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**Phoenix Single Family In-Home Visit
Water Conservation Program:
Design, Implementation, Evaluation and Impact**

Prepared for

City of Phoenix
Water Conservation Office
200 W. Washington Street, 9th Floor
Phoenix, Arizona 85003

Prepared by

BBC Research & Consulting
3773 Cherry Creek N. Drive, Suite 850
Denver, Colorado 80209-3868
303.321.2547 fax 303.399.0448
www.bbcresearch.com
hummkeen@bbcresearch.com

Phoenix Single Family In-Home Visit Water Conservation Program

The City of Phoenix conducted a pilot program examining ways to produce indoor and outdoor water savings among single family households. BBC Research & Consulting (BBC) conducted in-home visits with 36 homes in August and September 2007. The purpose of the visits was to:

- Better understand how customers perceive and use water;
- Test acceptance of personalized water conservation tips and technologies;
- Gauge water use behaviors; and
- Gather preliminary evidence on what impact such visits might have on single family water use.

Design of the Pilot Program

Participants in the pilot program were selected from about 650 Phoenix single family homes that BBC surveyed in 2006 as part of a study for the City of Phoenix and Arizona Municipal Water Users Association. In the original survey, homes were randomly selected and interviewed by telephone to obtain economic, demographic, attitudinal and behavioral information relevant to water use. BBC classified homes according to the following six segments:

- Predominantly grass landscape with pool;
- Mixed landscape with pool;
- Predominantly grass-free landscape with pool;
- Predominantly grass landscape with no pool;
- Mixed landscape with no pool; and
- Predominantly grass-free landscape with no pool.

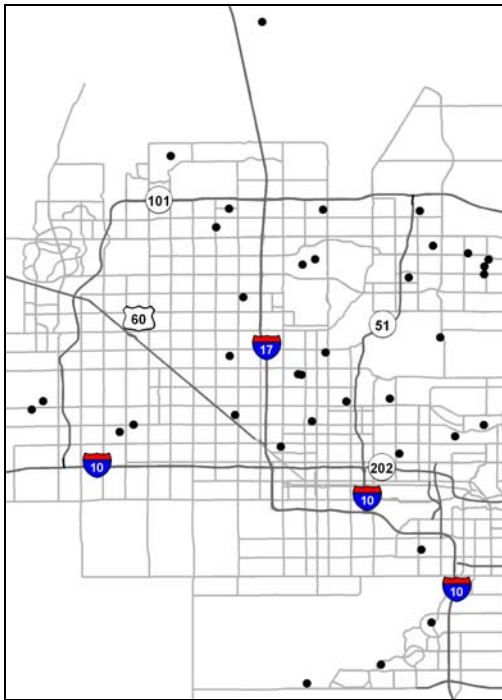
Selection for the pilot program. Mixed landscapes often had desert landscaping in the front yard and grass in the backyard. Landscapes with no grass varied from lush desert vegetation to homes with rock front and backyards with little other landscaping. Most of the homes selected for the in-home visit pilot were chosen because they were high water users in 2006 relative to other homes in their particular market segment. Using a water use model developed in part from information obtained in the survey, BBC was able to identify households in each segment whose 2006 use was substantially higher than predicted. An example of a visited home is provided below.

Front yard of a visited home



Recruitment for the pilot program. Selected homes received a letter from the City, informing them that they had been randomly selected to participate in a water delivery study. In the case of some segments where the response from the highest users was limited, letters were also sent to households that were more moderate water users. In total, 150 homes were contacted. BBC made up to three follow-up phone calls to each home that received a letter to determine the household's willingness to participate. Households were not informed that the visits concerned water conservation prior to the visit. The 36 homes that BBC visited represent the roughly one-quarter of contacted homes that agreed to participate in the pilot. As shown below in Figure 1, visited households were distributed throughout the City of Phoenix.

Figure 1.
Location of in-home visits in the City of Phoenix



Source: BBC Research & Consulting.

In-home visits. Visits took place in August and September 2007. BBC staff spent on average one hour in each home, discussing conservation ideas and the household's water use. BBC staff offered homeowners:

- A variety of water-saving tips tailored to each home's characteristics;
- Three guides providing additional tips on watering, plant selection and other conservation ideas;
- A free evapotranspiration (ET) controller for use with an automatic sprinkler system; and
- Ecosavr "fish" — a liquid pool cover designed to reduce evaporation from pools (offered if the home had a pool).

Following the visits, BBC attempted to contact the homes by telephone in October 2007 and November 2008 to assess the impact of the visits. BBC contacted 32 of the 36 participating homes at least once after the original visit.¹ Through the follow-up interviews, BBC was able to identify changes in behavior relating to indoor and outdoor water use as well as any modifications to the home or changes in household occupants.

The balance of this report summarizes the impact of BBC's in-home visits, including any changes in:

- Reported water use-related behavior of households;
- Household appliances, fixtures and other water-using characteristics of the home; and
- Recorded water use, based on an analysis of water use records provided by the City of Phoenix for the period 2006-2008.

The first part of this report summarizes the changes reported by households as part of the follow-up interviews. The second part analyzes changes in recorded water use, comparing water use for homes that were visited with other Phoenix single family homes for 2006-2008. Based on the analysis of water use records, BBC was able to estimate the impact of the visits in water use during 2008.

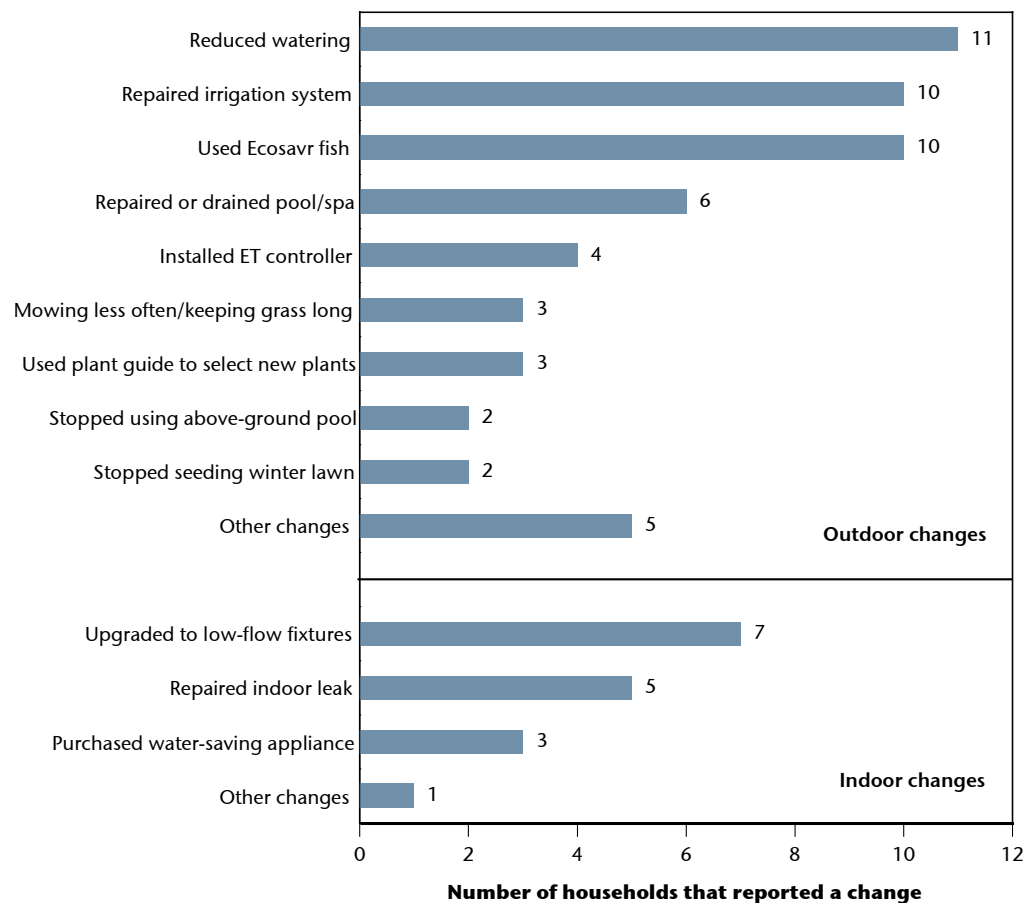
¹ Reasons for unsuccessful follow-ups include household relocation, changes to phone numbers, health issues and, in one case, death.

Summary of Changes Reported by In-home Visit Households

Follow-up interviews with households revealed that they had been receptive to the visits and the water saving ideas that were shared. In many cases, households appeared to have made earnest attempts to change behavior and conserve water. Only four of the homes that BBC successfully contacted in follow-up calls did not report any changes made as a result of the visits.

Households responded in a variety of ways to the visits. The greatest range of water-saving efforts occurred outdoors, although several indoor changes to reduce water use were also reported. Figure 2 identifies the most common changes that homeowners said they made in the 14 months following the visits. The most common changes included reduced watering outdoors and locating and repairing leaks, both indoors and outdoors. Most leak repairs were the result of leaks found in irrigation systems, although leaks were also located and repaired in pools, hose bibs, faucets and toilets. Several homes were able to locate and repair more than one leak during the year following the visit. Only four households reported no changes during the follow-ups.

Figure 2.
Changes reported during follow-ups



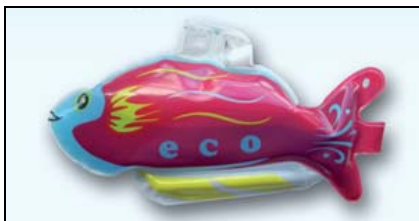
Source: BBC Research & Consulting.

Reduced watering. Several participants reported cutting back on outdoor watering with no negative effects on their plants. On more than one occasion, homeowners commented that they now believed that they had been over-watering before the visits. Reductions in watering were made through changes to the operation of automatic irrigation systems as well as less hand watering.

Repairs to irrigation systems. The most common type of leak repair undertaken following the visits was to irrigation systems. Several households hired professionals to inspect and service their sprinkler systems. In a number of cases, more than one inspection took place at the home between the in-home visit and the November 2008 follow-up. Repairs included replacement of broken or clogged sprinkler heads and fixing drip systems. One household stopped using their sprinkler system entirely until the leaks were located and fixed. More than one homeowner commented that they would never have found the leak without the prompting of the in-home visits.

In addition to sprinkler and drip systems, a number of households identified and repaired leaks in hose bibs and hoses.

Use of Ecosavr fish. As part of the original visits, BBC offered Ecosavr fish to each home with a pool. Ecosavr fish were designed to reduce water evaporation in pools. The Ecosavr fish contains a transparent liquid solar cover that spreads across the surface of the water. An image of an Ecosavr fish is provided below.



Depending on the pool size, three to six fish were offered to each home. Eighteen of the 19 homes offered fish accepted them. At the time of the second follow-up in November 2008:

- Ten homes had used at least one fish and five homes had used all of them;
- Four participants felt that the fish were effective at reducing evaporation from pools; and
- One home owner had purchased additional fish.

A number of the homes that had used the fish felt that they were not effective. Some of the households that had accepted the fish reported that they still intend to use them, but had not been able to for a variety of reasons.

Installation of ET controllers. As part of the original in-home visits, BBC offered homes a free ET controller to install as part of an automatic irrigation system (controller using historical data).

- Thirty homes were offered a controller and 20 accepted. Reasons for not accepting a controller included not having an automatic sprinkler system, already having a similar or near-new controller or being skeptical of their effectiveness.

- At the time of BBC's November 2008 follow-up, four homes had installed new ET controllers since the original in-home visit. In three of these cases, the homeowners had installed the controller that they had been given during the visit; in one case, the homeowners had decided to purchase their own controller.
- These four homes were among those showing the greatest reduction in use between 2006 and 2008, reducing their water use by an average of 29 percent compared with an average 18 percent reduction for all participating homes (this greater reduction may in part be due to other changes that these households had made).

Changes to pools and spas. In addition to the use of Ecosavr fish, several homes took more substantial measures to reduce water loss through pools and spas.

- One household chose to drain their pool and have it resurfaced following detection of a leak.
- One household identified and repaired a leak in the pool's auto-fill system.
- Two households stopped using a summertime above-ground pool completely and two other households reported no longer using their spa.

Changes in lawn maintenance. A number of homeowners changed how they maintained their lawn.

- Three homes reported either mowing less often or keeping their grass 2.5 inches in length in response to suggestions made during the visits.
- Some homes also reported using the "footprint test" when deciding when to water their lawns.
- Two households decided not to continue seeding a winter lawn.
- Another household removed an area of grass that had been difficult to maintain.

Use of literature. BBC offered households print materials including a watering guide, simple conservation tips guide and plant selection guide.

- A majority of households accepted the guides.
- Several homeowners subsequently reported reading these guides, although some felt that the guides were confusing.
- At least three participants had used the plant guide as an aid in selecting plants.

Indoor leaks. Although more leaks were found outdoors, several homeowners reported locating and repairing indoor leaks. These included a leaking toilet float valve, leaking faucets and one major plumbing leak in a bathroom. In a number of cases the location of the leak led to the installation of a new low-flow fixture.

New appliances and fixtures. Several homes reported upgrading fixtures or installing new appliances.

- Seven homeowners had replaced a showerhead or a dripping faucet with a low-flow fixture.
- Three homes purchased new water saving appliances. These households reported taking water efficiency into account when considering new appliances as a result of the visits.
- One home reported replacing both toilets with low-flow versions and a bath tub with a shower unit.

Other changes. A number of other changes impacting water use were only reported by one household. Outdoors, these less common changes included using mulch in beds, installing a pond filter, and refilling the spa less frequently. Indoors, the only other change reported was taking shorter showers.

Effect of In-home Visits on Recorded Water Use

BBC examined Phoenix water use records to compare water use for homes that received visits with other Phoenix single family homes, using data for 2006-2008. BBC used a number of approaches to compare changes in use, including:

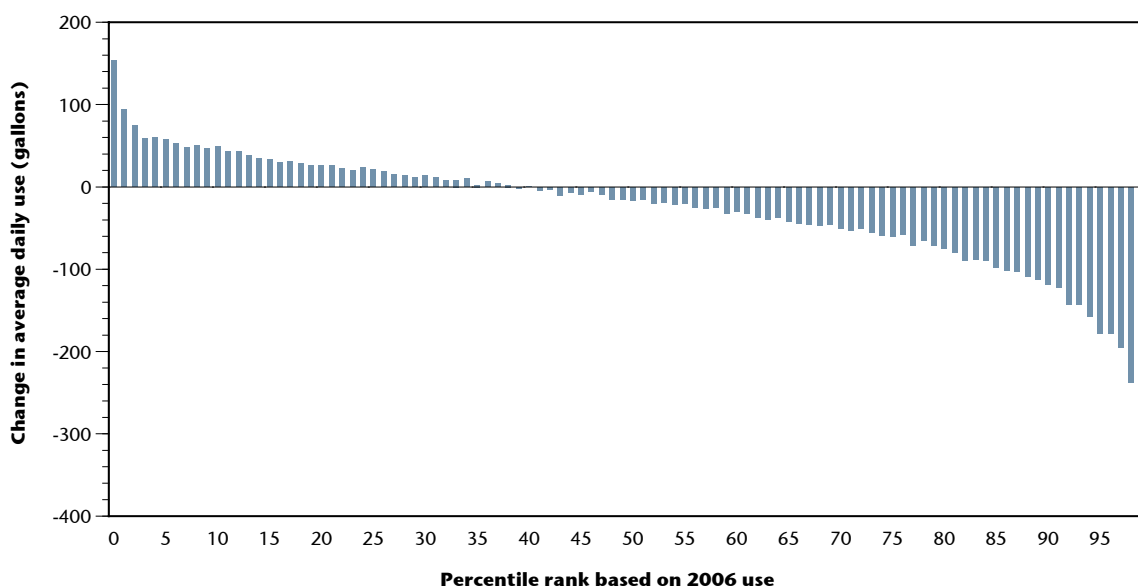
- The absolute change in average daily water use between 2006 and 2008 for homes that were visited and homes that were not;
- The percentage change in annual water use between 2006 and 2008 for homes that were visited and homes that were not;
- The percentage of homes whose annual water use declined from 2006 to 2008 for homes that were visited and homes that were not; and
- The change in water use over time for homes that were visited, compared to other single family homes.

Comparing water use for in-home visit households with other homes. Analysis of changes in use for homes participating in the in-home visits must take place in the context of changing use for all single family homes. Average water use for single family homes in Phoenix changes from year to year due to weather. Longer-term factors influencing average use include the amount and type of new development, changing landscape types and the prevalence of pools and spas. In recent years, Phoenix has seen a general decline in average single family water use.

There is also an important statistical relationship between a household's level of water use in one year and use in subsequent years. Homes with higher use in any one year tend, on average, to exhibit slightly decreased use in following years and homes with lower use tend subsequently to exhibit slightly increased use, on average. This "regression to the mean" phenomenon is common in many years, both in periods when overall use for single family homes is increasing or decreasing.

As most of the homes that received visits were above-average users, it is important to take this into account when trying to determine the impact of in-home visits on water use. BBC did this by attempting to compare in-home visit households with similar “high water use” households. BBC first calculated each home’s percentile rank of use in 2006 (based on average gallons per day) and comparing visited homes with all single family homes in the same or similar percentiles in 2006. Figure 3 illustrates the relationship between percentile rank of use in 2006 and the change in use between 2006 and 2008 for all Phoenix single family homes. Homes that showed the highest use in 2006 (e.g., 90th+ percentile) had the greatest reductions in water use by 2008. Homes ranking under the 35th percentile in 2006 use had increased their water use by 2008.

Figure 3.
Absolute change in average daily water use between 2006 and 2008 for single family homes in Phoenix, by percentile rank of use in 2006

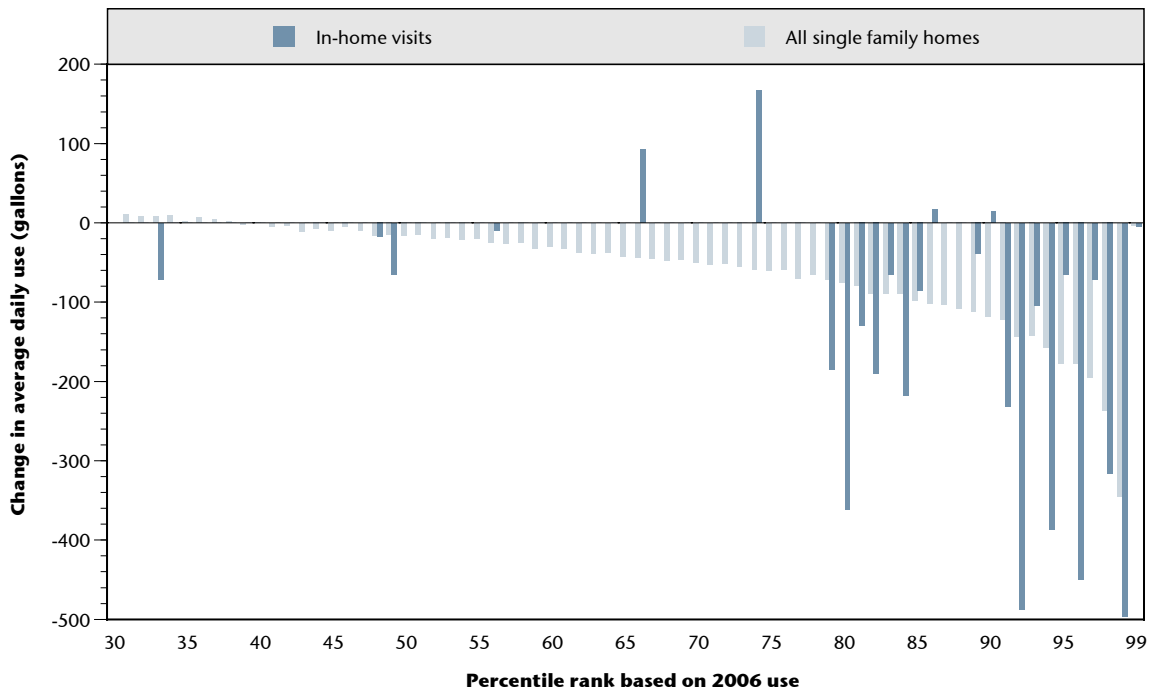


Source: BBC Research & Consulting from City of Phoenix Water Services Department water use data.

Even in the context of overall reductions in average use during 2006-2008 and taking into account the expected declines in use for above-average users, BBC’s analysis indicates that the in-home visits were effective in reducing water use. Phoenix water use records show that, on average, homes receiving visits recorded a greater reduction in use than would be expected for similar homes over the same time period, as explained below.

Absolute change in water use between 2006 and 2008. Figure 4 shows the absolute change in use (based on average gallons per day in 2006 and 2008) for homes that were visited and for all single family homes. Homes are grouped according to their percentile rank in 2006 — each bar represents the average change for homes in that percentile. Although most households that were visited were high users in 2006 who might be expected to record lower use in subsequent years, the decline in use for many of these homes is greater than might be expected. (Note that visited homes were high users compared with their segment, so some of the participants had low pre-visit use compared with all Phoenix households.)

Figure 4.
Absolute change in average daily water use between 2006 and 2008
by percentile rank of use in 2006



Source: BBC Research & Consulting from City of Phoenix Water Services Department water use data.

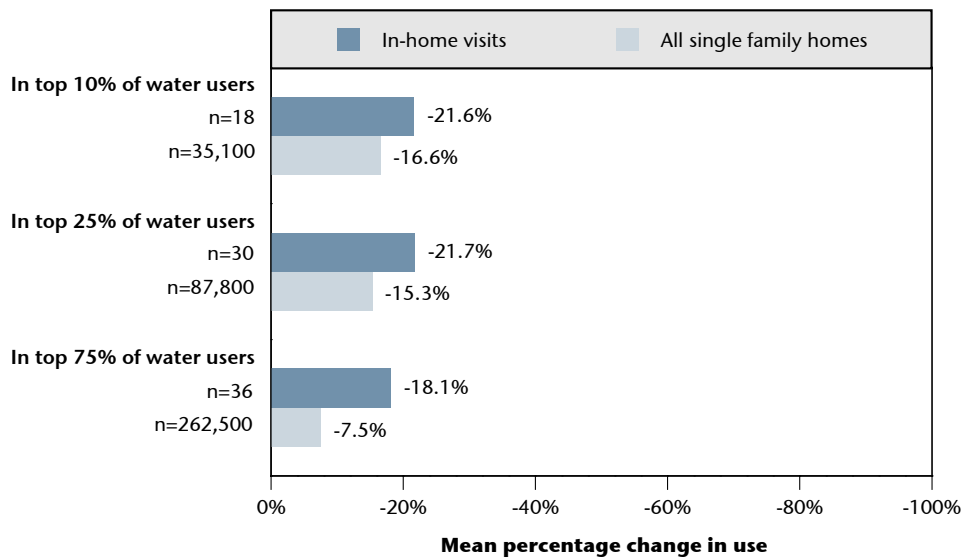
Percentage change in water use between 2006 and 2008. BBC also examined the percentage change in annual water use for single family homes between 2006 and 2008. Overall, homes that were visited used 18 percent less water in 2008 than in 2006.

As with absolute use, homes that were high users in 2006 tended to record a greater percentage decline in use than homes that were low users. BBC therefore took the level of water use in 2006 into account when comparing visited and non-visited homes. Figure 5 summarizes this analysis.

- One-half of all the homes visited were among the top 10 percent of water users in 2006. These homes reduced their use in 2008 by an average of 22 percent compared to an average reduction of 17 percent for all other single family homes that were in the top 10 percent of 2006 water users.
- Nearly all the homes that were visited were in the top 25 percent of water users in 2006. These homes reduced their use by 22 percent in 2008, compared to a reduction of 16 percent for all other single family homes in the top 25 percent of users in 2006.

Even when including participating homes that were not among the highest users in 2006, the percentage reduction in use in 2008 was higher than the reduction for other single family homes with similar or higher use levels in 2006.

Figure 5.
Percentage change in use between 2006 and 2008 for in-home visit households and all single family homes

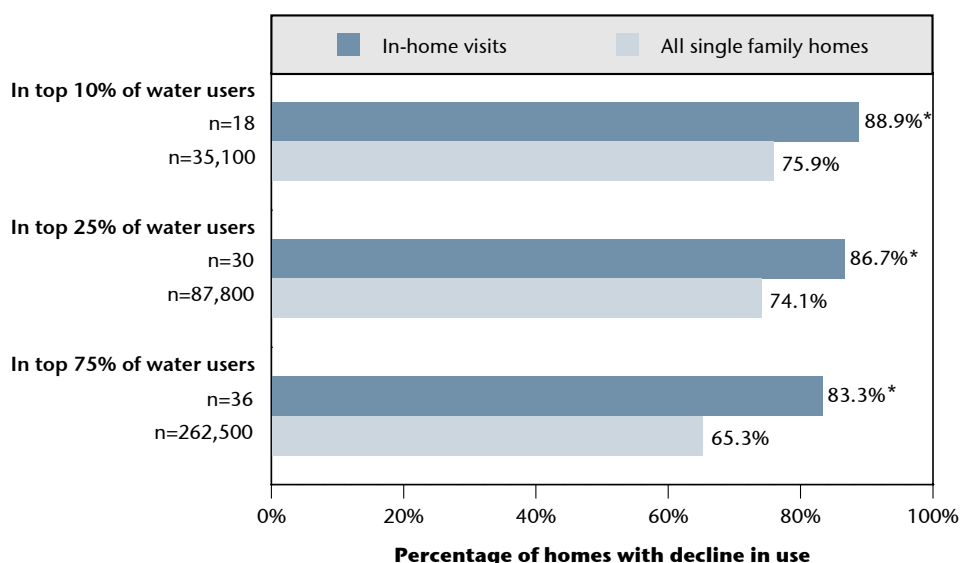


Note: "n" refers to number of homes.

Source: BBC Research & Consulting, from Phoenix Water Services Department water use data.

Percentage of homes with a drop in water use. Another approach to assessing the effectiveness of the visits is to examine the percentage of homes whose water use declined from 2006 to 2008. Homes that participated in the in-home visit program were more likely to record a drop in use between 2006 and 2008 than other, similar homes in Phoenix. Figure 6 shows the percentage of homes whose use declined between 2006 and 2008 for homes with different levels of use in 2006. About 89 percent of in-home visit participants that were in the top 10 percent of 2006 water users decreased their water use in 2008. This is higher than the 76 percent of other Phoenix single family homes that were in the top 10 percent (a statistically significant difference).

Figure 6.
Percentage of homes with a decline in use between 2006 and 2008
for in-home visit households and all single family homes



Note: n= refers to number of homes.

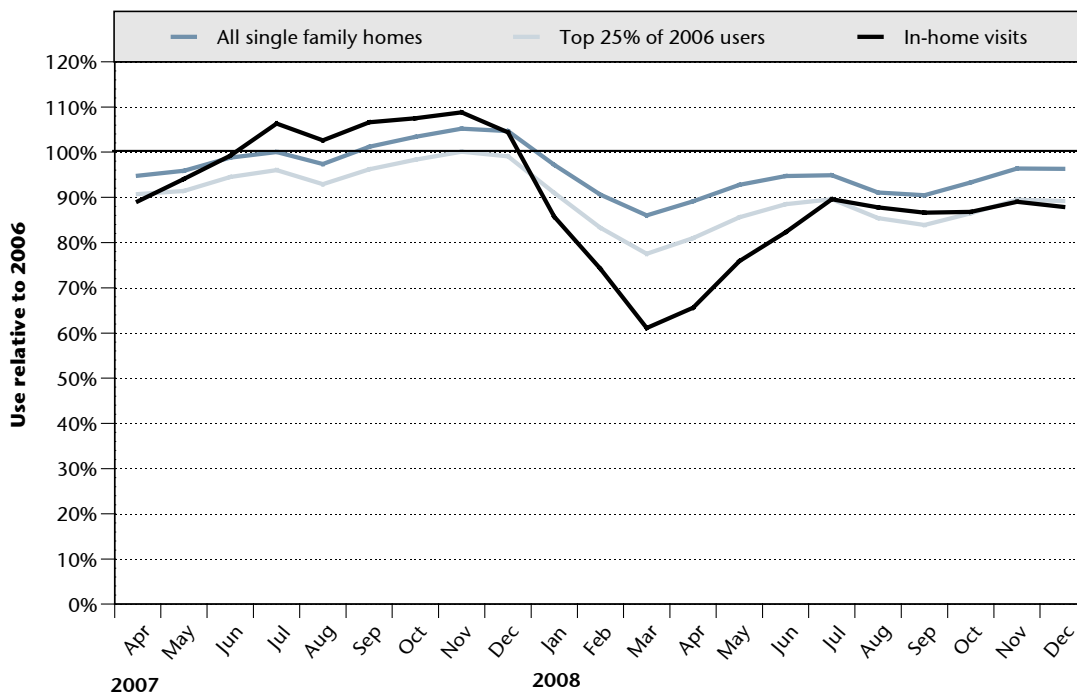
* indicates that the difference between homes that were visited and all single family homes in terms of the percentage of homes recording a decline in use is statistically significant at the 90 percent confidence level.

Source: BBC Research & Consulting, from Phoenix Water Services Department water use data.

Changes in use over time. BBC also examined how water use changed month-by-month after homes were visited in August and September 2007. Phoenix water use records suggest that the effect of the in-home visits on residential water use was not constant over time, but was greatest in early 2008.

Figure 7 shows how water use for homes that received visits varied in 2007 and 2008 relative to their use in 2006. Although use in early 2008 was lower than the same period of 2006 for all single family homes and in particular for the highest users, the drop in use for homes that were visited was much greater. As these homes were among the highest users in 2006, this drop in use relative to other homes during early 2008 is considerable both in percentage and absolute terms. (Some participating homes' use in the early months of 2008 was less than one-half that of 2006.)

Figure 7.
Average water use in 2007 and 2008 relative to 2006 use



Note: Four-month moving average.

Source: BBC Research & Consulting, from Phoenix Water Services Department water use data.

The drop in use for all single family homes may in part be explained by the wetter than average conditions experienced during late 2007 and early 2008. The fact that the reduction in use was much greater for homes that were visited indicates that these homeowners' irrigation habits may have become more responsive to weather conditions. It is also possible that the impact of conservation ideas was greatest when the memory of the in-home visits was still fresh in participants' minds. By late 2008, water use for participating households relative to 2006 was similar to that of the top 25 percent of all single family users in 2006.

Estimate of the savings resulting from in-home visits. Based on the evidence for additional reductions in water use resulting from the in-home visits, BBC estimated the total savings that could be attributed to the visits by comparing the percentage change in use between 2006 and 2008 for each home with the average percentage change in use for all homes in its percentile class. Based on this analysis, homes that received visits reduced their water use on average by an additional 4 percent beyond the reductions seen in similar households. This corresponds to an average saving of 37 gallons per household per day, or roughly 13,500 gallons each year. The total saving in water resulting from the visits to all 36 households was nearly 500,000 gallons in 2008.

Figure 8 summarizes the estimated savings in 2008 due to the in-home visits.

Figure 8.
Estimated water savings in 2008 for homes that were visited

Estimated water savings (gallons)	
Per-household impact	
Daily saving	37
Annual saving	13,505
Total impact	
Daily saving	1,332
Annual saving	486,180

Source: BBC Research & Consulting, from Phoenix Water Services Department water use data.

The City of Phoenix will continue to track water use for the 36 visited households.

Impact

In-home visit results have demonstrated:

- Deficiencies in customer water use knowledge (particularly outdoor use);
- Customer acceptance and response to City-driven outreach efforts; and
- Need for a high-touch, hands-on water conservation initiative and enhanced public education tools.

Because of the success of the in-home visits conducted by BBC, the City will strengthen its outreach efforts to high water users through a new high-touch water audit program. A team of water auditors will be specially trained to conduct in-home visits focused on detecting leaks and reducing outdoor water use. The City is adding similar high-touch, one-on-one outreach to its drought response plan. BBC has helped the City launch a new customer-focused Water Resources and Conservation website that incorporates what was learned from the in-home visits.