- Undertake continuous data collection, forecasting, and monitoring that capture multiple variables, including population growth and climate change
- Update the drought plan on a regular basis

The following eight case studies illustrate how these best practices are specifically being utilized at the local, regional, state, and national levels.

CIVANO

Civano is a sustainable master planned community nestled south of the Catalina Mountains and west of the Rincon Mountains in southeast Tucson, Arizona. It is the first master planned community in the United States designed to balance natural resources with human needs. It incorporates sustainable planning principles in every facet of its design through the integration of passive and active solar principles, sustainable building materials, and water conservation technologies. The 818-acre community consists of four mixed-housing residential neighborhoods, community facilities, retail and employment uses, and dedicated open spaces.

This Civano house includes water-conservation design features such as xeriscaping and a water-harvesting system.

Simmons B. Buntin

A showcase of locally built solar-powered homes in 1981 sparked a vision for a new community in Arizona, one of reduced resource consumption minimizing adverse environmental impacts. A decade later, the newly formed Solar Village Corporation sculpted that vision into a development called the Tucson Solar Village. The Arizona State Land Department dedicated the land for the project and the City of Tuscon approved rezoning to allow for the master planned community (Buntin n.d.). The city broadened the conditions of the rezoning to include additional sustainability goals and performance requirements beyond solar. In addition to sustainability goals related to reducing home energy consumption and internal vehicle miles traveled, the project sought to reduce potable water consumption by 65 percent (Civano Neighbors Neighborhood Association 2009).

In 1995 the city adopted an Integrated Method of Performance and Cost Tracking (IMPACT) System for sustainable development that set standards and performance targets to help achieve the conditions established in the rezoning approval. These included:

- Reducing interior residential potable water use to 53 gallons per person per day
- Reducing interior nonresidential potable water use to 15 gallons per employee per day

- Establishing a water budget per household of 28 gallons of water per person per day for exterior uses
- Discouraging the construction of private swimming pools (if installed, owners were required to install a pool cover and could only heat the pool using solar devices)

Other specific requirements included limiting site clearance for residential lots in order to preserve desert vegetation and maximize natural drainage; protecting important plant species and requiring that a significant portion of each building site maintain existing natural desert vegetation; applying city xeriscape landscape standards to all new developments; and requiring all landscape irrigation to be accomplished with nonpotable water through the use of reclaimed water, graywater systems, water harvesting systems, and other alternative irrigation systems (Tucson 2003).

With the IMPACT System in place, the city then sought out a master developer to undertake the project. In July 1996, a joint venture, the Community of Civano, purchased the property for $2.7 million with additional support provided by the city and private funders for infrastructure funding and energy designs; the Tuscon Solar Village was renamed Civano. The developer worked with consultants, universities, and community members to ensure that sustainable planning principles were incorporated into the final design.

The city entered into a memorandum of understanding (MOU) with the master developer in 1998 to guarantee that the standards would be implemented and the performance targets would be monitored. The master developer prepares an annual or biannual IMPACT System Monitoring Report to document the success of Civano in achieving the standards. The report includes a review of baselines, the methods for monitoring and establishing compliance, and the strategies and requirements appropriate to achieve compliance. Should the master developer for Civano discover a more effective or efficient way to achieve the performance standards, it can propose changes to the MOU. For example, the MOU was revised in 2003 when it was discovered that there was a substantial cost burden to homeowners for the use of separately metered reclaimed water at each home (Tucson 2003).

A reclaimed-water sign in the Civano community.

Simmons B. Buntin

According to the monitoring reports, Civano has been successful in reducing potable water usage well below the minimum baseline. In 2006 water use in Civano was 55 percent lower than the average city usage (Al Nichols Engineering 2009). A 2008 report found that in 2007 the Civano I neighborhood used approximately 59 percent less potable water and the Sierra Morado neighborhood used approximately 37 percent less potable water than the typical Tucson home (Witmer 2008).

Conclusion

Civano serves as a model of how to remarkably reduce potable water usage at the development level. By incorporating sustainability goals into the rezoning approval process and developing an IMPACT System to ensure the standards and performance targets are implementable and measurable, the community has drastically reduced its water usage as compared to the rest of the city. Through regular monitoring and evaluation, the community can also continually improve the strategies it employs to meet established standards. Other communities should look to this development when exploring effective water-conservation strategies and technologies at the project level.

HUALAPAI TRIBE

The Hualapai Reservation is located in northwestern Arizona and covers nearly one million acres of land, including 108 miles along the Colorado River and the Grand Canyon. Peach Springs, located at the southern boundary of the reservation, is the tribal headquarters location and where the majority of tribal members reside. In total, about 2,000 individuals live on the reservation (Christensen 2003).

Like most tribes in the United States, the Hualapai live in a drought-prone region of the United States and have experienced periodic droughts throughout history. In recent years, lengthy periods of drought and extreme drought conditions, coupled with rapid population growth and competition for water, have left the reservation (and the larger region) increasingly water stressed. In late 2002, the Hualapai began developing a Cooperative Drought Contingency Plan to help them better understand the physical characteristics of drought, investigate their drought vulnerabilities, and identify actions that can be implemented before and during drought to help minimize its effects (Christensen 2003).

The plan, funded by a cooperative agreement with the U.S. Department of Interior's Bureau of Reclamation (BOR), was developed entirely by members of the tribe. The plan took a little over a year to develop and was adopted in December 2003. In 2004 it became the first tribal drought plan to be accepted by Congress through the BOR's Lower Colorado Region (Christensen 2003).

Plan Development

A lead planner first undertook the process of developing the plan but soon realized that a collaborative effort was necessary to gain a broader understanding of potential drought mitigation and response measures appropriate for the reservation. As a result, the Hualapai Tribal Council created the Hualapai Drought Task Force (HDTF). The HDTF includes the water resources program manager; the Bureau of Indian Affairs fire management officer; the wildlife, fisheries, and parks program manager; the agriculture program manager; the air quality program manager; a tribal elder; the assistant agriculture program manager; and willing presidents of the livestock associations (Christensen 2003). Initially the HDTF met twice monthly, but this increased to twice-weekly meetings during the last two months of plan development (Christensen 2013).