity as well as dog kennels and bird, rat and worm production, industries not impacted by drought to the same degree as farms and ranches. The number of what could be considered traditional farms and ranches, to include livestock such as llamas and alpacas, is somewhat lower.

With 218 farms, or ranches, beef cattle represents the majority of operations in the county, 35%. There are 202 farms classified by NAICS as other animal production, or 32% of all farms. The next most predominate type of farm is greenhouse, nursery or floral operations. For better clarity, if NAICS code 112990 is removed, beef cattle farms constitute 52% and greenhouses and nurseries 11% of working farms- followed by sheep and goat farms (9%), poultry and egg production (7%), hay, sugarcane and other crops (6%), cotton farms (4%), dairy cow and milk (4%), Fruit and nut orchard (3%), hog and pig farms (2%), vegetable, melon and potato farms (1%) and oilseed and other grain (1%).

Regionally, a majority of farms are located in the Marana area with some situated along the Brawley Wash- these operations producing mostly durum wheat, cotton, barley and sorghum. There is some production along the San Pedro River, in the county's northeast boundary, of oat and alfalfa.

### Market Value

The sale of cattle and calves, 11,687 in 2007, represents the vast majority of livestock sales in Pima County, totaling \$7.5 million. Factoring in sheep and goat sales of \$111,000, poultry and egg production (\$44,000) and hog and pig sales (\$53,000), cattle and calve operations were 97% of livestock market value.

Other livestock production is tracked though market value is not disclosed, such as the sale of horses and other equines, miscellaneous animals and various animal products, to include honey and wool.

Nursery and greenhouse production includes floriculture crops, cut flowers, garden plants, indoor foliage plants, potted flowering plants and greenhouse vegetables and herbs. Value of sales within this subsector totaled \$6.3 million, a marked decline from the previous agricultural census in 2002 which recorded \$30 million in sales, though that would include landscape nursery sales correlating to the housing boom. The census calculates approximately 2 million square feet of green house or similar protected area within the county.

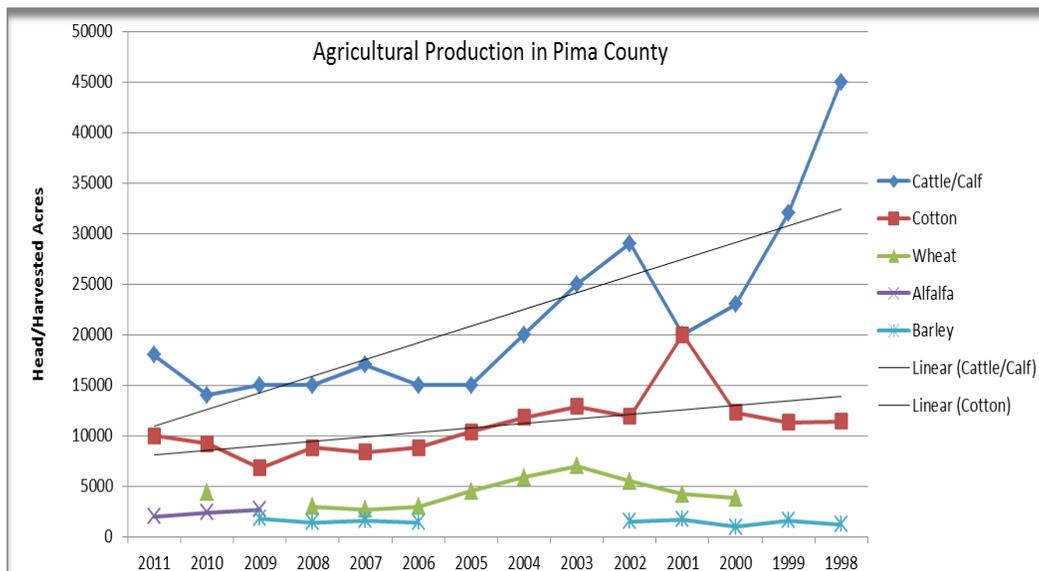
At \$4.2 million in market value, grain, oilseed and dry bean and pea sales increased 45% from 2002. Wheat sales totaled \$1.96 million followed by hay and other crops (\$1.43 million), sorghum (\$1 million), barley (\$806,000), and finally, vegetable, melon and potato sales (\$328,000). Data of cotton and cottonseed sales were not disclosed in either the 2007 or 2002 census.

### Production

Pima County is not a major agricultural producer in Arizona, though it consistently ranks 6<sup>th</sup> in cotton and 5<sup>th</sup> in durum wheat production since 1998. Yuma leads the state, followed by Maricopa, Pinal, Graham, La Paz and Cochise counties. Pinal County is the primary livestock producer- over \$600 million in sales in 2010. With a large cattle inventory in 1998, Pima County ranked 6<sup>th</sup> in the state at the time but after a 60% reduction in herd numbers, fell to 9<sup>th</sup> and has fluctuated as low as 11<sup>th</sup>.

In 2007, Pima County produced 39,232 bales of cotton from 16,227 harvested irrigated acres, compared to Pinal production of 224,237 bales from 73,718 acres. Durum wheat and barley production by the agricultural counties is in the millions of bushels, surpassing Pima County's farming sector, harvesting several hundred thousand bushels.

With \$15 billion in retail sales and merchant wholesale, Pima County's agricultural sector comprises less than one percentage (0.5%) of the regional economy and a fraction (0.08%) of its employment. However, ranching and farming are considered important to the history and culture of the county, which has taken steps to preserve tradition.



## Energy and Mining Economic Sector

### Electric

Electric utilities operating in Pima County are Tucson Electric Power (TEP)- owned by UniSource Energy, Trico Electric Cooperative, Sulphur Springs Valley Electric Co-Op, Arizona Public Service, and Ajo Improvement Company. Specific employment numbers are not available though economic Census Bureau data categorizes a range of between 1,000 and 2,500 county residents employed by the electric utility sector.

TEP serves some 400,000 customers in the Tucson Metro region while UniSource provides natural gas and electric to 235,000 customers in northern and southern Arizona. TEP's service boundary includes Green Valley, Sahuarita, Corona de Tucson, the SR-83 corridor, Vail, Tucson, Catalina Foothills and Marana along the I-10 corridor.

TEP receives power from a number of coal-powered generating stations in which it has a varying percentage of ownership. In northwest New Mexico, at the *San Juan station* TEP produces 340 MegaWatts (MW) and at *Four Corners station*, 110 MW. *Luna station*, in southwest New Mexico, generates 190 MW for TEP. In Arizona- the *Navajo station*, 168 MW; *Springerville station*, 777 MW; and locally at the *Irvington station*, 586 MW. In total, TEP has access to 2,651 MW of electric power produced from generating stations in the metro area as well as across the state and in New Mexico, to include power purchasing agreements<sup>8</sup>. Two-thirds of TEP's capacity is powered by coal, one-third by natural gas.

Arizona's Generation and Transmission Cooperatives provide generation and transmission to rural customers through its membership. Arizona Electric Power Cooperative (AEPCCO) is responsible for generation. "Rural electric co-ops were first established in the 1930s to bring electricity to rural areas that for-profit utilities refused to serve. Leaders adopted a cooperative business model where customers are owners. By the 1950s, local distribution co-ops outgrew their ability to meet the growing energy needs of their members. They formed their own power generation and transmission (G&T) cooperatives. Four Arizona electric co-ops formed AEPCCO in 1961"<sup>9</sup>- which includes Trico Electric and Sulphur Springs Valley. Arizona Electric Power Cooperative owns and operates the coal and natural gas powered Apache generating station in Cochise, Arizona, which is capable of 605 MW of generation.

Trico's service area surrounds the regions adjacent to, but outside, TEP service area and extends, according to the Arizona Corporation Commission, to include a majority of Pima County. Sulphur Springs Valley is primarily a service provider to Cochise County but extends service to the southeastern border of Pima County.

Arizona Public Service (APS) is the largest provider in the state, serving central Arizona from Casa Grande to Flagstaff and various pockets around smaller communities. Conversely, APS is a smaller provider in Pima County; APS transmits electric to the Ajo area and the northeast corner of the county.

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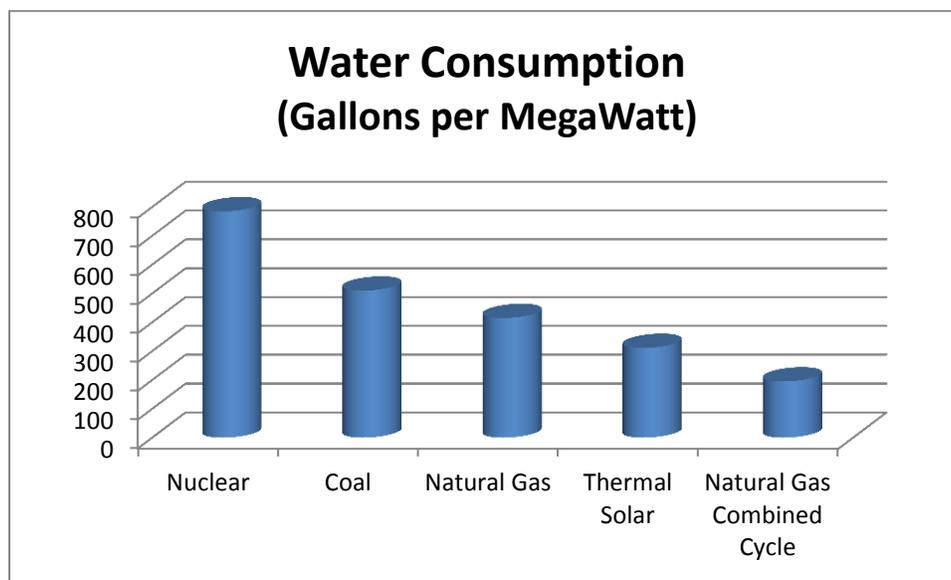
<sup>8</sup>TEP & UNS 2011 Summer Preparedness Report, Apr 11, 2011.

<sup>9</sup><http://www.azgt.coop/azgt-cooperative-energy/member-owned/>

APS's generating station portfolio includes: *Four Corners station*, 782 MW; *Cholla station*, near Holbrook, 615 MW; *Navajo station*; *Redhawk natural gas station*, near the Palo Verde plant; a west Phoenix natural gas station; and *Palo Verde Nuclear Generating Station*, of which APS operates and owns 29.1 percent.

Water consumption by generating station fuel type varies. Nuclear power plants consume 785 gallons per MW hour. Coal burning plants require an average of 510 gallons per MW hour; natural gas, 415 gallons; and natural gas combined cycle, 195 gallons. Thermal solar plants consume on average 311 gallons per MW hour though large plants in California require between 800-1000 gallons<sup>10</sup>. Of course, photovoltaic solar and wind energy do not require water.

**Figure 3-Water Consumption by Fuel Type**



Solar

Given the climate of our region, local governments and their partners hope to capitalize on and expand the solar energy sector. From Pima County's Solar One Stop and Renewable Energy Incentive District program to the City of Tucson's designation as a Solar America City, local government recognizes the potential for growth in research and development of renewable energy in the county.

TREO counts 35 established solar companies in the county engaged in manufacturing, distribution and installation, while the US Energy Information Service records the following solar plants in the county:

1. Amonix UASTP Solar Power Station 1.9 MW
2. Prairie Fire Tucson Electric Power 5 MW
3. UASTP I Tucson Electric Power 1.2 MW

<sup>10</sup> ASU, School of Geographical Sciences. The Water Costs of Electricity in Arizona. Martin Pasqualetti, Scott Kelley. Dec 22, 2008.

4. UASTP II Tucson Electric Power 2.8 MW
5. Picture Rocks Solar, LLC NVT LICENSES, LLC 20 MW
6. Roger Road WWTP SunE M5C Holdings LLC .9 MW
7. Avra Valley Solar First Solar Energy LLC 25 MW
8. RE Ajo 1 LLC 4.5 MW

#### Mining

Mining is not necessarily incompatible with Pima County's long-term goals provided disturbance to the Conservation Land System (CLS) is manageable. The County Administrator has concluded development of "high job generating, high salary generating copper mining enterprise that does not compromise our environmental and other community values" is possible.<sup>11</sup>

Arizona is the top copper producing state in the nation, extracting more than \$2 billion in mineral commodities in 2012, though declining from record \$7.5 billion in 2007 sales.<sup>12</sup> Of all US domestic copper mining- 1.15 million tons worth \$9 billion- 99% of production originates from eighteen mines in the West, Arizona leading. Pima County's mines ranked fourth, fifth and sixth among the state's copper operations. Demand remains high, as export to developing countries, mainly China, continues to increase leading to a projected increase in production.<sup>13</sup>

Copper prices have reached several record highs, \$4.62 per pound in February 2011, but some market volatility remained through 2011. Current prices (December 2013) range from \$3.18 to \$3.37 per pound depending on type of production. Molybdenum now trades between \$12 and \$9 per pound, a dramatic decrease from the 2007 price of \$29.91 per pound.

Census statistics tally NAICS coded mining, quarry, oil and gas extraction industries responsible for \$145 million in annual payroll (2011) originating from 39 firms, oil and gas extraction a small subset. Categorized employment is between 1,000 and 2,500. Large mining operations in the county include the Sierrita and Mission Mines in Green Valley, extracting copper and molybdenum, and the copper producing Silver Bell Mine in Marana. The cement Rillito Mine, CA Portland Cement Company's site, and other sand and gravel pits are present in the county as well. The proposed Rosemont Mine continues through the environmental impact analysis process though Pima County has deemed impact to the CLS unmanageable given the magnitude of disturbance.

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<sup>11</sup> June 22 2012 County Memo, A Tale of Two Mines- A Analytical Comparison of the Proposed Rosemont Copper Mine with the Proposed Oracle Ridge Mine.

<sup>12</sup> Ascarza, William. "Mine Tales: Copper Isn't the Only Mineral Common in Arizona." Arizona Daily Star, 4 Nov. 2013. Web. <[http://azstarnet.com/news/local/mine-tes-copper-isn-t-the-only-mineral-common-in/article\\_63b82335-f729-5467-b225-04fb663a13e7.html](http://azstarnet.com/news/local/mine-tes-copper-isn-t-the-only-mineral-common-in/article_63b82335-f729-5467-b225-04fb663a13e7.html)>.

<sup>13</sup> USGS 2013 Mineral Commodity Summaries. Daniel Edelstein. <http://minerals.usgs.gov/minerals/pubs/commodity/copper/mcs-2013-coppe.pdf>

Freeport McMoRan operates the Sierrita Mine, the nation's fifth largest copper mine<sup>14</sup> producing 177 million pounds of copper in 2011, employing more than 1,200. Literature distributed by Freeport claims a direct and indirect economic impact of \$286.7 million in Pima County and employee compensation of \$99 million and secondary job creation of some 4,500 positions<sup>15</sup>. Expansion of mining activity at this site is under consideration.

ASARCO produced 134 million pounds of copper concentrate in 2012 at the nation's seventh largest mine- Mission Mine, which employed 620 with annual payroll and benefits of \$58 million. The Silver Bell Mine, ranked 13<sup>th</sup> in the country, also an ASARCO operation, employed 175 with payroll and benefits totaling \$16.6 million. Production at Silver Bell was 45.9 million pounds of copper in 2012.

Copper production in Pima County has remained relatively stable during the past decade, each mine extracting approximately the same tonnage every year, although all are dwarfed by the very large Morenci Mine (800 million pounds per year). Water consumption used in production fluctuates depending on multiple factors- average gallons per pound of copper produced was highest at the Sierrita Mine (54.6), followed by the Mission Mine (25) and Silver Bell (6.7)<sup>16</sup>.

### Hunting, Fishing and Other Outdoor Recreation Economic Sector

#### Hunting and Fishing

An Arizona State University study, *The Economic Importance of Fishing and Hunting*, tallied 2001 expenditures and wages and jobs generated for each county, finding these activities to have been an "immensely powerful part of the Arizona collective economic fabric" with a statewide economic impact of \$1.34 billion supporting 17,190 jobs.

In Pima County, hunters spent \$8.2 million on equipment and \$9.4 million on trip expenses- \$17.6 million total. Arizona Game and Fish measured 131,345 hunter days active in the county- 42,130 of those were travelers to the region, 65% of Arizona travelers from Maricopa County. Total fishing expenditure topped \$66 million, \$22.7 million in trip expenses and \$44.2 million in equipment purchases as anglers, mostly local residents, were active for 153,893 fishing days. Combined, \$84.5 million was spent in county- the local associated businesses employing 1,187 residents, paying \$18.3 million in wages and generating \$5.4 million in state and local tax revenue

#### Wildlife Watching

In a more recent report, the Tucson Audubon Society surveyed participants observing, feeding or photographing wildlife, or non-consumptive activities, both at home and traveling to a wildlife watching destination. Total retail sales in Pima County related to birding and similar activity was \$179 million in 2011, factoring in a multiplier effect sums to \$304 million. Payroll for associated 2,736 industry jobs was

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<sup>14</sup>USGS 2011 Minerals Yearbook

<sup>15</sup>L. William Seidman Research Institute, Arizona State University

<sup>16</sup> Arizona Department of Mines and Mineral Resources. Water Consumption at Copper Mines in Arizona. Special Report 29. M Singh. Dec 2010.

\$98 million. Of total retail sales, \$41 million was spent by neighboring county residents and \$42 million from out of state travelers. The county's economic activity generated \$20 million in state and local tax revenue.

### Other Outdoor Recreation

A similar study to the ASU economic analysis of hunting and fishing reviewed OHV (off-highway recreational vehicle) activity, where a vehicle such as an ATV, 4-wheel drive, SUV, motorcycle or sand rail was used as recreation or to engage in outdoor activity (hunting, fishing, camping, hiking, sight-seeing, etc.). Pima County residents spent \$112 million on OHV vehicles in 2001, \$323 million in total OHV spending to include \$71.7 million on trip expenses such as fuel (\$24.2 million), lodging (\$5.5 million) and food (\$14.1 million) and groceries (\$17.5 million) as well as \$139.4 million on accessories and equipment. "Driving back roads" and "Sightseeing" were the most popular activity with 836,803 OHV days occurring in the county, just over a third travelers from other counties. In all, this sector had a \$400 million economic effect with 3,307 industry employees receiving \$84 million in wages and generating \$17.7 million in state and local tax revenue.

### Tourism and Sports Economic Sector

Three and a half million tourists travel to Pima County each year, a majority enjoying outdoor attractions such as Saguaro National Park and the Arizona-Sonoran Desert Museum, combined with other major events like the world's largest gem and mineral show, PGA's Accenture Match Play and the Vaqueros Rodeo Parade. In 2011, tourist recreation, lodging, dining, shopping and entertainment venues generated \$2.4 billion in sales in Pima County, supporting over 21,000 local jobs. Visitors spent \$627 million on food services, \$422 million on shopping and \$320 million on other travel spending. \$976 million is generated by visitors from Mexico. Maintaining and expanding the region's tourism is a priority for the county's economic development organizations, TREO and the Metropolitan Tucson Convention and Visitors Bureau. Of the \$154 million in local taxes generated, a portion is directed to the county's Sports and Tourism Bureau to further promote this sector and youth and amateur sports, an economic driver in its own right<sup>17</sup>.

The county supports El Tour de Tucson which attracts 9,000 cyclists, approximately half visiting to the area, and 30,000 spectators generating \$80 million<sup>18</sup>. Amateur league play at Kino Sports Complex is promising with over 500 games played during the 2011 amateur baseball season. County investment in the facility is luring amateur baseball, soccer and other sports<sup>19</sup>. The Fort Lowell Soccer Shootout brings

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<sup>17</sup><http://www.visittucson.org/media/tourism-pays/tucson-pima/>

<sup>18</sup><http://tucsoncitizen.com/pima-county-news/category/sports/>

<sup>19</sup><http://tucsoncitizen.com/pima-county-news/2012/08/07/amateur-sports-at-kino-sports-complex-benefits-the-whole-community/>

more than 300 teams to the county and accounts for over \$3 million in direct spending<sup>20</sup>. Not to be overlooked, the county's only ski resort, Mount Lemmon Ski Valley recorded over 190,000 in attendance in 2011.

### Forestry and Logging Economic Sector

This economic sector does not have a significant presence in Pima County. Extrapolating from employer statistics, the Census Bureau's 2011 County Business Pattern report shows 21 businesses with a combined employment of less than 250 employees (a categorized range of 100 to 249) in the Agriculture, Forestry, Fishing and Hunting sector<sup>21</sup>- most of which occurs in agriculture. Annual payroll, in 2011, was \$4.3 million. The 2010 Non-Employer Statistics report recorded ten businesses, comprised mostly of sole proprietorship establishments, associated with specific forestry and logging industry code, with \$286,000 in receipts that year, a decline from the previous year's \$420,000. The relative small size of this sector precludes it from mitigation discussion.

### Municipal and Industrial Water Sector

The county is served by 22 water providers- a mix of private water companies, improvement districts and municipal and governmental water systems<sup>iii</sup>. Pima County is not a water provider though unincorporated residents in the county receive water from Tucson Water and other smaller water providers. County residents could be impacted by water supply curtailment of the M&I sector, however those providers maintain their own jurisdiction and elected boards, of which the county has no authority. The county has worked closely with all water providers and will continue to do so in water planning efforts. The infrastructure, regulatory structure and planning processes associated with the regions' water companies has been thoroughly covered during the City/County Water and Wastewater Study and Action Plan<sup>22</sup>, adopted in 2010.

It is important to note that in Arizona, M&I drought plans are a requirement for community water systems. Per ARS Section 45-342, both small and large providers are to submit a System Water Plan<sup>iv</sup> that includes a water supply plan, water conservation plan, and drought preparedness plan and provide and update to ADWR every five years. In addition, Annual Water Use<sup>v</sup> reports are required as well, in an effort by ADWR to "help ensure that community water systems reduce their vulnerability to drought and are prepared to respond to potential water shortage conditions"<sup>23</sup>.

The Central Arizona Ground Water Replenishment District (CAGR) facilitates development in Active Management Areas (AMA's) where infrastructure is lacking to deliver renewable water. CAGR Member Lands and Member Service Areas are subdivisions and water providers or local governments,

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<sup>20</sup>Johnson, Kyle. "Tucson Soccer Enticing Sports Tourism." Arizona Sonora News Service, n.d. Web. 11 Mar. 2014.  
<<http://arizonasonoranewsservice.com/stories/34-stories/274-tucson-soccer-enticing-sports-tourism>>

<sup>21</sup>Defined as establishments primarily engaged in growing crops, raising animals, harvesting timber, and harvesting fish and other animals from a farm, ranch, or their natural habitats.

<sup>22</sup><http://www.tucsonpimawaterstudy.com/>

<sup>23</sup><http://www.azwater.gov/AzDWR/StatewidePlanning/Drought/CWS.htm>

respectively that enroll for legal authority to pump groundwater and then have the GRD manage the required recharge for that groundwater pumping. The GRD recovers the cost of operation through property tax bills, in the case of enrolled subdivisions, and water provider rate schedules.

GRD's water supply portfolio includes a CAP M&I priority subcontract, water and effluent leases and purchase of long term storage credits, with the goal of acquiring 25,000 acre-feet per year (afy) by 2015. Excess CAP no longer reliably available as part of its portfolio, GRD is planning an acquisition strategy that includes effluent, Colorado River entitlements and fallowing, reallocations and credit purchases to meet a projected demand of 136,500 afy by 2035. Costs will increase to subdivisions through taxes and through water companies increasing rates to cover the acquisition of new water to recharge in order to meet obligations. In the Tucson AMA, 93% of subdivisions are enrolled either as a Member Land or Service Area.<sup>24</sup>

While not a water service provider, Pima County can employ demand management strategies through land use planning and development standards. County water conservation Code amendments were enacted in 2006 and 2007 requiring low use fixtures, renewable water use requirement for turf facilities, irrigation conservation measures and restrictions on fountains and water features. The county encourages sustainable home building through its Green Building and LEED Certification programs. The Comprehensive Plan's Water Resource Element helps to clarify water supply and use impacts of requested land use changes. All are examples that contribute to drought preparedness and mitigation through water and energy conservation. However, discussion within Pima County's Local Drought Impact Group (LDIG) suggested county land and resource management adapt and incorporate drought mitigation more robustly; progression beyond policies promoting water conservation to policies derived from an expectation of "a new normal" of severe and prolonged drought, to include associated impacts. Counties draft conservation and climate change planning within their Comprehensive Plans and development standards to varying degree; unknown at this time is the willingness of the public, or appropriateness, of county Development Services initiating adoption of more stringent strategies considered elsewhere, such as creating disincentives (fines) for conventional, non-LEED certified new construction or mandating water efficient fixtures as retrofit for existing buildings.

Suggested adaptation discussed low impact development (LID), an approach to stormwater management that allows more natural hydrologic function within development by forgoing complex infrastructure and engineering designed to shed water expeditiously for increased infiltration of rainwater into the local aquifer. Green space is key to LID strategy of managing stormwater as close to its source point as possible. Natural landscape features and pervious surfaces control water runoff effectively and more economically than conventional stormwater engineering while filtering runoff. Other benefits are realized by the supported green space that improve quality of life for the surrounding neighborhood to include "enhanced property values and re-development potential, greater marketability, improved wildlife habitat, thermal pollution reduction, energy savings, smog reduction, enhanced wetlands

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<sup>24</sup> Central Arizona Groundwater Replenishment District Membership in the Tucson Active Management Area 2005-2009. Pima Association of Governments, Sept. 2011.

protection, and decreased flooding.”<sup>25</sup> Expanded application of LID can help maintain or restore watershed level flows and ecology.

In practice, LID employs multi-benefit bio-retention basins, urban forest streetscapes, rain gardens, green rooftops and bio-swales as well as retro-fitting techniques such as curb cutting to direct rainwater into street side green basins. Pima County has prepared LID guidance documents based on case studies and best management practices compiled through its LID Working Group<sup>26</sup> and PAG encourages incorporation of LID design into projects and land planning efforts. A successful example of such design is the Kino Environmental Restoration Project (KERP), which captures stormwater for irrigation while sustaining recreated upland and riparian habitat.

### **Potential Sector Impacts**

Some impacts are universal across sectors. Threat from wildfire, increased operating or maintenance costs, decreased spending, revenue and production, sector unemployment and reduced quantity, quality and reliability of water supplies threaten drought sensitive sectors as a whole.

#### Wildfire

In addressing the threat of wildfire, Pima County’s Community Wildfire Protection Plan (CWPP) is an effort to improve fire prevention and suppression of identified at-risk public and private lands in the wildland-urban interface (WUI). A number of tactics are employed to reduce fire risk and priority is assigned to the WUI and the municipal watersheds and critical wildlife habitat within. The CWPP recognizes the need to reduce hazardous vegetative fuels while improving watershed and range health and restore ecosystem processes to improve resiliency- cooperating regional fire agencies are encouraged through the plan to adopt these same goals that include consideration of watershed and riparian health given that “wildlife, and unique plant communities, especially desert areas with saguaro cactus, (are) important economically for maintaining property values and tourism.”

Following the creation of Core Teams, significant analysis of various factors (vegetative fuel type, normal and extreme rainfall years, topography, population density, slope, native/non-native species, etc.) identified 1.5 million acres of WUI; 18% of these acres are deemed to have high resource value as cultural, historic, or sensitive wildlife habitat areas and watersheds, another 8% classed as having high fire risk and 59% at moderate risk. The CWPP concedes additional site-specific analysis of fuel and vegetation treatment within sensitive species habitat may be needed given complexity of habitat conservation plans and threatened and endangered populations.

Overall, the CWPP has taken into account the “environmental, economic, and aesthetic resources” of the county and responded accordingly with a strategy that prioritizes resource protection and fuel reduction and is informed of drought and non-native vegetation impact:

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<sup>25</sup> Stormwater Strategies Chapter 12 Low Impact Development." Wwww.nrdc.org. Natural Resources Defense Council, n.d. Web. 9 Apr. 2014. <<http://www.nrdc.org/water/pollution/storm/chap12.asp>>.

<sup>26</sup> <http://rfcd.pima.gov/pdd/lid/workinggroup.htm#background>

*Many of these wildland fire ignitions have occurred within areas infested with nonnative grasses such as buffelgrass, red brome, and Mediterranean grass...Continued extreme weather conditions, dry fuels, increased nonnative invasive vegetation, and increased fuel loading on federal and nonfederal lands contribute to the potential for catastrophic wildland fires within Pima County. Wildfires... exhibit erratic behavior due to dry light and heavy fuels from high average daily temperatures and seasonal droughts. In recent years, the southwest United States has experienced widespread and intense drought, which has been stressing forests (Karl et al. 2009). Record wildfires are also being driven by rising temperatures and related reductions in spring snowpack and soil moisture (Westerling et al. 2006). Associations between wildfire and hydroclimate in western forests indicate that increased wildfire activity over recent decades may be tied to reduced winter precipitation and an early spring snowmelt, particularly in mid-elevation forests (Westerling et al. 2006). If the Southwest becomes warmer and drier, as projected by many climate models, wildland fire seasons are anticipated to increase in length and severity driven by rising spring and summer temperatures and related reductions in spring snowpack and soil moisture (Karl et al. 2009; Westerling et al. 2006; USDA 2012). If periods of extended drought and warmer temperatures become more common in Pima County, increases in wildland fire occurrences, particularly in higher-elevation vegetation associations, and fire severity can be anticipated.*

Appropriate vegetative types can absorb the natural process of fire, thus critical wildlife habitat restoration and non-native eradication is a purposeful fire suppression tactic. To that end, the CWPP stresses partnership with the Southern Arizona Buffelgrass Coordination Center (SABCC) and private landowners in completing fuel modification plans supplemented by inmate labor crews working Treatment Management Units. Public education and reporting is an important component; homeowners can help by reviewing their property for compliance with the Firewise Communities program recommendations while SABCC has developed a smartphone app that records individual reports of buffelgrass infestation to improve eradication efforts and mapping of high risk areas.

#### County Assets

Neither a water provider nor engaged in drought sensitive industry, impacts to the county are varied and can be most profound at the second order- loss of tax base from decreased economic output, for instance. Direct impacts are more straightforward- loss of buildings or assets to fire or loss of landscaping. The most significant vulnerability is to county open space lands and planning efforts, in which case county asset vulnerability overlaps with environmental vulnerability. Impacts across county departments include:

1. Increased management requirements
2. Decreases in revenue
3. Loss of groundwater wells
4. Diminished water rights inventory

Foregoing a detailed scientific analysis of drought impact to county land, it is important to note drought, combined with sector water use, has already degraded riparian areas in the county's land inventory. The Water Resources Research Center (WRRC) has undertaken an environmental water needs assessment, examining and compiling the existing science of environmental water needs, or e-flow, necessary for the

maintenance of healthy aquatic ecosystems and riparian areas. This effort will help quantify streamflow volume needed to support these environs<sup>27</sup>.

Suffice for this discussion, riparian habitat decline is underway. The Cienega Creek has experienced decreased stream flow, as documented by PAG's "Drought Impacts on Flow Extent Along Lower Cienega Creek" report:

*The perennial flow extent was reduced to 0.93 miles in June 2013, the lowest flow extent on record and 0.31 miles shorter than the previous June. This is only 10% of the flow extent compared to the wet years in the mid 1980s when fully 9.5 miles flowed in Preserve during the dry season<sup>28</sup>.*

Cienega Creek and its wildlife and plant diversity have been recognized as a state resource, earning an "Outstanding Water" designation (R18-11-112) by the Arizona Department of Environmental Quality (ADEQ). As a result, site-specific water quality standards are established to maintain and protect the existing water quality. The certificate of in-stream flow rights was granted by the Arizona Department of Water Resources (ADWR) to Pima County Regional Flood Control District in December 1993 (No. 89090.0000). Both Cienega and Davidson Canyon have priority aquatic and riparian resources as specified in the Sonoran Desert Conservation Plan.

Similar decline is recorded at Sabino Creek, Arivaca Creek, Bingham Cienega and the Upper Cienega Creek and San Pedro River. To compensate for increased aging and morbidity of cottonwood species, the US Fish and Wildlife Service has planted replacement cottonwoods in the Arivaca Cienega. Drought induced decline of riparian habitat has reduced the leopard frog's range, resulting in a decline of that population in Cienega Creek and elsewhere. Dying trees and brush remain as fuel for wildfire increasing the potential for scorching and sterilization of the soil- thus precluding any replacement growth<sup>29</sup>.

The County's Natural Resources, Parks and Recreation Department (NRPR) has measured the natural spring at Agua Caliente Regional Park, recording decline over the past decade. Lack of recharge to the aquifer has caused flow to reduce from 106 gallons per minute in 2000 to 13 gpm in 2003, eventually ceasing flow in 2012. In that time, the park's three ponds have been reduced to one, which is supplemented with up to 65,000 gallons a day of groundwater to maintain below normal water level.<sup>30</sup>

County riparian restoration and flood control projects rely mostly on effluent as a water source. Some projects utilize storm water collected after flood events from detention basins or rain water harvesting, which of course receive less water during drought. Discussion with project managers included the consideration that effluent may be put to other uses, stressing the need for resilient design that does not

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<sup>27</sup> WRRRC, Environmental Flows and Water Demands: Southeastern Arizona Region, July 2012.

<sup>28</sup> PAG. Drought Impacts on Flow Extent Along Lower Cienega Creek. August 2013

<sup>29</sup> Davis, Tony. "Cienega Creek, Other S. AZ. Streams, Increasingly Dry." Azstarnet.com. Arizona Daily Star, 29 July 2012. Web. 03 Jan. 2014. <[http://azstarnet.com/news/science/environment/cienega-creek-other-s-az-streams-increasingly-dry/article\\_f0e30953-13be-5a93-86e0-4fe6ae6a061b.html](http://azstarnet.com/news/science/environment/cienega-creek-other-s-az-streams-increasingly-dry/article_f0e30953-13be-5a93-86e0-4fe6ae6a061b.html)>.

<sup>30</sup> Jung, Yoohyun. "Historic Park's Pond Drying Because of Drought." AZPM.org. Arizona Public Media, 29 Aug. 2013. Web. 09 Mar. 2014. <<https://www.azpm.org/p/home-featured/2013/8/29/26428-historic-parks-pond-water-drying-because-of-drought/>>.

rely on groundwater and sustains wildlife habitat<sup>31</sup>. Should effluent dependent restoration projects receive diminished allocations, they would be susceptible to the same drought stressors non-effluent riparian areas are currently experiencing. Curtailment of the water supply translates into decreased effluent production and thus declining long term storage credit accumulation and less water available for restoration.

The county's parks provide recreation and a venue for amateur and youth sports. Turf and park landscape experience reduced growth and die back of annual roots from reduced photosynthetic activity and decreased pest resistance in turn during drought. This increases the cost of maintenance as more water and chemical application is needed for pest and weed control to maintain plant health. Park districts have reported increased injury, and thus liability, due to hard fields<sup>32</sup>.

### Agriculture and Ranching

This sector is not a significant economic driver in Pima County, though it is a valued cultural tradition and as previously mentioned, helps define an urban boundary while keeping intact biologically important habitat. Perhaps the most sensitive sector, impacts include:

1. Loss of crop, decreased yield
2. Loss of livestock, reduced herd size and limited forage availability
3. Decreased, unreliable water for irrigation and livestock
4. Higher feed and water costs, increased consumer prices
5. Reduced livestock health and birthing rates
6. Forced sell of livestock

Ranching is becoming cost prohibitive as forage conditions decline and ranchers are forced to rely on feed. Across central Arizona, cattle operations are selling off approximately 20% of their herds in response to drought conditions and preparing for more liquidation. This has long term implications as herds must be reconstituted over many years. In the short term, beef prices, already impacted by drought, will continue to rise.<sup>33</sup>

Agricultural production loss in the state has resulted in all 15 counties, including Pima County, declared as natural disaster areas by the USDA.<sup>34</sup> Forage production across the state was 66% of average in 2013 with below average production expected to continue; livestock water shortages were reported across Pima County and cropland water shortages in the Upper San Pedro area.<sup>35</sup>

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<sup>31</sup>WRRR. Riparian Restoration Efforts in the Santa Cruz River Basin. Fabre, Cayla. March 2009.

<sup>32</sup><http://www.sdaco.org/m/downloads/2013/T-1%20The%20Drought%20Will%20Impact%20All%20of%20Us.pdf>

<sup>33</sup> Patrick, John. "Arizona drought forcing ranchers to sell cattle" KVOA.com. KVOA News, 06 Feb. 2014. Web. 09 Mar. 2014. <<http://www.kvoa.com/news/arizona-drought-forcing-ranchers-to-sell-cattle/>>.

<sup>34</sup> Ronquillo, Ina. "USDA drought declaration now covers all of Arizona" KGUN9. KGUN News, 07 Mar. 2014. Web. 09 Mar. 2014. <<http://www.jrn.com/kgun9/news/USDA-drought-declaration-now-covers-all-of-Arizona-249075751.html>>.

<sup>35</sup> Natural Resource Conservation Service

## Energy and Mining Sector

Energy generation and mining can have water intensive production processes. The energy/water nexus describes the requirement of both for the delivery of each. As demand for energy increases, energy production will demand more water. And water cannot be delivered or recovered from wells without energy. Energy is a significant cost component of water production, delivery and wastewater treatment.

Research during the Colorado plan found that this sector had some buffer from drought given these industries generally had senior water rights yet “there are compound impacts between power producers and the mining industry because nearly all of the current power generation in (Colorado) is fossil fuel based. Any impacts to the mining industry will in turn impact power providers and the effects will cascade back to water providers, mining, and society as a whole<sup>36</sup>.” Impacts to consider include:

1. Decreased, unreliable water for processing
2. Decreased production, increased import from other electric generating stations
3. Increased consumer cost
4. Electrical power cutbacks, rolling brownouts, blackouts
5. Secondary impacts from power outages (public health threat, economic interruption)
6. Infrastructure loss and outages from wildfire

Analyses of incidents in Arizona indicate the energy sector is vulnerable to weather extremes. The Springerville Generating Station came under threat during the Wallow Fire in 2011. Forecast models illustrated the potential cascading failure. Peak energy demand during extreme temperatures, associated with drought, strains infrastructure trying to generate and transmit enough electricity for air conditioning, which constitutes 70% of residential consumption. A September 2011 blackout in Arizona and California occurred for multiple reasons but a report noted the heavy power imports required during record heat days. Of note- it took 11 minutes for the cascading failure to occur, lasted 12 hours and cost the San Diego area alone \$100 million in lost economic output. Public health was threatened as sewage spilled onto beaches after pump failures. It is plausible brownouts and blackouts will increase as well as the negative economic impact of such events.<sup>37</sup> TEP states it has active extreme event response plans in place with emergency towers and specialty replacements packages for deployment.

Electricity costs will rise for the consumer due to decreased hydroelectric efficiencies, increased cooling water costs and air quality controls. Summer demand generation is already twice as costly as off peak generation. The under-utilized solar generating capacity of Arizona must be considered- estimates place that capacity at approximately 2.5 gigawatts of concentrating solar electricity capable of delivering 5.8 gigawatt hours.<sup>38</sup>

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<sup>36</sup> Colorado Drought Mitigation and Response Plan Annex B. August 2013

<sup>37</sup> Sundt, Nick. "Rising Temperatures Expose Cities' Vulnerable Electrical Supplies." ClimateScienceWatch.org. Climate Science Watch, 24 May 2012. Web. 10 Mar. 2014. <<http://www.climatesciencewatch.org/2012/05/24/rising-temperatures-expose-cities-vulnerable-electrical-supplies/>>.

<sup>38</sup> Repetto, Robert. "Economic And Environmental Impacts of Climate Change In Arizona." Demos.org. Demos, n.d. Web. <[http://www.demos.org/sites/default/files/publications/AZ\\_ClimateChangeInTheStates\\_Demos.pdf](http://www.demos.org/sites/default/files/publications/AZ_ClimateChangeInTheStates_Demos.pdf)>.

### Hunting, Fishing and Other Outdoor Recreation

Drought stresses habitat and impacts game which in turn impacts associated consumptive and non-consumptive uses. Arizona Game and Fish hauls an average of 400,000 gallons of water each year to remote catchments to keep wildlife alive through the summer. Taxes from sales in this sector benefit conservation programs which then suffer from decreased spending at a time when more money is needed. Impacts include:

1. Increased wildlife mortality, reduced health and birthing rates
2. Loss of critical habitat, dry streams and springs
3. Increased competition further reduces population, drives game to urban areas
4. Increase in rabies and disease, human interactions with wildlife
5. Decreased participation, decreased money for management
6. Threat from wildfire causing forest, campground closures
7. Disruption in animal behavior, migrations

### Tourism and Sports

Sectors interdependent upon each other compound impacts due to related vulnerabilities. Many county assets are environmental and recreational assets that draw tourism. Many factors influence personal decision in choosing recreation, or business conference and retreat destinations. Analysis of “a marked hot-season drop-off of business travel to Arizona, measured by business segment hotel rooms sold during the summer months” points to the deterrent effect of prolonged and excessive summer heat (exacerbated by urban heat island effects). Further experience “confirms that visitation is highly sensitive to climate and its effects. Controlling for other influences, drought reduces visits to some national parks by seven percent.”<sup>39</sup>

Given the complexity of tourism, the full range of impacts may be obscure but direct impacts include:

1. Decreased visitation, length of stay, participation and revenue
2. Increased operational costs

### Environment

Environmental impacts for this analysis are considered in the context of a county or economic nexus. Habitat loss and decreased biodiversity from drought, or secondary impact of wildfire or disease, has wide ranging impacts and is not easily quantified or mapped. It is not possible to assign a value to Pima County's environment though it is an economic driver. Habitat lost is not recovered without expensive restoration and even then natural ecological functions may not return, leaving permanent disruption.

Shallow groundwater areas provide water to more sensitive wildlife habitats that are part of larger wildlife corridor systems. PAG's “Shallow Groundwater Areas in Eastern Pima County, Arizona” report has documented 32 such areas in 10 regions and the trend of water well pumping in vicinity. This allows for

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<sup>39</sup> Repetto, Robert. "Economic And Environmental Impacts of Climate Change In Arizona."Demos.org. Demos, n.d. Web.

some insight into the level of shallow aquifer decline, illustrating the most vulnerable areas where drought combined with human consumption compounds impacts by the competing interests<sup>40</sup>.

### Municipal Water Sector

The municipal and industrial sector's vulnerability is a function of water service providers' physical systems, water portfolio and associated rights and drought mitigation plans. Key factors for reliability are water supply, distribution, demand and adaptive capacity.

As one mitigation strategy for municipal vulnerability, the state has created the Arizona Water Banking Authority (AWBA) to maximize the state's Colorado River allotment. Preparing for shortages, the AWBA stores water that might not otherwise be retrieved from the Colorado, firming these supplies for the M&I sector by earning long term storage credits- 32,399 acre feet in the Tucson AMA. Additionally, shortage sharing agreements for Colorado River water offer clarity and a process to reduce water deliveries by agreed priorities, curtailing agriculture and recharge use while sparing municipal demand<sup>vi</sup>.

Specific impacts that community water systems are vulnerable to during drought include:

1. Reduction in M&I well production
2. Reduction in storage reserves
3. Disruption of water supplies
4. Degraded water quality
5. Higher water treatment costs
6. Sediment and fire debris loading to reservoirs following a wildfire
7. Loss of operations revenues
8. Increased expenses for public education
9. Loss of system flexibility
10. Limited new hookups, construction

### Socio-Economic Sector

This sector includes many second order impacts that are not immediately recognized but follow from vulnerabilities in the other sectors. For instance, the condition of the environment enhances or detracts overall quality of life and land value. Second order impacts can lag and remain sometimes after first order impacts have subsided.

Socio-economic vulnerability is greater where the economic base is composed of a larger percentage of drought sensitive economic sectors, impacting supporting industry and negatively affecting associated indirect spending and any economic multiplier effect.

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<sup>40</sup>PAG. Shallow Groundwater Areas in Eastern Pima County, Arizona: Water Well Inventory and Pumping Trend Analysis. Oct 2012.

Correlating indirect impacts reverberate through the economy- “recent study by researchers at the Sandia National Laboratory considered impacts of precipitation declines on the half-dozen industries with the greatest water consumption (e.g., agriculture, utilities, mining, chemical manufacturing), sectors that make relatively small contributions to the state’s GDP. The study found that economic damages would be spread widely throughout the rest of the state’s economy because of higher input costs, lower consumer incomes and spending, population changes and changes in the state’s inter-regional competitiveness. Retail trade, food manufacturing and construction would be among the sectors most severely affected by these secondary effects but no sector would be unscathed. This study found Arizona to be among the nation’s most vulnerable states.”<sup>41</sup>

Additionally, drought related health impacts will place added stresses on the public. “Asthma attacks and allergies will be exacerbated by higher air pollution levels, including ozone, particulates from dust and wildfires, and higher pollen counts that start earlier in the spring. Higher ozone and particulate levels are reliably linked to increased mortality and morbidity. Among the elderly, stroke and heart attack increase with rising heat... In the past decade, a six percent increase in heat-related mortality was observed for each one degree Fahrenheit rise in the heat index and mortality also rose with the duration of the heat wave. Low-income households are much more vulnerable to these health effects because the high cost of electricity...”<sup>42</sup>

Impacts can be categorized by secondary economic impact and behavioral and public health and include:

1. Decreased public health, increased respiratory distress and other disease
2. Diminished quality of life
3. Increased unemployment and crime
4. Reduced income
5. Poor housing sales
6. Relocation
7. Diminished tax base
8. Compromised water and air quality
9. Stress, depression and suicide
10. Loss, replacement of private wells

There are 7,600 exempt wells in the Tucson AMA. Private well users are susceptible to dropping water tables during drought requiring owners to deepen or drill a new well to access water. Increasing depth to water results in increased pumping costs and can lower water quality, to include more mineralization.

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<sup>41</sup> Repetto, Robert. "Economic And Environmental Impacts of Climate Change In Arizona."Demos.org. Demos, n.d. Web.

<sup>42</sup> Ibid.

## Public Education and Impacts

Arizona's Drought Preparedness Plan (ADPP) workgroups investigating mitigation goals across sectors realized the necessity of increasing public awareness and drought education and improving information dissemination. A drought public information campaign can have many messages depending upon the audience and mitigation intended. A common purpose is to maintain a clearinghouse of conservation, drought and assistance information for the public at large.

LDIG is a link between local communities and the state, providing input and information on a sub-regional scale, and while the state maintains a public information clearinghouse (website), improving outreach and education is a defined LDIG task within the ADPP. Updated comprehensive information on the county's drought plan, coordination with the state and other jurisdictions, notifications of wildfire or habitat and wildlife impacts, climate forecasts, public health and educational workshop alerts are examples for public information dissemination.

Expanding beyond general public education, messaging can target sectors and be tailored to local conditions. For example, tourism messaging could be coordinated with the Metropolitan Tucson Convention and Visitors Bureau, educating that audience of living in a desert environment and introducing alternative recreational opportunity to impacted sectors or stressing continued operation despite drought. Residents concerned with municipal supply could be educated on the various tiers of CAP shortage level reductions. Private well owners could receive targeted messaging emphasizing conservation and potential impacts from drought-related water table declines. Improved outreach could help increase impact reporting locally, especially second order impacts.

## Conclusions

1. County owned and maintained open space and riparian habitat is the most vulnerable county asset. The County's long term planning programs associated with these lands are also a significant asset. A drought management plan for the county should protect these investments by prioritizing adaptive management strategies and resources for these sectors.
2. Agriculture and ranching are not dominant economic drivers in Pima County however are valued as a distinct regional cultural heritage. Ranching is most beneficial to the county as a land management and habitat maintenance tool.
3. Birding and wildlife watching, combined with other outdoor recreation and tourism, are dominant economic drivers for the county. Birding offers economic benefits comparable to the region's largest copper mine. The county's habitat programs are of benefit to these economic sectors.
4. Tourism is multi-faceted and duplicative in other sectors and sub-sectors. Of the drought sensitive industries considered in this narrative, it is the most dominant economic driver. Outdoor activities associated with the natural environment are the most popular county attractions.

5. Socio-economic impacts are second and third order impacts easily obscured. Collecting reports on all order of impact is an important function of Pima County's LDIG.

## **Recommendations**

Suggested changes to the drought ordinance and recommendations submitted to LDIG include:

1. Revise drought stage and trigger events (Table 8.70.050) to more accurately reflect and communicate current conditions, improve coordination with other jurisdictional declarations, correct front loading of response measures, provide more flexibility and buffer against oscillating changes of status. Include some exceptions for rainwater harvesting systems to incentivize use. Provide a range of status condition allowing discretion in stage declaration and distinction, for example of a recent and limited Severe finding versus a prolonged Severe finding with more pronounced impacts.
2. Consider appropriate levels of duplication with the City of Tucson and other providers to encourage cooperation and prevent disparate enforcement.
3. Cooperation and consolidation of effort is necessary. LDIG, as a component of the ADPP, is designed to augment the response plan (ordinance) as a repository of assessment information and as a recommendation body. Formalize decision making process within LDIG to coordinate new declarations with water providers. Table 8.70.050 serves as a guideline for drought declaration; LDIG analysis and report to the County Administrator is integral to providing context of drought status.
4. Increase public education and information collection and dissemination with drought sensitive sectors. Conduct a review of department procedures for receiving and responding to violations of the drought and water wasting ordinance.
5. Designate a Drought Liaison within relevant County departments responsible for information sharing of drought impacts and other pertinent data with LDIG.
6. Continue implementation of the Sustainability Action Plan for County Operations (SAPCO), Water and Wastewater Infrastructure, Supply and Planning (WISP) Study and Action Plan and Water Resource Asset Management Plan (WRAMP).
7. Consider purchase of wells near groundwater dependent ecosystem areas and permanently retire the groundwater rights associated with them.
8. Continue refinement of the County's Strategic Plan for Use of Reclaimed and similar strategy and criteria for use or transaction of accrued Long Term Storage Credits.
9. Initiate a process to identify data and information gaps and assess changing vulnerability over time to provide LDIG improved analysis.

The Pima County Local Drought Impact Group has considered a number of recommended drought response strategies. The current Pima County Drought Response Plan includes short term water restrictions targeted to public water demand. To address anticipated long term persistent drought conditions, drought responses should be long term; requiring permanent water conservation measures such as low impact development and development standards.

- Education and outreach should educate visitors and seasonal residents on the importance of water efficiency in our desert environment. Education should include private well owners who could be impacted by declining groundwater levels
- Strategies for the environmental sector could include rainwater catchments and acquisition and protection of water rights
- Rising temperatures and persistent drought can be mitigated by green spaces incorporated in land use design
- Cooling centers for communities could be established during summer power outages to help low income areas
- On-going drought monitoring is needed to distinguish between short term and long term drought impacts
- The impacts of CAP shortage declarations at various tiers should be evaluated
  - Shortage Level One impacts to the availability of excess CAP water and the agricultural settlement pool
  - Shortage Level Two impacts to further reductions to the agricultural settlement pool and potential for increased agricultural groundwater pumping
  - Shortage Level Three impacts to more reductions to the agricultural settlement pool and impacts to CAP water rates for all CAP water subcontractors

Potential mitigation strategies for various sectors impacted by drought can include:

#### Wildlife and environment

1. Water catchments
2. Import water to remote areas (costly)
3. Acquire and protect water rights
4. Desert wash protection
5. More environmental restoration projects
6. Use reclaimed water for environmental restoration. This source of water is “drought-proof”

#### Tourism

1. Education focusing on living in a desert environment instead of drought
2. Collaborate messaging with Tucson Convention & Visitors Bureau

#### Water Supply

1. Education to private well owners
2. Consistency in drought declarations among jurisdictions (all are in stage 1 until a Colorado River shortage is declared)
3. Effluent may need to be reallocated during prolonged drought
4. Implement long term water conservation measures such as low impact development and rainwater harvesting to sustain landscaping

#### Forestry

1. Wildfire plans for federal lands
2. Wildfire plans for county, especially lands abutting Forest Service
3. Continue invasive species control (buffelgrass eradication)

#### Energy

1. Water shortages can limit power production
2. Drought impacts might affect power production
3. Increase reliance on renewable energy
4. Provide community cooling centers
5. Build more green spaces that provide passive cooling

New ordinance with long term restrictions may be needed during prolonged drought

i

- Bar V Ranch- 1,763 fee acres/12,674 acres grazing lease. Shallow ground water area. Biological Core, Important Riparian Area. Perennial, Intermittent Stream Flow. 34/55 Priority Vulnerable Species (PVS).
- Sands Ranch- 5,040 fee acres.
- Clyne Ranch- 880 fee acres. Important Riparian Area, Multiple Use. 15/55 PVS.
- Empirita Ranch- 2,700 fee acres. Biological Core, Important Riparian Area. High sensitive archaeological zone. 1,600 acre feet (af) water right.
- Marley Ranch- 6,337 fee acres. Largest working ranch at 114,400 acres.
- Rancho Seco- 9,574/21,662 acres. Multiple Use.
- Sopori Ranch- 4,135/10,480 acres.
- Canoa Ranch- 4,800 acres. Non-working ranch.
- Buckelew Farm- 505/2,000 acres. Working farm. 1,092 af Irrigation Grandfathered Right (IGR). Multiple Use, Important Riparian, Special Species Management Area.
- King 98 Ranch- 1,034/3,096 acres. IGR, fallow fields. Multiple Use, Special Species Management and Important Riparian Areas. Water rights may provide restoration opportunity for a stretch of the Altar and South Mendoza washes.
- Diamond Bell Ranch- 191/29,904 acres. Biological Core, Multiple Use and Special Species Management Areas.
- Six Bar Ranch- 3,292/9,000 acres. Currently stocked at about 20% of allowed use, due to drought conditions. Biological Core, Important Riparian Area corridor.
- A-7 Ranch- 6,829/34,195 acres. County operated, county employees and owned cattle. Cow/calf operation of 300 head- 40% of allowed use. Biological Core, Multiple Use Management and Important Riparian Area.
- Carpenter Ranch- 560 acres. Cochie Spring and an associated riparian area- Important Riparian Area, Multiple Use Management Area, and Special Species Management Area. Livestock grazing on the Carpenter ranch has been significantly reduced during the current drought.
- Old Hayhook Ranch- 839 acres. Non-working ranch. Historic Preservation site and cultural resource protection.
- Steam Pump Ranch- Non-working, cultural resource historic ranch site.

ii

- Agua Caliente Park
- Ajo Regional Park
- Arthur Pack Regional Park
- Augie Acuna Los Niños Park
- Brandi Fenton Memorial Park
- Branding Iron Park
- Canoa Preserve Park
- Casas Adobes Park
- Catalina Neighborhood Park
- Catalina Regional Park
- Children's Memorial Park

- Curtis Park
- Dan Felix Memorial Park
- Denny Dunn Park
- E.S. "Bud" Walker Park
- Ebonee Marie Moody Park
- Feliz Paseos Park
- Flowing Wells Park
- Forrest "Rick" Rickard Park
- George Mehl Foothills Park
- Lawrence Park
- Linda Vista Park
- McDonald Park
- Meadowbrook Park
- Mike Jacob Sports Park
- Mission Ridge Park
- Northwest Community Park
- Palo Verde II Park (tennis courts in Ajo)
- Picture Rocks Park
- Pima Prickly Park
- Richardson Park
- Rillito Regional Park
- Rillito Vista Park
- Star Valley Park
- Summit Old Nogales Park
- Sunset Pointe Park
- Ted Walker Park
- Thomas Jay Regional Park
- Three Points Veteran Memorial Park
- Vesey Park
- Wildwood Park
- Winston Reynolds-Manzanita Park
  
- Ajo Pool (E.S. "Bud" Walker Park)
- Brandi Fenton Splash Pad
- Catalina Pool
- Flowing Wells Jr. High School Pool
- Kino Pool (Mulcahy YMCA)
- Los Niños Pool
- Manzanita Pool
- Northwest YMCA - Thad Terry Pool
- 9. Picture Rocks Pool and Splash Pad
- Wade McLean Pool (Marana High School)
  
- 36th Street Trailhead
- Abrego
- Agua Caliente Park

- Agua Caliente Hill South
- Avenida de Suzenu
- Bear Canyon
- Camino de Oeste
- Campbell
- Central Arizona Project
- Colossal Cave Road
- David Yetman West
- El Camino del Cerro
- Explorer
- Gabe Zimmerman Davidson Canyon
- Gates Pass
- Iris Dewhirst Pima Canyon
- King Canyon
- Richard Genser Starr Pass
- Richard McKee Finger Rock
- Sarasota
- Sweetwater Preserve
- Ventana Canyon
- Gilbert Ray Campground
- Anza Trail connections

iii

- Arizona State Prison
- Avra Water Co-Op
- Arizona Water Company-Oracle
- Community Water Company-Green Valley
- DMAFB Water System
- Farmers Water Company
- Flowing Wells Improvement District
- Green Valley Domestic Water Improvement District
- Lago del Oro Water Company
- Las Quintas Serenas Water Company
- Los Cerros Water Company
- Marana Domestic Water Improvement District
- Metropolitan Water Improvement District
- Rancho Sahuarita Water Company
- Ray Water Company
- Saquaro Water Company
- Town of Marana
- Town of Oro Valley
- Tucson Water
- University of Arizona System
- Vail Water Company
- Voyager Water Company

<sup>iv</sup>The System Water Plan consists of three components:

Water Supply Plan – describes the service area, transmission facilities, monthly system production data, historic demand for the past five years, and projected demands for the next five, 10 and 20 years.

Drought Preparedness Plan – includes drought and emergency response strategies, a plan of action to respond to water shortage conditions, and provisions to educate and inform the public.

Water Conservation Plan – addresses measures to control lost and unaccounted for water, considers water rate structures that encourage efficient use of water, and plans for public information and education programs on water conservation.

<sup>v</sup>Includes such information as water pumped or diverted, water received from other suppliers, water delivered to customers, and effluent used or received.

<sup>vi</sup>While CAP holds a junior priority within Arizona and will be subject to shortages, CAP would manage shortage by first reducing the excess water deliveries and ceasing portions of its recharge operations. If additional reductions were warranted, CAP would limit its water delivery to agricultural customers, who have limited rights to CAP water and could turn to pumping groundwater or other sources. If reductions were to be required beyond this level, then CAP would begin to recover the excess water stored underground to protect existing municipal and industrial CAP customers from experiencing reductions in deliveries of CAP water and to recover water stored to meet Arizona's obligations pursuant to Indian Water Rights Settlements.

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## Chapter 8.70 DROUGHT RESPONSE PLAN AND WATER WASTING

### Sections:

[8.70.010 Purpose and Applicability.](#)

[8.70.020 Definitions.](#)

[8.70.030 Water Wasting Prohibited.](#)

[8.70.040 Drought Stages—Required Drought Conservation Measures.](#)

[8.70.050 Declaration of Drought Stage.](#)

[8.70.060 Variances.](#)

[8.70.070 Technical Assistance.](#)

[8.70.080 Violation—Enforcement.](#)

### 8.70.010 Purpose and Applicability.

- A. The purpose of this chapter is to provide a drought response plan for the unincorporated areas of Pima County.
- B. Because of varying conditions related to water resource supply and distribution system capabilities, it is necessary to establish and to enforce methods and procedures to ensure that, in time of emergency shortage of the local water supply, the water resources available to the residents of unincorporated Pima County are put to the maximum beneficial use, that the unreasonable use, or unreasonable method of use is prevented, and that conservation of water is accomplished in the interests of the public health, safety, and welfare.
- C. This chapter applies to the unincorporated areas of Pima County.  
(Ord. 2007-47 § 1 (part), 2007; Ord. 2006-43 § 1 (part), 2006)

### 8.70.020 Definitions.

- A. "Arizona Drought Monitoring Report" means the long-term drought status report issued by the Arizona Department of Water Resources' Monitoring Technical Committee (MTC), created by the Governor's Drought Task Force, which is responsible for gathering drought, climate, and weather data and disseminating that information to land managers, policy-makers, and the public. The MTC determines drought conditions based on monitoring data, tracks changes in weather and physical conditions, forecasts likely future conditions, and provides early detection of changes in drought severity. The MTC will also assess local area impact assessment information provided by the Pima County Local Drought Impact Group ~~citizens throughout the state~~.
- B. "Department" means the Pima County Health Department.
- C. "Director" means director of the health department.
- D. "Pima County Local Drought Impact Group~~Drought Monitoring Committee~~" means a drought monitoring committee comprised of individuals skilled in monitoring climate, area water supplies, ecosystems, and economic and social impacts as a result of drought and facilitates the role of a Local Area Impact Assessment Group prescribed in the Arizona Drought Preparedness Plan.

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- E. "Economic hardship" means a threat to an individual's or business' primary source of income.
- F. "Notification to the public" means notification through local media, including interviews and issuance of news releases.
- G. "Person" means a government or government subdivision or agency, the county, a municipality, district or other political subdivision, a cooperative, association, corporation, company, firm, partnership, individual, or other legal entity.
- H. The term "pool" applies to all pools regulated by Pima County's adopted building or technical codes, regardless of whether the pool is installed above- or below-ground or whether it is a temporary or permanent structure.
- I. "Water" means potable or reclaimed water from all sources.
- J. "Rainwater harvesting system" means a system or series of components or mechanisms that are designed to provide for the collection and storage of rainwater for use of the collected water on the same property.

(Ord. 2007-47 § 1 (part), 2007; Ord. 2006-43 § 1 (part), 2006)

**8.70.030 Water Wasting Prohibited.**

At no time may a person waste water or use water unreasonably. Wasteful or unreasonable uses of water include but are not limited to the following practices:

- A. Causing or permitting water to leave a property by drainage onto adjacent property or public or private roadways or streets due to excessive irrigation and/or uncorrected leaks.
- B. Failing to repair a water leak following initial notification.
- C. Washing driveways, sidewalks, parking areas, or other impervious surface areas with an open hose or with a spray nozzle attached to an open hose or, through other means, under regular or system pressure, except when required to eliminate conditions that threaten the public health, safety, or welfare. This restriction does not apply to residential customers.

(Ord. 2006-43 § 1 (part), 2006)

**8.70.040 Drought Stages—Required Drought Conservation Measures.**

Following the declaration of a drought stage, no person may make, cause, use, or permit the use of water for residential, commercial, industrial, agricultural, governmental or any other purpose in a manner contrary to any provision of this section, or in an amount in excess of that use permitted by the drought management stage. The water use restrictions in each less restrictive stage apply to all more restrictive stages unless the higher stage has a more stringent requirement on the same subject.

- A. Stage 1, Water Alert. During a Water Alert, the department shall issue one or more notifications to the public. The department shall ask all persons to implement voluntary reductions in water use, ask restaurants to provide water only upon request, urge hotels and motels to conserve water, and engage in a campaign to increase public education to promote awareness about water conservation issues.
- B. Stage 2, Water Warning. During a Water Warning, the following additional conservation measures will be implemented:
  - 1. Persons may only irrigate landscaping between the hours of 7 p.m. and 7 a.m.
  - 2. Persons working in or operating restaurant-type uses may provide water only upon request.

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3. No person may operate outdoor misters;
  4. No person may operate or use public fountains or water features;
  5. No natural person may wash a car except with use of a bucket and a shut-off nozzle;
  6. No charity car washes may occur except at commercial car washes that recycle water; and
  7. No person may overseed turf areas. Areas to be irrigated exclusively by a rainwater harvesting system are exempt from this measure.
- C. Stage 3, Water Emergency. During a Water Emergency, the following additional conservation measures will be implemented:
1. No person may fill a newly constructed residential pool. Pool permits will remain in active status for 3 months after Stage 3 is downgraded to Stage 2;
  2. No person may operate a car wash unless it is equipped with a water recirculation system; and
  3. A person may top off a pool only to maintain water level; no person may refill a pool.
- D. Stage 4, Water Crisis. During a Water Crisis, the following additional conservation measures will be implemented:
1. Landscape irrigation is restricted to only trees and shrubs; ~~no~~ person may irrigate turf or ground cover with harvested rainwater only;
  2. No person may fill a newly constructed pool. Pool permits will remain in active status for 3 months after Stage 4 is downgraded to Stage 2;
  3. No person may use water to wash a car except for water captured by a rainwater harvesting system;
  4. No person may use water to clean a parking lot or street; and
  5. No person may use potable water in construction projects, either for dust control or toward the erection of new improvements or structures.

(Ord. 2007-47 § 1 (part), 2007; Ord. 2006-43 § 1 (part), 2006)

**8.70.050 Declaration of Drought Stage.**

- A. Drought Stage Trigger - The triggers defining each drought stage are listed in Table 8.70.050.
- B. Declaration of Drought - A drought stage for all or any area of the county may be declared by the Board of Supervisors upon a recommendation from the county administrator and information developed by the ~~Local Drought Impact Group~~ ~~Drought Monitoring Committee~~. A declaration by the U.S. Secretary of the Interior of either a shortage on the Colorado River or a curtailment of water delivered through the Central Arizona Project canal to any local water provider may increase the drought level by one stage. If the severity of the drought lessens, the Board of Supervisors may downgrade the drought stage to a lower stage.

**Table 8.70.050**

Indicator	Arizona Drought Monitor Report <sup>1</sup> Based on Findings Related to Pima County
Stage 1 Alert	<del>Abnormally Dry</del> <b>Moderate-Severe</b>

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Stage 2 Warning	<del>Moderate</del> <b>Severe-Extreme</b>
Stage 3 Emergency	<del>Severe</del> <b>Extreme-Exceptional</b>
Stage 4 Crisis	<del>Extreme</del> <b>Exceptional</b>

See <http://www.azwater.gov/dwr/drought/MTC.html>

(Ord. 2007-47 § 1 (part), 2007; Ord. 2006-43 § 1 (part), 2006)

**8.70.060 Variances.**

The director is authorized to review hardship cases and special cases within which strict application of this chapter would result in serious hardship to a person. A variance may be granted only for reasons involving health, safety or economic hardship. Application for variance from requirements of this chapter must be made on a form provided by the director.

(Ord. 2007-47 § 1 (part), 2007; Ord. 2006-43 § 1 (part), 2006)

**8.70.070 Technical Assistance.**

The director shall continually monitor and report the nature and severity of the drought condition to the county administrator or designee.

(Ord. 2006-43 § 1 (part), 2006)

**8.70.080 Violation—Enforcement.**

- A. In the event of any violation of this chapter, the department shall post on the property where the violation occurred written notice and mail a duplicate notice to the registered owner of the property and to any person known to the department who is responsible for the violation or its correction. Such notice shall describe the violation and order that it be corrected, ceased or abated immediately or within such specified time as the department determines is reasonable under the circumstances and shall further contain a description of the fees and penalties associated with such violation. If the cited person fails to comply with such order, the department will contact the water provider who may disconnect the service where the violation occurs. The property owner will be responsible for any reconnection charges in addition to other fees or charges imposed by the water provider.
- B. In addition to being grounds for discontinuation of service, violation of any provision of this chapter is a civil infraction. Any person found to be non-compliant with any provision of this chapter may be assessed a civil penalty of not less than two hundred fifty dollars for a violation occurring during drought management stage 2, not less than four hundred dollars for a violation occurring during drought management stage 3, and not less than six hundred dollars for a violation occurring during drought management stage 4. Each act of violation and every day upon which such violation occurs shall constitute a separate infraction. The Director may also seek injunctive relief.

(Ord. 2007-47 § 1 (part), 2007; Ord. 2006-43 § 1 (part), 2006)