



Report on Civano Water Use, 2004*

Prepared for the Community of Civano LLC

Al Nichols Engineering, Inc.
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Conversions rates, measures and costs

~326,000 gallons/acre foot

748 gallons/CCF

~\$.17/ccf energy cost to deliver potable water

~5.21 lbs. CO₂/CCF emissions for potable water

-0.34 lbs. CO₂/CCF emissions for reclaimed water

1. Introduction: Purpose of the Study, Data and Methods

Purpose of the Study

In keeping with the Civano IMPACT System Memorandum of Understanding on Implementation and Monitoring Process (signed June 26, 1998), this report monitors and reports on water use at Civano for the year April 2003- March 2004.

Reclaimed and potable water to be used at are as follows (Appendix 2 characterizes the differences between *reclaimed* and *potable* water):

Section 5.0, Specific Procedures for Implementation

5.1.3. Establish exterior water budgets, monitor water consumption, and develop a contingency program to achieve compliance with the budgets if water conservation targets are not met, which utilize City-provided reclaimed water in landscaping for individual residential properties not to exceed 28 gallons per capita per day.

5.1.5 Establish interior water budgets, monitor water consumption and develop a contingency program to advance compliance with the budgets if water consumption targets are not met for each building, and design the plumbing systems accordingly that will reduce the interior use of water in residential structures to 53 gallons per person per day and to 15 gallons per person per day in non-residential structures. The guidelines shall specify the manner in which water use has been calculated and the principal measures to be taken to meet these budgets.

The goal of the Memorandum of Understanding is to confirm the strategies for sustainable development and to implement and monitor the Civano IMPACT System. *Subsequent monitoring of performance* is intended to determine the success in meeting the IMPACT System Standards and to provide a basis by which to improve conservation and sustainability strategies and standards (Civano IMPACT MOU, Sections 1-3). The ANE, Inc. report on Civano water for 2002-2003 reported on the relative success of reclaimed water use for residential use as compared to its use for common areas. The summary of these results is excerpted and provided as Appendix 1 of the current report and is not further addressed here.

Data and Methods

Potable and reclaimed water are metered individually for Civano residences. Data from potable water use by 44 individual Civano residences, and from reclaimed water use by 34 residences were supplied by Tucson Water Company. Of these samples, 37 provided a full year of utility data for potable water and 29 provided a full year of utility data for reclaimed water. Thus, of the 37 samples, eight do not use reclaimed water. Three of these eight residences are on very small lots with very little landscaping, two have rain water cisterns and three stopped using reclaimed water over a year ago.

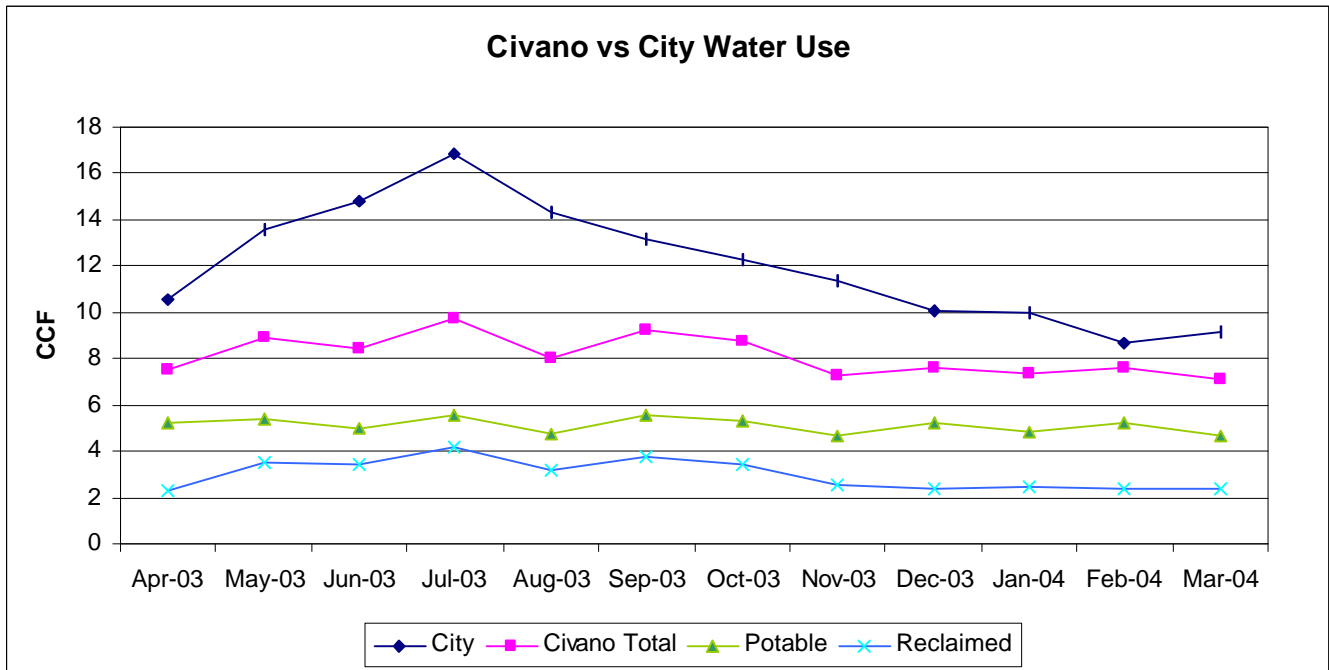
In the energy study performed by ANE, Inc. for Civano 2003-2004, 41 homeowners returned a survey questionnaire relating characteristics of Civano homes. Of those, 19 provided occupancy data. With a range between 1-5 occupants per home, these preliminary data indicated 2.17 occupants per residence at Civano. This compares with 2.25 occupants per residence assumed in previous reports. Since full and

current demographics for the 37 homes in the sample are not available, we will use the 2.25 per residence assumed previously for the sake of consistency.

2. Civano Water Use

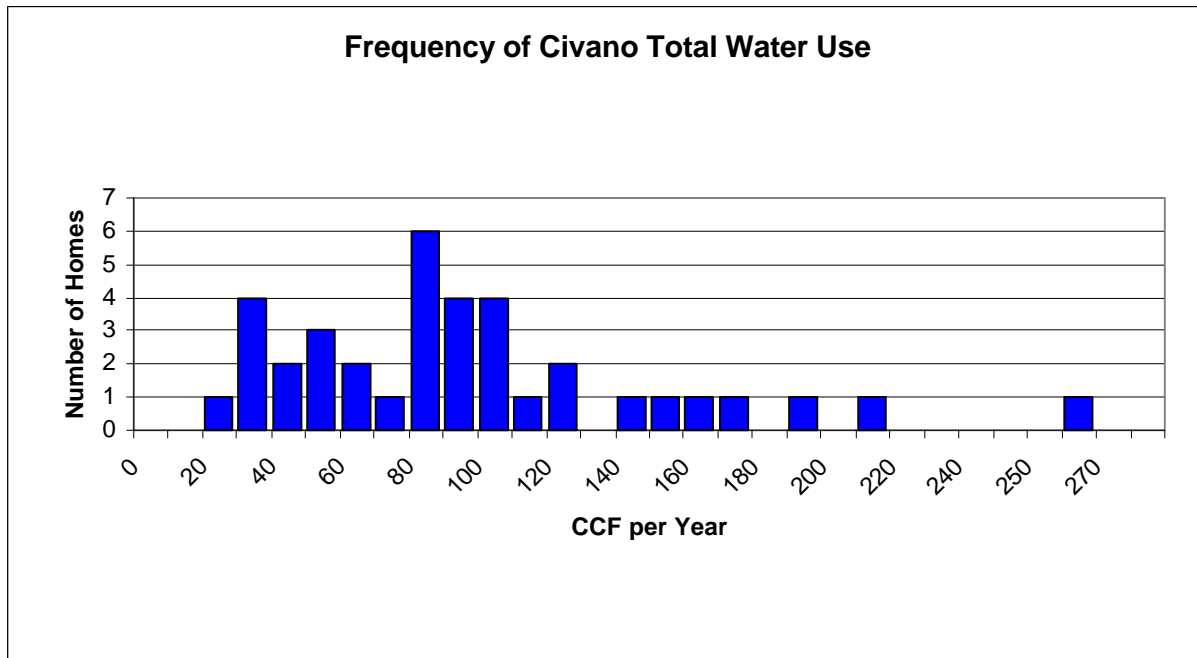
Results

Samples returned indicate an overall average monthly potable water use of 5.13 CCF per residence (3,837 gallons). An average of 3.0 CCF (2,244 gallons) reclaimed water are used per residence per month. Total monthly residential water use is 8.12 CCF (6,074 gallons).



Graph 1. Comparison of City of Tucson (“City”) water use with Civano total water use; Civano potable and Civano reclaimed water use are shown for comparison.

The range of water data gathered from the 37 homeowners appears as in Graph 2.



Graph 2. Histogram showing range of total water use per home as CCF per year.

As can be seen from the spread in home water usage, great variation characterizes homeowner behavior. Previous reports have indicated a similar range in use patterns.

Table 1 compares Civano IMPACT Goals with Civano residential water use results from 2001-2004 (daily average/occupant):

Year	Potable Water	Reclaimed Water	Total Water
IMPACT Goals	53 gallons	28 gallons	81 gallons
2001-2002	52 gallons	25 gallons	78 gallons
2002-2003	51 gallons	32 gallons	82 gallons
2003-2004	56 gallons	33 gallons	89 gallons

Table 1. Comparison of years 2001-2004 for Civano Water Use

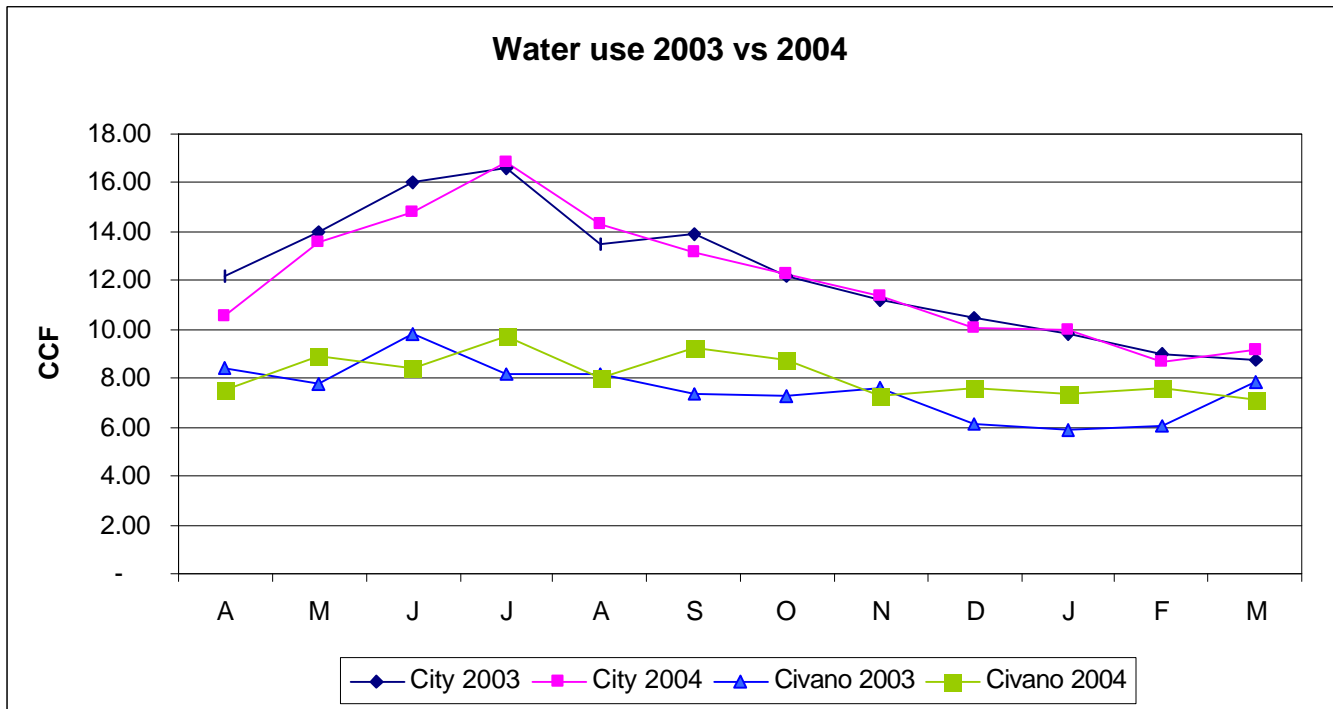
Civano water use is increasing, however is still significantly lower than the City of Tucson (below).

Comparison to Water Use in Tucson Homes

Tucson Water Company provided data from the total Tucson population of residential water users as 9,208 gallons/residence per month, or 303 gallons/residence/day potable water use. This compares to 6,074 (total water) gallons/residence per month for Civano homes, and 3,837 gallons monthly potable water for Civano residences. Thus, total Civano water use is approximately 64% that of Tucson homes (a 36% reduction). Additionally, reclaimed water use for residential landscaping at Civano provides for a further reduction in potable water use over Tucson homes; Civano uses 41% of the potable water that

Tucson homes use (a 59% reduction). Overall water savings is likely a result of strict landscape standards, small lot sizes, use of cisterns, and community awareness.

Graph 3 below compares city of Tucson water use with Civano use over two years. During this period, City water use dropped by 2.0%, while Civano total water use increased by 8.5%, and potable water use is up by 7.8%.



Graph 3. Comparison of Tucson (“City”) water use for 2002-03 and 2003-04 with Civano use for 2002-03 and 2003-04.

Although Civano potable water use is up, given the sample size and characteristics of this study, the increase may not be significant enough to require action at this time. However, methods to be applied in Civano Neighborhoods 2 and 3 require close study to assure compliance with the Civano water IMPACT requirements.

Additional Water Savings Options at Civano

Civano homes use conventional water saving plumbing fixtures that meet the usage requirements of the State Plumbing code, as do the newer Tucson homes, thus contributing to interior potable water savings.

As an alternative to using reclaimed water for exterior use, homeowners can install rainwater harvesting cisterns. For the two homeowners with cisterns, total (potable) water use was 5.58 CCF/month. Six remaining residences use no reclaimed or cistern water. Three residences with small lots used 5.75 CCF/month, and the three that had cancelled reclaimed water use used an average of 5.58 CCF/month.

The overall use for these eight samples is 9% higher (5.64 CCFs/month average) than the Civano average potable water use (5.13 CCF/month).

Water Use in Common Areas

Potable water is used in common areas only for the existing and new pools. In addition to the individual residential total and potable water savings shown here, the common area landscaping uses xeriscape and reclaimed water, which further decreases potable water (and further reduces energy use and CO2, see below) while successfully providing shade and grass spaces in the community. See the ANE, Inc. 2001-2002 report for indications of the substantive contributions from use of reclaimed water for common areas (not computed this year as build out continues).

Reclaimed water use for common-area landscaping at Civano in 2002-2003 accounted for 8,326 CCF/year, or approximately 19 acre feet/year. As the project builds out, landscape water use is expected to decline as the landscape matures, which will further reduce the need for water. *This strategy is strongly recommended for any commercial venture within reach of reclaimed water lines.*

3. Costs, Energy Savings and CO2

Water costs energy to drill, extract and transport, which in turn costs money and emits CO2 into the atmosphere (see cost averages on cover page). Table 2 evaluates energy and CO2 use for an average home at Civano as compared to an average Tucson home.

	Civano	Tucson
Potable Water	61.5 CCF	144.7 CCF
Energy cost	\$10.46	\$24.60
CO2 Emitted	320 lbs	754 lbs
Reclaimed Water	36 CCF	0
CO2 Emitted	12 lbs	0
Total Energy Cost	\$10.29	\$24.60
Total CO2 Emitted	332 lbs	754 lbs

Table 2. Annual costs and CO2 associated with water delivery to Civano and Tucson homes.

While the relevance of these costs may not seem obvious when each individual residence is evaluated, consider totals based on the cumulative results for 300 Civano homes as compared with 300 Tucson homes. With Civano costing 44% for energy to deliver water, and releasing 44% of the CO2 from the energy costs associated with delivery of water, 300 Civano homes save an average of \$4,293 for cost to deliver water, and avoid release of 126,600 lbs (63.3 tons) of CO2 every year. If we consider the average life expectancy of the home to be 50 years, this is a cumulative savings of \$214,000 and

6,330,000 lbs (3165 tons) avoided CO₂ over the life of each set of 300 houses built to the standards employed by Civano versus those of Tucson. In today's explosion of residential development numbering in the thousands built per year, these figures and potential savings are, literally, enormous.

Appendix 1. Lessons Learned—Community Acceptable Practices. Excerpted from ANE, Inc. report on Civano Water, 2002-2003.

The Civano MOU (signed June 26, 1998) specifies maximum per-residence use of reclaimed and potable water at Civano and provides that *subsequent monitoring of performance* will provide the basis for determining the success in meeting the IMPACT System Standards, and as well, will serve as the basis for improving future conservation and sustainability strategies and standards (Civano IMPACT MOU, Sections 1-3). While specific language for design change is not indicated, the MOU demands intelligent change given lessons learned from experience. It falls to the stakeholders to develop the particulars constraining any evolution of the standards.

In meeting with 70 Civano neighbors who have lived with xeriscape and reclamation, consensus demonstrated that the reclaimed water requirement to each residence should not be extended into the new Civano neighborhoods. The primary reasons given indicate prohibitive financial burden for individual residential use of reclaimed water: the cost of the additional meter, backflow preventer and expansion tanks add considerable start-up financial burden to the homeowner. Moreover, the on-going cost-of-use is at issue since most homes use potable water at the lowest cost—about \$1.03 per CCF—while reclaimed water costs about \$1.31/ccf. Additionally, high water pressure caused some drip systems to fail and high maintenance of the drip systems results from the mineral content of the reclaimed water. The city added a pressure-reducing valve to the project at a cost reportedly near \$25,000.

In terms of community-acceptable practices, the xeriscape requirement is working, should continue and would greatly benefit Tucson were it applied systemically as a code requirement. Use of reclaimed water for common spaces, where professional landscape personnel are responsible for handling the water system and where a per-residence financial burden does not exist, is recommended for further expansion at Civano; reclaimed water use for common-areas provides for a significant savings in potable water use, energy use and CO₂ production. Effectiveness, economics and satisfaction of water harvesting practices remain for further investigation.

To conclude, the reduction in total and potable water use at Civano over Tucson homes is likely due in some measure to landscape requirements, small lot sizes, and xeriscape landscaping requirements, given the total water savings indicated and the potable water savings.

Appendix 2. Potable and Reclaimed Water

The City of Tucson Water Department provides potable water to Civano and to Tucson. Potable water is purified to a degree optimal for drinking and bathing/washing as per the State of Arizona's standard of "full-body" contact. Cost-to-supply potable water in Tucson includes drilling of groundwater, cost for CAP water, pumping and distribution, and metering and monitoring costs. Supply of potable water uses energy at a cost of approximately \$0.17 per CCF in Tucson, with approximately 5.21 pounds of CO₂ per CCF released into the atmosphere. Reclaimed water use cost of pumping creates 0.34 lbs. of CO₂ per ccf.

Reclaimed water is supplied to Civano and to the City of Tucson by Pima County Wastewater Management. Reclaimed water is the final product of a multiple-stage treatment that cleans wastewater. This process produces water suitable for irrigation but not for full-body contact. Using reclaimed water matches water quality with water use to conserve groundwater resources. High quality water is reserved for drinking and bathing, while reclaimed water is ideal for irrigation.

At Civano, reclaimed water is used at the individual home site and in common-areas (for landscaping, such as walkway foliage, trees, etc.). Because it is not drilled and extracted from depths determined by the level of the groundwater table, nor is it pressurized (to the same degree as potable water), the energy needed to supply reclaimed water is somewhat less than that for potable water; therefore, CO₂ production/release is also somewhat less for reclaimed water than potable water.

Homeowners at Civano use reclaimed water for landscaping. They are served reclaimed water at their homes; this water is metered through a separate meter at each home. Or the homeowner may install water harvesting devices (collection devices which claim rain or runoff water) rather than using City-supplied reclaimed water for home landscaping needs. The impact of reclaimed water use at Civano is reported here, while information on water harvesting at Civano is limited.