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A Pilot Water Conservation Program

California Department of Water Resources

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State of California
The Resources Agency

Department of
Water Resources



A Pilot Water Conservation Program

Bulletin 191
October 1978

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Department of
Water Resources

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3th Bulletin 191 ₇

A³ Pilot Water Conservation Program₃

⁴ October 1978 ₄

Huey D. Johnson
Secretary for Resources

Edmund G. Brown Jr.
Governor

Ronald B. Robie
Director

The Resources
Agency

State of
California

Bureau of Reclamation
Denver, Colorado
FEB 1 2010

Department of
Water Resources

FOREWORD

Use of water saving devices in the home—particularly in bathrooms—is a direct and effective way to achieve significant urban water conservation.

This bulletin reports on a study of the best and most cost effective ways to introduce such devices into homes. It is based on pilot projects conducted during the summer and fall of 1977 in six California communities of diverse characters and settings.

The Department carried out the program under the authorization of Assembly Bill 380 (Chapter 28, Statutes of 1977) by Assemblyman Eugene Gualco, chairman of the Assembly Committee on Water, Parks and Wildlife. The bill, an urgency measure, was signed into law by Governor Edmund G. Brown Jr. on April 6, 1977.

Although the research purposes of the project were paramount, the program overall was a cost effective and successful water saving effort in a time of severe drought. Despite the success of this program, it should be kept in mind that installing water saving devices is only one phase of a successful urban residential water conservation program. Longer-term benefits will come from changes in building code standards that require built-in conservation features in homes, from standards for more efficient water-using appliances, and finally from development of conservation awareness on the part of the general public.

The lessons learned in the studies described in this report will be of value to water suppliers and citizen groups interested in water conservation. I urge all California water suppliers who have not already done so to adopt aggressive water conservation programs, and commend this report to them as a valuable source of information.



RONALD B. ROBIE, *Director*
Department of Water Resources
The Resources Agency
State of California

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- APPENDIX A: San Diego
- APPENDIX B: Santa Cruz
- APPENDIX C: Sanger
- APPENDIX D: El Dorado Irrigation District
- APPENDIX E: El Segundo
- APPENDIX F: Oak Park
- APPENDIX G: Device Testing
- APPENDIX H: Device Selection

Copies of this bulletin are available without charge from:

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City of San Diego	District (Oak Park)
City of Sanger	Metropolitan Water Company (Oak Park)
County of San Diego	Santa Cruz County Board of Supervisors
El Dorado Irrigation District	and local water districts

* This program was initiated by the Resource Evaluation Office under the direction of G. Donald Meixner, Supervising Engineer, Water Resources. The Resources Evaluation Office was subsequently incorporated into the Division of Planning.

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Department of Water Resources
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The California Water Commission serves as a policy advisory body to the Director of Water Resources on all California water resources matters. The nine-member citizen Commission provides a water resources forum for the people of the State, acts as liaison between the legislative and executive branches of State Government, and coordinates Federal, State, and local water resources efforts.

CONVERSION FACTORS

English to Metric System of Measurement

<u>Quantity</u>	<u>English unit</u>	<u>Multiply by</u>	<u>To get metric equivalent</u>
Length	inches (in)	25.4	millimetres (mm)
		.0254	metres (m)
	feet (ft)	.3048	metres (m)
	miles (mi)	1.6093	kilometres (km)
Area	square inches (in ²)	6.4516×10^{-4}	square metres (m ²)
	square feet (ft ²)	.092903	square metres (m ²)
	acres	4046.9	square metres (m ²)
		.40469	hectares (ha)
		.40469	square hectometres (hm ²)
		.0040469	square kilometres (km ²)
	square miles (mi ²)	2.590	square kilometres (km ²)
Volume	gallons (gal)	3.7854	litres (l)
		.0037854	cubic metres (m ³)
	million gallons (10 ⁶ gal)	3785.4	cubic metres (m ³)
	cubic feet (ft ³)	.028317	cubic metres (m ³)
	cubic yards (yd ³)	.76455	cubic metres (m ³)
	acre-feet (ac-ft)	1233.5	cubic metres (m ³)
		.0012335	cubic hectometres (hm ³)
		1.233×10^{-6}	cubic kilometres (km ³)
Volume/Time (Flow)	cubic feet per second (ft ³ /s)	28.317	litres per second (l/s)
		.028317	cubic metres per second (m ³ /s)
	gallons per minute (gal/min)	.06309	litres per second (l/s)
		6.309×10^{-5}	cubic metres per second (m ³ /s)
	million gallons per day (mgd)	.043813	cubic metres per second (m ³ /s)
Mass	pounds (lb)	.45359	kilograms (kg)
	tons (short, 2,000 lb)	.90718	tonne (t)
		907.18	kilograms (kg)
Power	horsepower (hp)	0.7460	kilowatts (kW)
Pressure	pounds per square inch (psi)	6894.8	pascal (Pa)
Temperature	Degrees Fahrenheit (°F)	$\frac{t_F - 32}{1.8} = t_C$	Degrees Celsius (°C)

INTRODUCTION

Well before the 1976–77 drought the Department of Water Resources (DWR) began promoting water conservation in California.¹ Although the drought gave greater impetus to this effort, Department policy remained that water saving should be a California way of life in wet years or dry.

One plan under consideration was the statewide distribution of devices to modify water fixtures in homes—particularly in bathrooms—to reduce water use without causing inconvenience.

As a result of this planning the San Diego metropolitan area was chosen for a pilot project to determine the most effective means of distributing devices and the probable water saving that would result.

After attempts to obtain federal funding to help with the study failed, Assemblyman Eugene Gualco, chairman of the California Assembly Committee on Water, Parks, and Wildlife, introduced funding legislation. This legislation directed that a pilot study be conducted which would include at least three communities of varying water supply conditions. It also specified that devices be free in some pilot studies and offered for sale in others.

The Legislature enacted Assemblyman Gualco's bill—AB 380 (Chapter 28, Statutes 1977)—and Governor Edmund G. Brown Jr. signed it into law on April 6, 1977. The measure appropriated \$600,000 for the pilot program and specified that DWR obtain local participation for at least 10 percent of the cost of the studies. In addition to the money provided by AB 380, DWR allocated \$100,000 to the project and the California Energy Commission contributed \$50,000.

Program Goals

The goals of the pilot program were:

- To find out whether a significant amount of water and energy could be saved by installing water saving devices in dwellings.
- To determine which methods of distribution are most successful and cost effective.
- To evaluate the relative merits of offering devices free or selling them, and to determine which kinds of devices are most acceptable to the public.
- To determine the feasibility of distributing water saving devices throughout the State.

Pilot Area Selection

Pilot areas were selected on the basis of community type and water supply situations.

DWR Director Ronald B. Robie chose these areas, listed with the project variables:

San Diego Metropolitan Area. An urban area without critical water shortages and no rationing; devices were to be given away through these distribution methods: Mass, where kits were simply hung on doorknobs; door-to-door, where teams vi-

The Drought Effect

The projects described in this report were conducted in an atmosphere of acute public awareness of the 1976–77 drought, one of the worst in California history.

Inevitably the intense public consciousness of water shortages affected the results of the studies, even in areas where there were no immediate supply problems. There is no doubt that greatly enhanced the willingness of the public to accept and use water saving devices. Indeed, the studies show many persons in the project areas began water saving practices even before the program began.

As a result of this drought factor, it is uncertain what the outcome of these projects would have been had they been conducted in normal times. Readers should use care in predicting overall results of other similar efforts, and should include in program designs greater emphasis on such factors as informing and educating the public as to the need for and benefits of water conservation.

sited householders and left kits if the residents wanted them; and depot, where kits could be picked up.

Santa Cruz County. An urban and rural area with a water shortage and rationing in part of the county; devices were to be free, available at several locations, and with free delivery and installation available by appointment.

City of Sanger. An agricultural community with no water shortage and no rationing; devices to be given away and delivered, but no installation service.

El Dorado Irrigation District. A rural community with severe water shortages and rationing; devices to be sold at several locations, but without installation service.

¹ See Bulletin 198, *Water Conservation in California*, May 1976, Department of Water Resources; *Proceedings, An Urban Water Conservation Conference*, January 16–17, 1976, Department of Water Resources; and *Proceedings, Agricultural Water Conservation Conference*, June 23–24, 1976, Department of Water Resources and U.C. Cooperative Extension Service.

City of El Segundo. An urban area without a critical water shortage, but with rationing; devices to be sold at various locations but no installation service.

Community of Oak Park. Suburban area with no critical water shortage and no rationing; devices free and delivered and installed at no charge.

The vast majority of homes in the pilot areas had water meters. Descriptions of the areas are in Table 1, and further details are in Appendixes A through F of this Bulletin.

Leak Detecting Dye Tablets

Dye tablets for detecting leaks in toilets were selected for pilot project kits only after analysis by the State Department of Health. (One bidder unknowingly submitted a corrosive formulation which would injure a person if swallowed.)

In addition to health safety factors, bid specifications called for tablets to be easily and readily soluble in water.

TABLE 1
DESCRIPTION OF PILOT PROGRAMS

<i>Pilot Area</i>	<i>Type of Community</i>	<i>Number of Households</i>	<i>Water Supply Condition</i>	<i>Method of Kit Distribution</i>	<i>Free/Purchase</i>	<i>Type of Promotion Campaign</i>
San Diego Metropolitan Area	Urban	370,000	No rationing	Mass; door-to-door with personal contact; depot	Free	Information post cards, paid ads, public relations activities
Santa Cruz County	Urban and rural	60,400	45 percent of County had rationing ordinances to achieve up to 30 percent reduction	Depot and home delivery with free installation upon request	Free	Public relations activities, home canvassing
City of Sanger	Small agricultural community	3,000	No rationing	Home delivery upon request	Free	Information post cards
El Dorado Irrigation District	Small urban and rural	13,300	Pricing structure and rationing ordinance designed to achieve 50 percent overall reduction	Depot	Purchase	Leaflets, paid ads in newspapers, public relations activities
City of El Segundo	Urban	6,000	Water rationed. Ordinance designed to achieve 10 percent reduction	Mobile sales depot	Purchase	Paid ads in newspapers, mass mailing, newsletters
Community of Oak Park	Small suburban	753	No rationing	Free installation service	Free	Public relations activities

Water Saving Device Selection

When this program began, two of the areas—El Dorado Irrigation District and Oak Park—already had selected devices and had begun distribution.

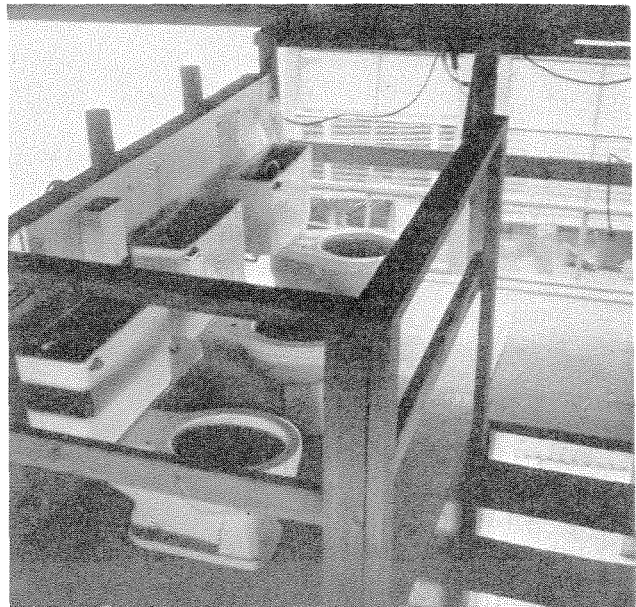
DWR selected devices for the other four areas after testing 131 types in a laboratory especially set up for the purpose. Not all the devices were used in all the areas. And in the San Diego and El Segundo studies a variety of devices serving the same purpose were used to test their relative effectiveness and acceptability in practical applications. Devices used in each of the pilot areas are listed in Table 3 at the end of this report.

Toilet devices used in the pilot program were water dams, plastic water displacement bottles, plastic water displacement bags, toilet float adjusters, adjustable flush valves, flush valve controls, and leak detecting dye tablets for use in toilet tanks.

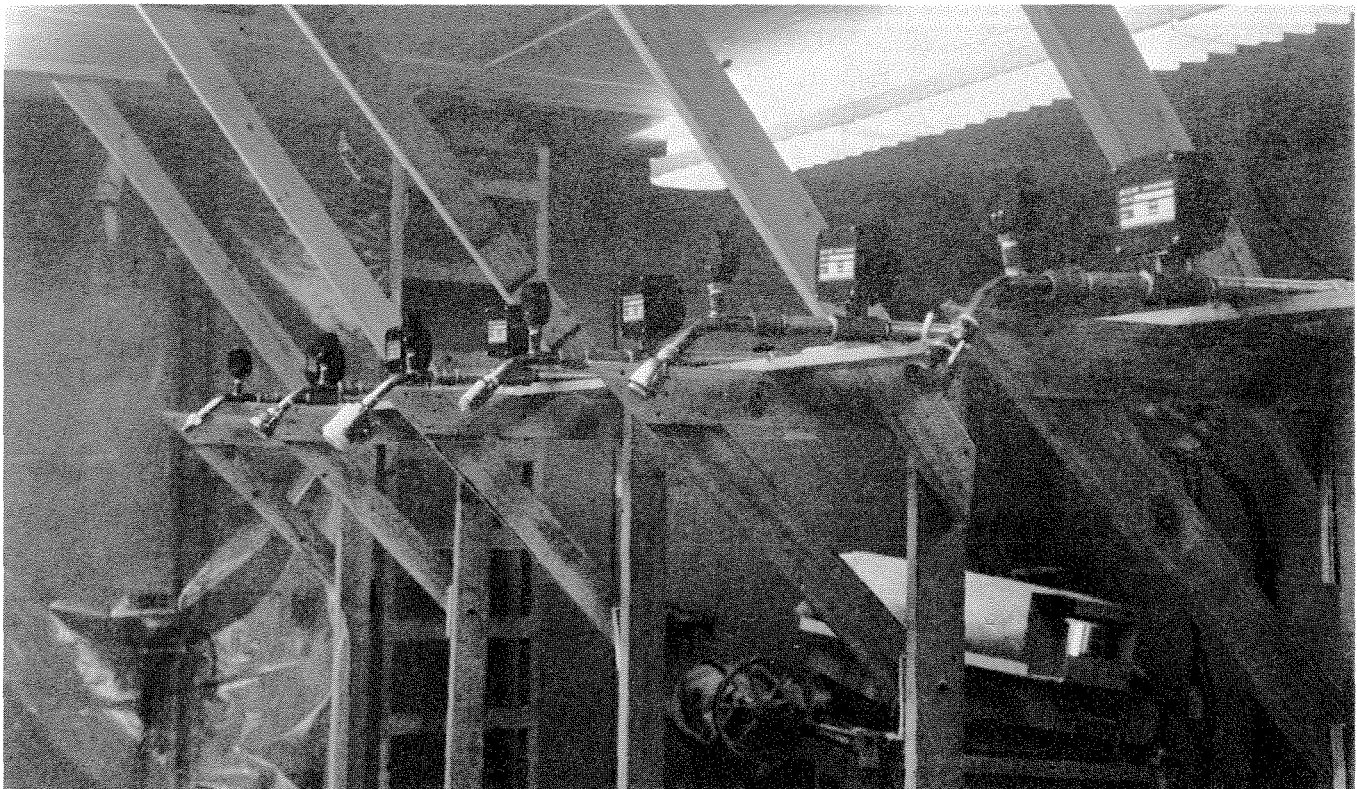
Three types of shower flow reducing devices were used—internal and external flow reducers and low flow showerheads. A faucet flow reducer was also used, but in the El Segundo study only. Detailed information on device testing and selection is in Appendixes G and H of this report.

More than 500,000 devices were distributed. About 1,240 persons took part in the administration, distribution, and—in some cases—installation in the six

pilot areas. About 180,000 households received devices.



A test facility consisting of three toilets was built at DWR's Bryte lab. Water use was monitored by a calibrated water meter, and an average of three flushes was calculated.



The shower testing facility was enclosed with plastic on three sides and a heavy gauge plastic trough on the bottom. It was constructed to recirculate water from the catch basin to two 55 gallon drums for reuse. A direct reading flow meter and a pressure gauge were mounted on each of the six shower arms.



Many kinds of devices are available to help save water in toilets and showers. Dams, bottles, and bags reduce the amount of water used to flush a toilet; special shower heads and restrictors reduce shower flow. The Department of Water Resources tested 131 devices and selected 18 (13 are shown here) for use in the pilot program.

TABLE 2
CRITERIA USED FOR SELECTION OF TOILET DEVICES

- 1. DURABILITY**
- 2. AMOUNT OF WATER SAVED**
- 3. WHETHER OR NOT MAINTENANCE OF DEVICE IS REQUIRED**
- 4. APPLICABLE TO WIDELY USED TYPES OF FIXTURES**
- 5. ADEQUACY OF INSTALLATION INSTRUCTIONS**
- 6. COST OF DEVICE**
- 7. TIME REQUIRED TO INSTALL DEVICE**
- 8. EASE OF INSTALLATION BY CONSUMER**
- 9. WARRANTY**
- 10. CHANGE IN CONSUMER HABITS**
- 11. TOOLS REQUIRED FOR INSTALLATION**
- 12. MODIFICATION TO EXISTING FIXTURES**
- 13. BULK**
- 14. WEIGHT**
- 15. COST EFFECTIVENESS**

Assembly Bill No. 380

CHAPTER 28

An act relating to water conservation, making an appropriation therefor, and declaring the urgency thereof, to take effect immediately.

[Approved by Governor April 6, 1977. Filed with Secretary of State April 7, 1977.]

LEGISLATIVE COUNSEL'S DIGEST

AB 380, Gualco. Water conservation.

Existing law requires the water resources of the state to be put to beneficial use to the fullest extent of which they are capable. Existing law also requires the Department of Water Resources to take all appropriate proceedings to prevent waste, unreasonable use, or unreasonable method of diversion of water in this state.

This bill would appropriate \$600,000 to the Department of Water Resources for the purpose of making a pilot water conservation study, consisting of the purchase, distribution, and installation of water conservation devices, including, but not limited to, low flow showerheads, showerhead flow restrictors, and toilet tank displacement devices or other toilet tank flow reducing devices.

The bill would require such study to be undertaken in at least three communities, selected by the Director of Water Resources, of varying water conditions. The bill would require such funds to be commingled, to the extent feasible with other federal, state, and local funds.

The bill would require the department to obtain participation of at least 10% of the cost of the study and report the results to the Legislature by specified dates.

The bill would take effect immediately as an urgency statute.

Appropriation: yes.

The people of the State of California do enact as follows:

SECTION 1. The Legislature finds and declares that water conservation, in conjunction with existing and future major water facilities which provide long-term carryover water storage, is an important and necessary element of providing adequate water supplies at a reasonable cost to meet water needs in accordance with the California Water Plan.

SEC. 2. The Legislature hereby appropriates six hundred thousand dollars (\$600,000) from the General Fund to the Department of Water Resources for expenditure during the 1976-1977 and the 1977-1978 fiscal years, for the purpose of making a pilot water conservation study. To the extent feasible, such funds may be

commingled with other federal, state, and local funds.

The pilot study shall consist of, but shall not be limited to, the purchase, distribution, and installation, where appropriate, of water conservation devices which reduce shower and toilet consumption. These devices shall consist of, but shall not be limited to, low flow showerheads or showerhead flow restrictors, and toilet tank displacement devices or other toilet tank flow reducing devices. The study shall include the evaluation of distribution methods where devices are distributed free and where individuals pay for the devices. In purchasing devices, the request for bids shall not specify any particular type of toilet or shower device. Upon receipt of bids, the department shall select one or more bids based upon unit price, effectiveness in conserving water, ease of installation, durability, cost-effectiveness, useful life, applicability to widely used bathroom fixtures, and effect on operation of other household water using devices. The department shall assess the effectiveness of installed devices in reducing water and energy consumption, including devices which have been installed by consumers in their own residences.

The pilot study shall be undertaken in at least three communities, selected by the Director of Water Resources, which have varying water supply conditions. The department shall obtain local participation of at least 10 percent of the cost of the pilot study. The department shall submit a preliminary report on the results of the study to the Legislature on or before July 31, 1977, and a final report on or before December 31, 1977.

SEC. 3. This act is an urgency statute necessary for the immediate preservation of the public peace, health, or safety within the meaning of Article IV of the Constitution and shall go into immediate effect. The facts constituting such necessity are:

The Legislature finds and declares that the continuing drought is causing increasing hardships and crises in many areas of the state. The Legislature further finds and declares that the economic, social, and environmental consequences of the drought may be significantly alleviated by a statewide water conservation program which could be implemented by the Legislature, by cities and counties, or by local water districts, if this pilot study is determined to be successful.

In order to implement the conservation methods developed in this pilot study in this critically water short year, it is, therefore, necessary that this act take effect immediately.

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Key Questions

The six pilot studies gave these answers to key questions about home water conservation projects:

What Is The Best Way to Distribute Devices?

- In San Diego, the most cost effective way (the most savings per program dollar) was to hang free device kits on each doorknob. The depot method, in which residents could pick up free devices, was a close second in cost effectiveness. However, the depot method included a substantial amount of free labor that—if included—would have made depots much less cost effective.
- Offering devices free rather than selling them results in a much higher installation rate.
- In San Diego the greatest water and energy saving was accomplished through the mass distribution method—where kits were hung on doorknobs.
- Free devices and *free installation* offered to each household resulted in the highest absolute installation rate, but at much higher costs per household than other methods.

How Well Were Devices Received?

- Overall, devices were well received. Projecting the results of the best device (dams) and best method (mass distribution) in San

Diego, a 35 percent installation rate can be expected for toilet devices and a 10 percent rate for shower restrictors, given similar attitudes and conditions.

- Devices judged simplest to install were those most widely used.
- Most devices installed were reported to be working well, and most householders planned to leave them installed.
- More householders installed toilet devices than shower devices.
- Of toilet devices readily accepted by householders, dams saved the most water per flush and were also the most cost effective.
- Most users of shower devices said length of showers were the same or shorter after installation.

How Much Water And Energy Did The Program Save?

- Annual water savings from devices installed in the six pilot areas is 5.2 cubic hectometres (4,200 acre-feet).
- Annual energy savings (mostly reductions in hot water needed for showers) in the pilot areas is equal to 76,000 barrels of oil worth more than \$1 million today.

DEVICE DISTRIBUTION

Devices: Free or For Sale?

To test the argument that charging for water saving devices might result in higher installation rates, devices were sold in two of the six study areas—El Dorado Irrigation District (EID) and the City of El Segundo.

The answer was that—considering all the households in a test area—more devices were installed when they are free than when sold. Even though buyers were more likely to install devices than those who got them free, the much smaller percentage who would buy devices made these programs less successful.

In the EID, which was severely affected by the drought, 27 percent of the householders bought kits, while in El Segundo (where water supplies were also limited) only 7 percent bought devices.

In EID, 89 percent of those buying—or 24 percent *total*—installed toilet devices. Sixty-two percent of those buying in the district installed shower devices but in *total* only 16 percent of the district householders installed them.

In El Segundo 94 percent of the purchasers installed toilet dams, and 74 percent installed shower devices. But in the test area as a *whole*, only 5.6 percent installed toilet devices and 2.4 percent installed shower devices.

The reasons for the strikingly low installation rate in El Segundo are not clear, and post-project surveys of residents there failed to pinpoint a cause. Residents did, however, achieve significant reductions in

water use mostly through changes in water use habits. Monitoring will continue to see if these practices are maintained.

In contrast to the results in the for-sale test areas, in the free San Diego mass distribution area, 53 percent of the householders who were given toilet dams installed them, and 23 percent receiving shower devices put them in.

If the mass distribution method had reached all households in the test area, those percentages would also presumably have been the installation rates for the area as a whole—a much higher rate than in the two areas where devices were offered for sale.

As noted elsewhere in this report, on an overall basis only 67 percent of the householders in the San Diego mass distribution area actually received devices because of a variety of problems in the distribution.

Highest Installation Rates

In terms of absolute rates of getting devices installed, the aggressive home canvassing program conducted in the community of Oak Park proved to be the most successful distribution method.

Installers talked in person to about 97 percent of the householders and offered free installation. The result was that devices were actually installed in more than 88 percent of the community's homes.

Important factors were program flexibility to make contacts and installations at the most convenient

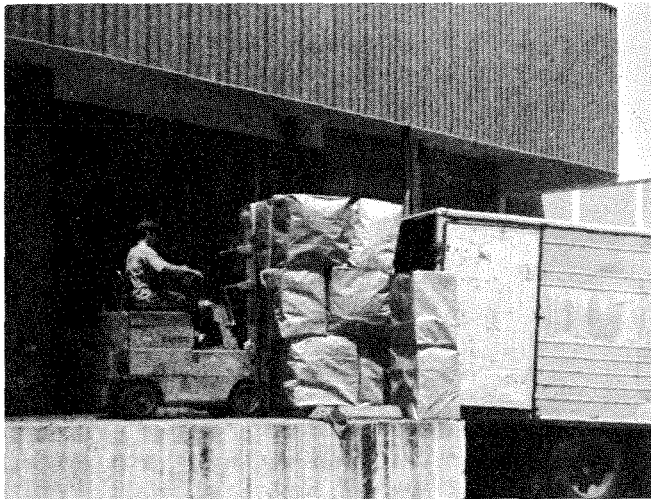
Shower or Tub Baths?

In general, the pilot study research shows, Californians prefer showers to tubs by about two to one.

In the El Dorado Irrigation District study, about 57 percent of residents questioned said they took showers always or almost always; another 20 percent took tub baths always or almost always, and most of the rest said they bathed about equally with shower or tub.

In Sanger, 61 percent said they showered always or almost always, and 25 percent used tubs always or almost always.

In El Segundo, nearly three-quarters of the residents who had purchased devices said they preferred showers; this preference was less among those who did not buy devices but were saving water in other ways (69 percent) and even lower among those who did not buy and were not conserving—54 (54 percent).



The logistics of a large-scale water conservation program are immense. The 180,000 water-saving kits distributed in San Diego were stored at a central warehouse and trucked to various depots and distribution points as needed.

hours, the strong community spirit, and the support of the active Oak Park community association.

Measurements of waste water show a 23-percent decrease in water use inside the homes in Oak Park as a result of the program. Monitoring will continue to determine the long term water use reductions.

San Diego Distribution

The San Diego study, involving more than 80 percent of the households in all six pilot study areas, was designed to evaluate three methods of distribution to determine the most effective way of getting devices installed.

The mass distribution method, in which kits were hung on front doorknobs of an area, resulted in the highest savings of water and energy per area resident. It was also the most effective method when benefits are compared to costs.

The depot method, where residents could pick up kits at a variety of neighborhood locations, was nearly as cost effective as the mass distribution method. But it was only 75 percent as effective as the mass method in per-household water savings, and 89 percent as effective in per-household energy savings.

The third method—where teams went door-to-door to hand out kits to residents—was the least effective in terms of benefits compared to costs, and also in household savings in energy. The per-household water savings were 74 percent of the savings in the mass distribution area, and per-household energy savings were 72 percent of those in the mass area.

The teams did not leave kits if householders were not at home. If they had, the distribution rate and effectiveness of this method would have been much higher.

A wide variety of volunteer groups from service clubs, youth and environmental groups, and other organizations worked in the door-to-door and depot distribution in San Diego. The value of their labor and that of the California Conservation Corpsmembers, who were paid from other sources, was not included in the cost calculations for these methods. If these costs had been included, both depot and door-to-door would have been far less effective than the mass method, where delivery costs were paid for from the program and included in the benefit-cost calculations.

How Many Toilets and Showers Per House?

In the San Diego area, surveys revealed an average of 1.6 toilets and 1.3 showers per household. Other study area results on this question were El Dorado Irrigation District, 1.7 toilets, 1.3 showers; Sanger, 1.4 toilets, 1.1 showers; Santa Cruz, 1.6 toilets, 1.2 showers; and El Segundo, 1.64 toilets, 1.3 showers.



Kits were distributed in various ways, including by volunteer workers such as boy scouts. Each of the large plastic bags shown in the photo contained 50 kits. Each kit contained a toilet device, devices for two showers, dye tablets, order forms, installation instructions, and conservation information.

One of every five kits in San Diego included a set of bulky plastic bottles, which complicated storage and distribution.

DISTRIBUTION METHODS

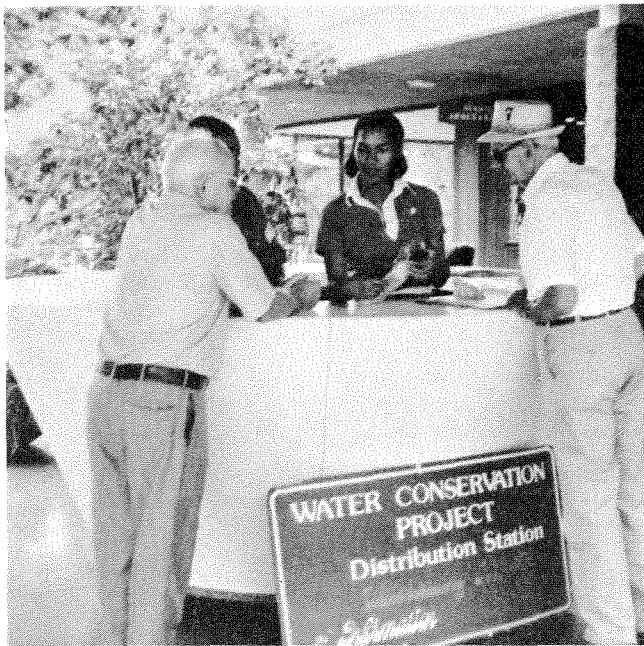


Who Installs—Male or Female?

Householders installing toilet water conservation devices were much more likely to be male than female, although the ratio depended on the type of device.

In San Diego, about 91 percent of the installers of float adjusting devices—considered to be the most complex to put in—were male. The highest percentage of female installers—23 percent—put in plastic displacement bags.

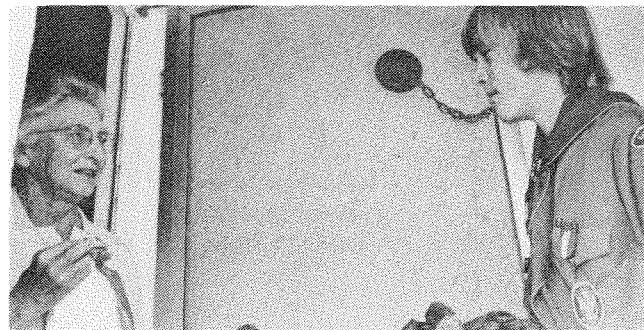
Devices were distributed in various ways in the six pilot areas. In San Diego three methods—mass, depot, and door-to-door—were tested for effectiveness under controlled conditions.



MASS DISTRIBUTION—Workers hung kits on front doorknobs without talking to residents. This method was the most successful in saving water and energy, and was also the most cost effective—it gave the greatest return per dollar spent.

DEPOT DISTRIBUTION—Depots were established in a variety of neighborhood locations such as shopping centers and fire stations. Householders could easily stop by, get program information, and pick up kits.

This was the second most effective method of the three used in San Diego. Overall costs¹ were about the same as in the mass method, but the percentage of persons in the test area installing devices was lower.

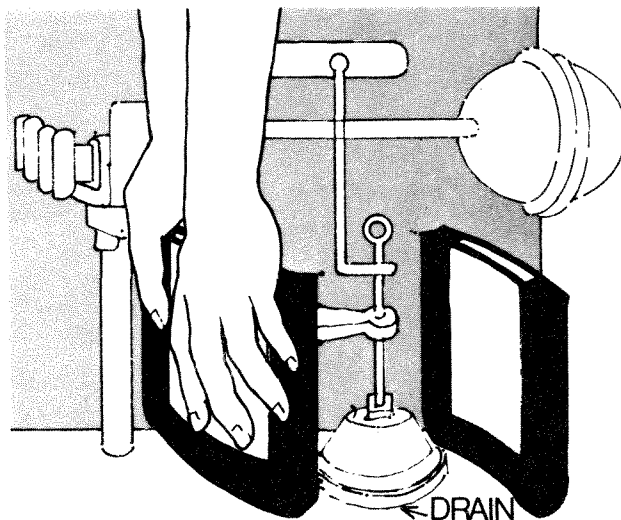
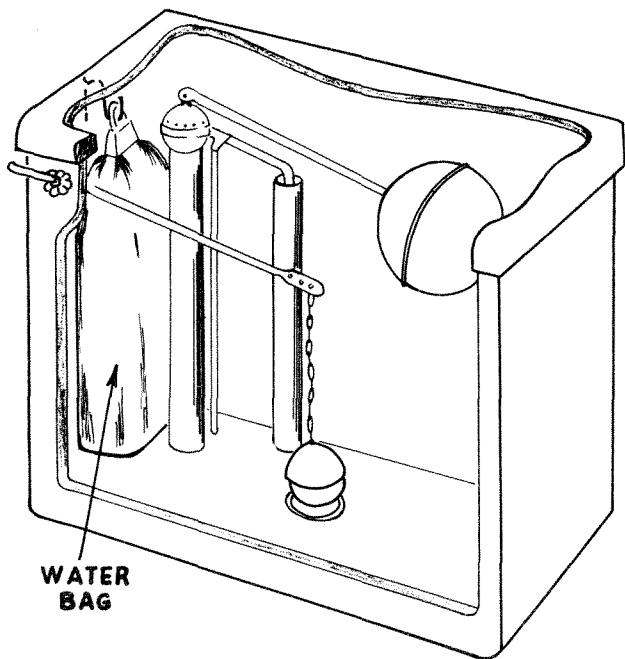


DOOR-TO-DOOR—Workers called at each home, explained the program, asked the resident to participate and—if desired—left a kit. This was a time-consuming and expensive method, and was the least effective in terms of water and energy saved per dollar invested.

¹ All costs for mass area were paid by program; in both depot and door-to-door methods free labor was not included in cost calculations.

TOILET DEVICES

Toilet devices were installed more often than shower devices, probably because shower installations required more effort. Of toilet devices tested, dams were most frequently installed, saved the most water, and returned most benefits per dollar than other types.

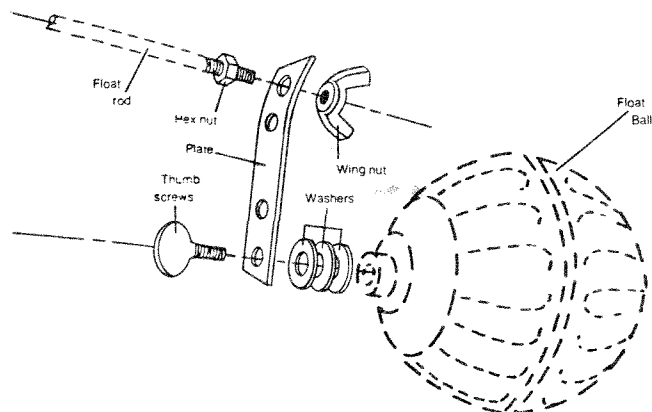


Toilet Dams

Dams are flexible panels that seal around three edges and hold back water when the toilet is flushed.

Bottles and Bags (Displacement Devices)

Bottles or bags displace their own volume in water, decreasing the amount flushed.



The Big Dipper

This device is a bracket that lowers the float ball, which in turn lowers the water level in the tank.



Of the more-acceptable toilet devices, dams saved the most water and proved to be the "best buy."

SAVING WATER, SAVING MONEY

Use of shower flow restrictors can mean significant householder savings in water heating bills —as much as \$64 per year if heaters are electric and energy costs are high.

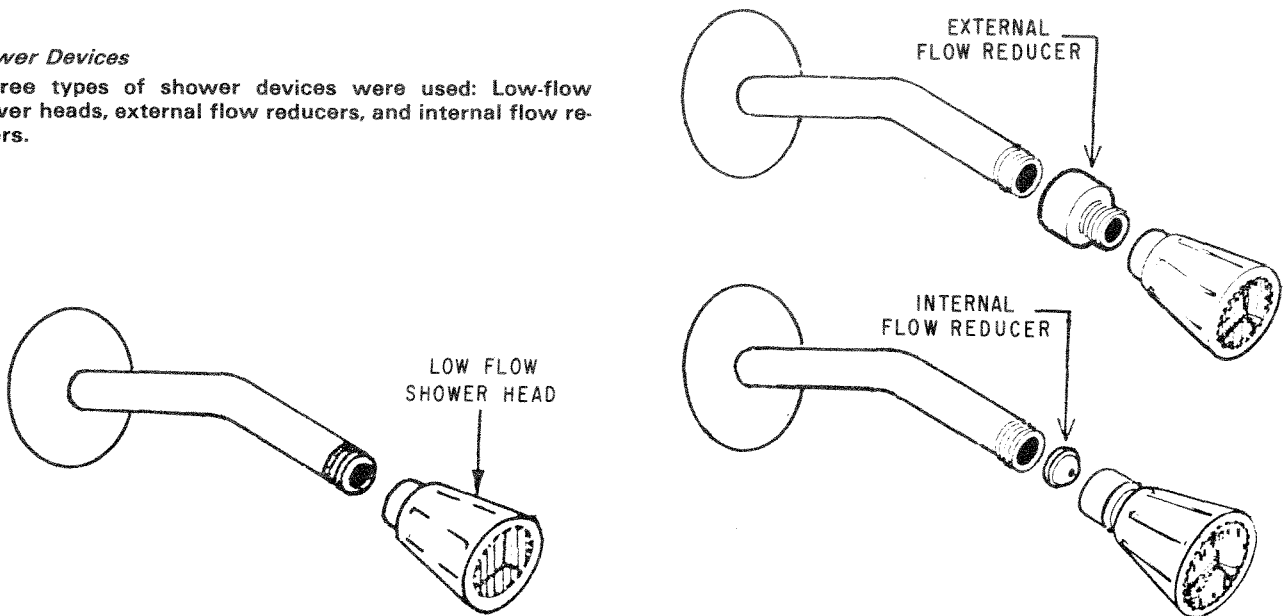
Electric Water Heaters	
Kilowatt Hour Costs (cents)	Annual Savings
2	\$32
3	\$48
4	\$64

Gas Water Heaters	
Costs Per Therm (cents)	Annual Savings
15	\$11
17	\$13
19	\$14
21	\$16
23	\$17
25	\$19
27	\$21

(Energy savings were computed from San Diego project results. Costs for energy depend on area, amount used, and other factors.)

Shower Devices

Three types of shower devices were used: Low-flow shower heads, external flow restrictors, and internal flow restrictors.



DEVICE USE

Devices Well Received

More than 500,000 toilet and shower devices were distributed in the six pilot areas. Most of those were in San Diego, the largest of the test areas. It was found that 67 percent of those in San Diego who received toilet dams (the best device in terms of both ease of installation and amount of water saved) put them in their toilets. The most complicated device to install—a toilet float adjuster—was used by 45 percent of those who received them. Sixty-one percent of those who received displacement bottles installed them, and 57 percent of those receiving displacement bags installed those.

The overall shower flow restrictor installation rate in San Diego was about 13 percent. The restrictor installation rate did not vary significantly with the type of toilet device received.

Device Effectiveness

About 80 percent of device users questioned said they were working effectively—that is, toilets were flushing properly or shower operation was adequate. More than 80 percent also replied “yes” when asked if they thought their devices were saving water.

Long-Term Installation

Once devices were installed, users were generally satisfied and more than 90 percent questioned said they planned to leave them installed permanently. The Department will conduct follow-up surveys to determine how many are left in use on a long-term basis, and also to monitor the physical condition of the various toilet and shower devices installed.

Toilet Devices More Popular

Householders overall in the test area were about 1.7 times as likely to install toilet devices as shower

devices, and even more likely when toilet devices are the easy-to-install dams. In the San Diego mass distribution area, for instance, the installation of dams was 2.3 times more likely than installation of a shower device. These results strongly suggest that ease of installation is very important to success, since shower devices require more effort to install than do dams and most other toilet devices.

Toilet Dams

Toilet dams were found to be the most effective of toilet devices used in the San Diego program. This assessment was made on the basis of costs of devices distributed, percentage installed, probable device life, and amount of water saved. Dams save 5.9 to 6.6 litres (1.6 to 1.7 gallons) per flush; by comparison, plastic bags or bottles save about 2.5 litres (0.7 gallon) and the float adjuster device about 7.7 litres (2 gallons) per flush.

No Change In Shower Length

Most householders (65 percent of device uses in San Diego) reported no change in length of showers after installing restrictors. Another 26 percent reported taking shorter showers after reducing flows.

Toilet Leak Detection

Leaks in toilets can be detected by placing a dye in the tank and seeing if it seeps into the bowl. In San Diego, of those who received kits about 41 percent used the dye tablets in the mass area, 48 percent used them in the door-to-door area, and 61 percent used them in the depot area. Overall, about 7 percent of those who received kits found leaks with the tablets, and about 70 percent of those who found leaks fixed them.

Motel Test

An 18-month program to monitor more precisely the energy and water savings that can result from use of low flow showers and toilet flush reducing devices began in March 1978.

This DWR experiment is being conducted in 33 rooms of a San Francisco motel. Objectives of the study, which will be reported on later, are to:

- Test the conclusion reached in the pilot studies that persons do not shower longer when using low flow shower devices.
- Test effectiveness of various types of toilet devices.
- Measure energy and water savings of the various shower and toilet devices used in the test program under actual operating conditions.

Figure 2.

HOUSEHOLDERS AWARE OF PROGRAM

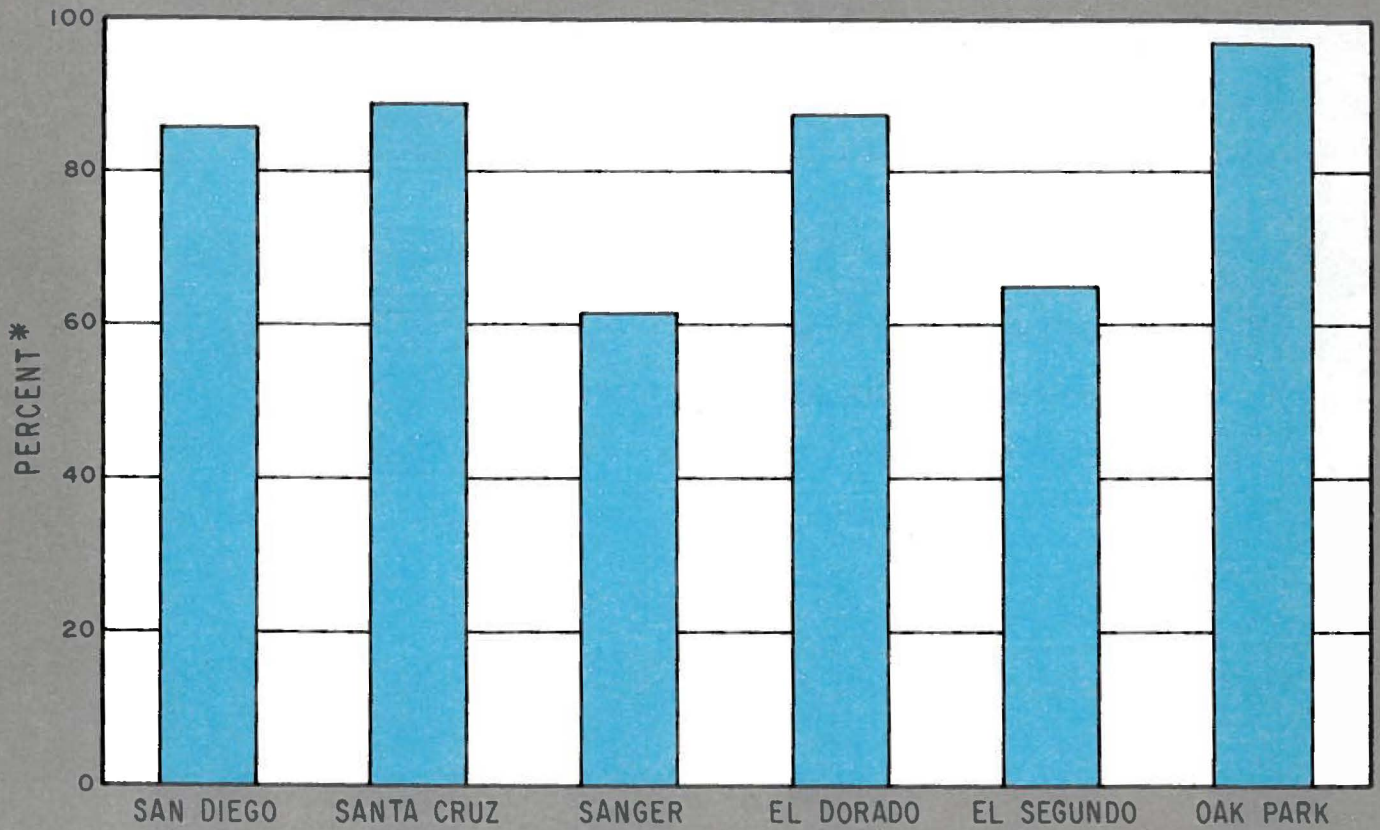
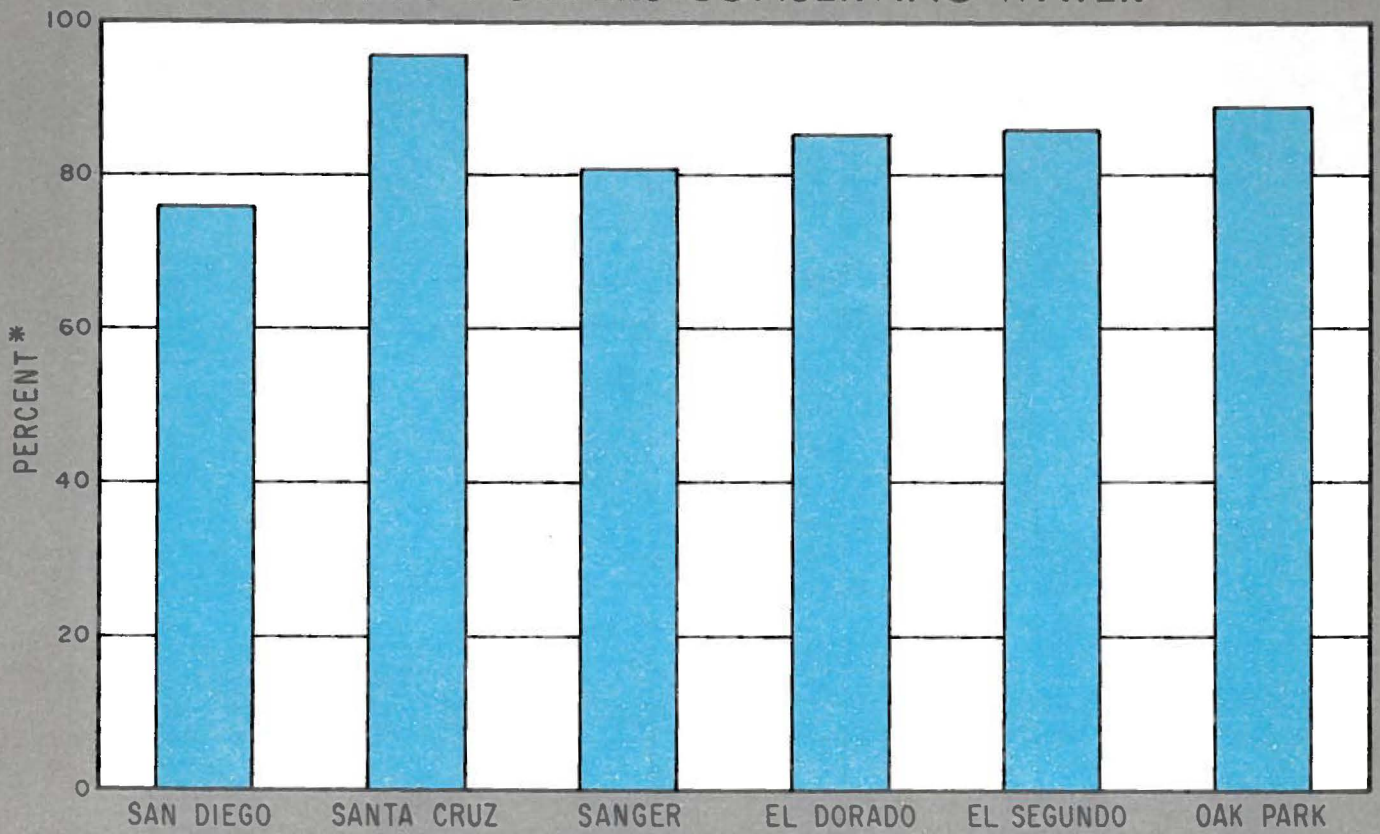


Figure 3.

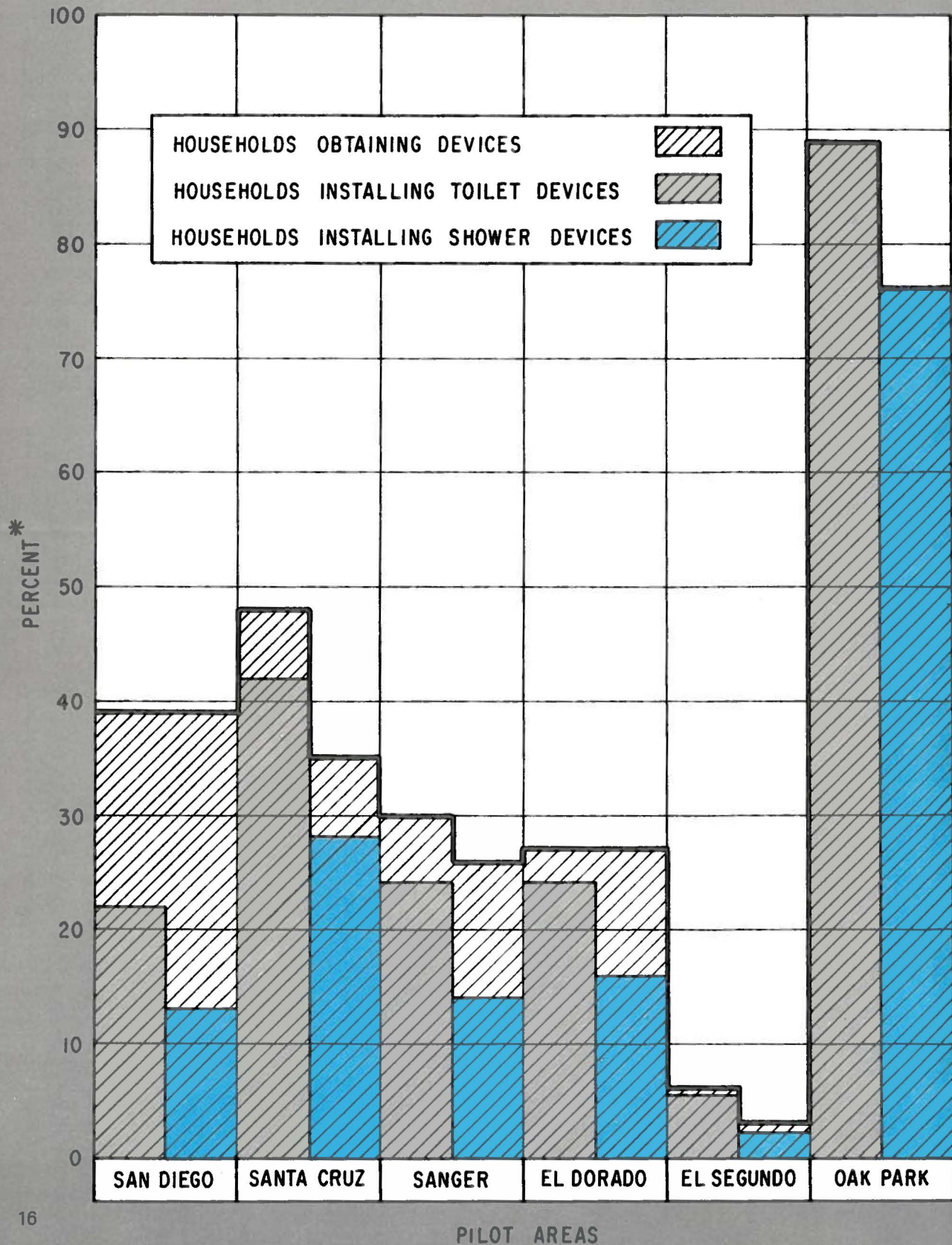
HOUSEHOLDERS CONSERVING WATER



* PERCENT BASED ON TOTAL HOUSEHOLDS IN PILOT PROGRAM AREA

Figure 4.

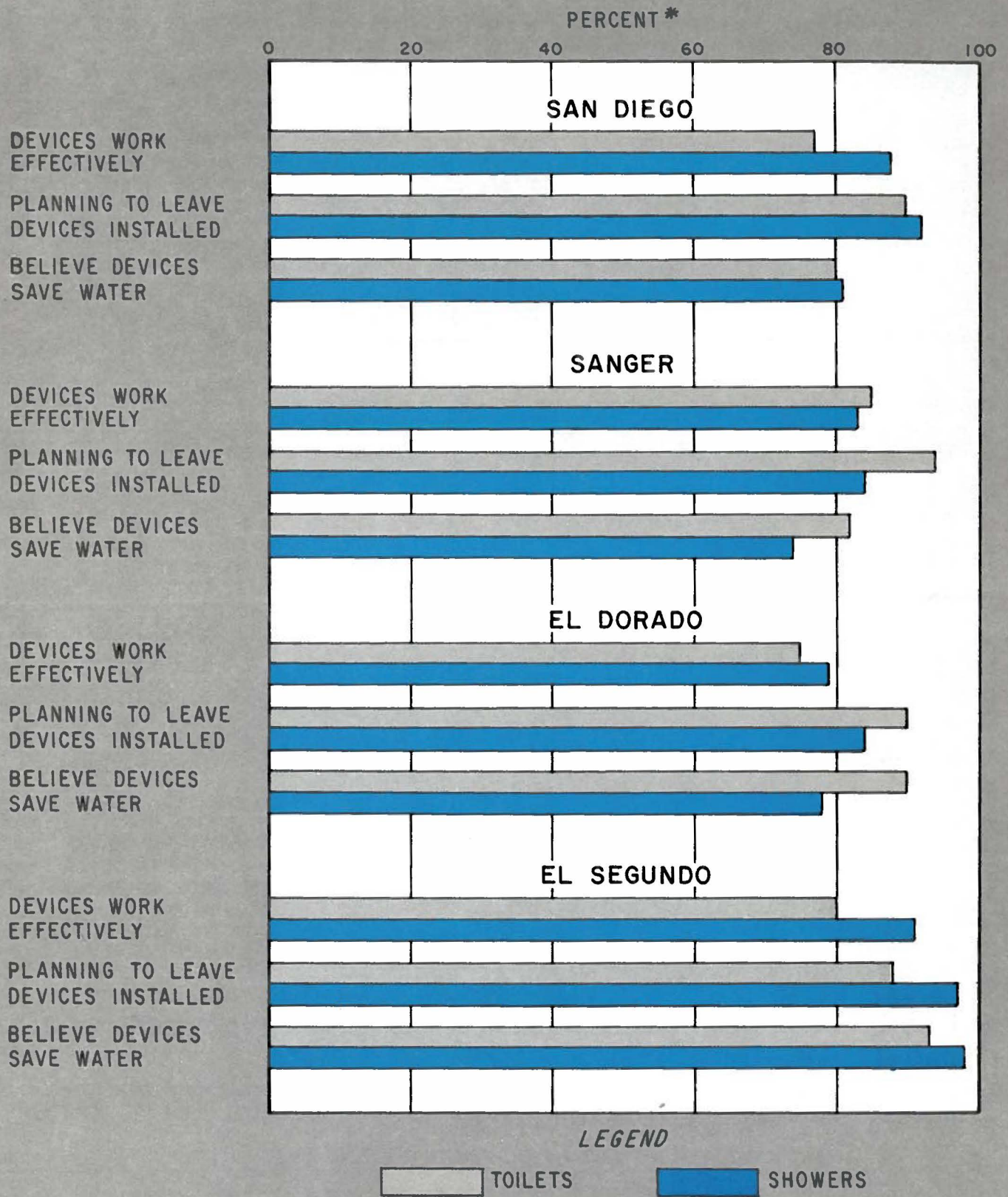
PERCENT OF HOUSEHOLDERS OBTAINING AND INSTALLING DEVICES



* BASED ON TOTAL HOUSEHOLDS IN PILOT PROGRAM AREA

Figure 5.

PUBLIC ACCEPTANCE OF DEVICES



NOTE - DATA NOT AVAILABLE FOR SANTA CRUZ AND OAK PARK

* PERCENT BASED ON HOUSEHOLDS INSTALLING DEVICES

WATER AND ENERGY SAVED IN PILOT AREAS

Saving Water Saves Energy

Energy savings as a result of water conservation reported in this bulletin are mostly (97 percent) from reduced energy requirements for heating water for showers. The other three percent includes local treatment and delivery costs. Not included are energy costs for long-range water delivery, such as pump operation.

Water Saved

Devices installed in the six pilot areas are saving about 5.2 cubic hectometres (4,200 acre-feet) of water each year—enough to serve about 25,000 persons per year.

Energy Saved

The devices installed in the pilot areas are saving energy equivalent to about 76,000 barrels of oil per year, mostly from reduced water heating for showers. The savings are enough to meet energy needs of about 3,200 homes per year.

Additional Savings

Surveys showed that most residents in the pilot areas said they were also saving water in other ways. Some of this may have been a spinoff from the pilot

programs, while other savings may have been from general drought awareness.

Benefits And Costs

Device use in the pilot areas is saving water worth more than \$400,000 per year; the energy savings are worth more than \$1 million at current prices. The total annual benefits from the six programs is \$1,586,000.

The total State and local program cost is estimated to be \$1,337,800* Using a six percent interest rate and a five-year functional life for the devices, the annual cost is \$317,594. The overall benefit to cost ratio is five to one—a five dollar return for each dollar invested.

* Final costs will not be known until program accounting is completed.

Water and Energy Saved

Water savings in pilot areas were calculated from program findings of installation rates, numbers planning to leave devices installed, partial versus complete retrofitting, household occupancy rates, and device performance as determined by tests.

It was assumed that each person flushes a toilet an average of five times a day, showers on the average twice in three days and for six minutes per shower at an 11.4 litre (3 gallon) per minute rate.

More information on procedures is in Appendix A of this bulletin.

Figure 6.

ANNUAL WATER SAVINGS IN PILOT AREAS

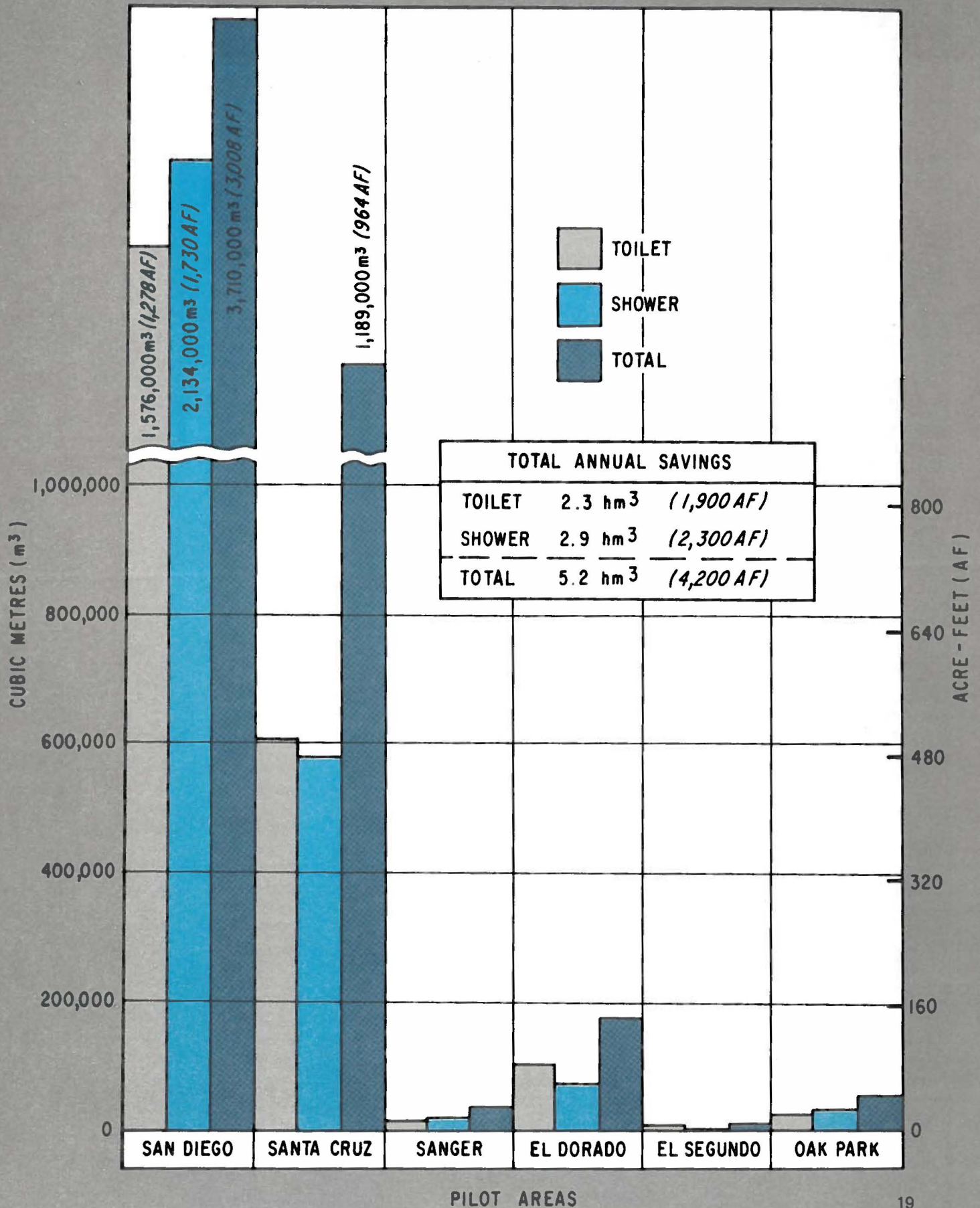
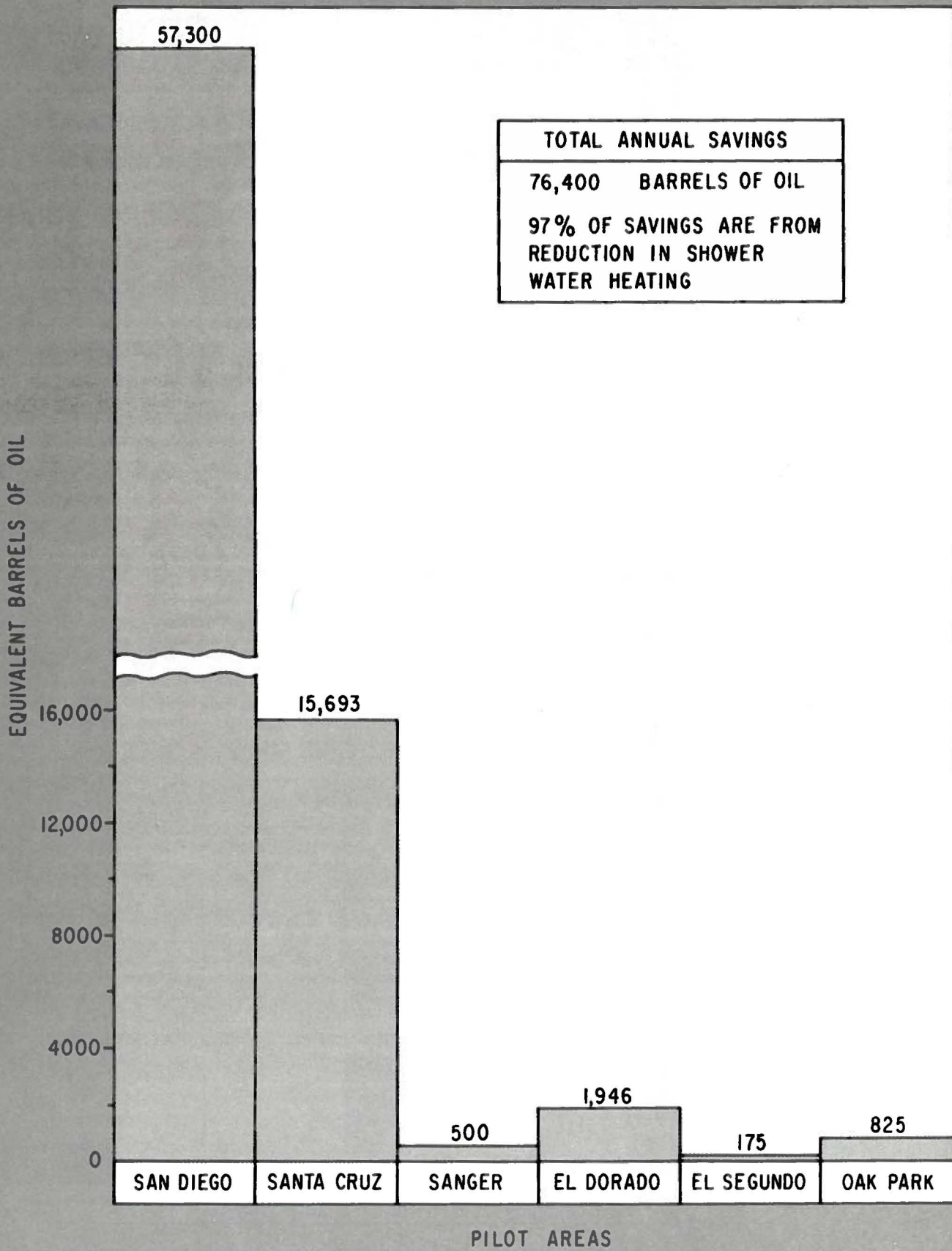


Figure 7.

ANNUAL ENERGY SAVINGS IN PILOT AREAS



THEORETICAL STATEWIDE PROGRAM

A theoretical study was made of what might happen if water conservation devices were distributed statewide, using the most effective devices (toilet dams and shower flow restrictors) and best distribution method (mass) used in San Diego.

Because a keystone of this study was the response of San Diego residents to the conservation program during the severe 1976-77 drought, the projections may not apply in times of normal water supplies.

Study Findings

The study, described in more detail in Appendix A, showed:

- About 35 percent of California householders would install toilet dams and about 10 percent would install shower flow restrictors.
- Annual water savings would be about 110 cubic hectometres (90,000 acre-feet), enough for 195,000 households for a year.
- Annual energy savings would be equal to 822,000 barrels of oil, enough to meet the energy needs of about 34,000 homes per year.
- Cost of a statewide program built upon lessons learned in the pilot study would be about \$15 million. Benefits from water and energy saved would pay that off in less than a year.

- Other savings would probably come from changes in water use habits because of increased awareness generated by a statewide program.

Program Assumptions

The projections were based on the assumption that kits would be given to 67 percent of the households in the State, the same level achieved in the San Diego mass distribution area. This could probably be improved in a future program with more careful monitoring of the distribution. If so, the projected installation rates would rise correspondingly.

The study took into account such factors as probability of changing water use habits, home ownership versus renting, and attitudes toward the drought. It was assumed the statewide response to the program would be similar to that shown by San Diegans, taking into consideration State averages in income, numbers of persons per household, characteristics of householder age and income, and age of dwellings.

Because of the "drought effect" mentioned earlier, a statewide program conducted in years of normal water supply would probably require increased emphasis on advertising and other means of generating public interest in water conservation to achieve the projected results.

The display on the following pages shows what would happen if 100 percent of the state's households saved water in toilets and showers.

What if ... everyone used

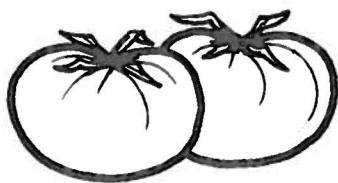
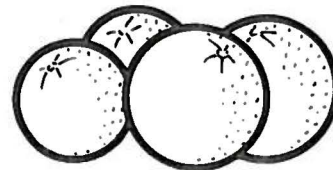
CALIFORNIANS WOULD SAVE 900 CUBIC HECTOMETRES OF WATER A YEAR, ENOUGH FOR:

The water needs of 4,300,000 persons for one year, or



Enough water for 13 billion showers with flow restrictors, or enough for each Californian to shower nearly 600 times, or

Water to irrigate 1 100 square kilometres (270,000 acres) of orange trees that would produce 2.5 million tonnes of oranges, or



Water to irrigate 970 square kilometres (240,000 acres) of tomatoes that would produce 2.5 million tonnes of produce.

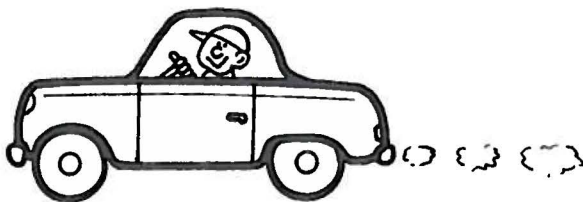
shower and toilet devices ?

**CALIFORNIANS WOULD SAVE ENERGY EQUIVALENT TO
11 MILLION BARRELS OF OIL A YEAR, ENOUGH FOR**



The total energy needs of
460,000 homes for a year,
or:

The electricity needed to light 7,710,000
100 watt bulbs for year, or



The gasoline required to drive
an average car 17 billion
kilometres, or around the
world nearly 430,000 times.

'77 TV AND RADIO CAMPAIGN

Figure 9.

The Department of Water Resources released eight 30-second television public service announcements (PSA's) during 1977, urging people to conserve water. This was part of a long-range media program begun in 1976. The program is designed to help change attitudes and personal habits, so that water conservation will become a permanent part of people's lives.

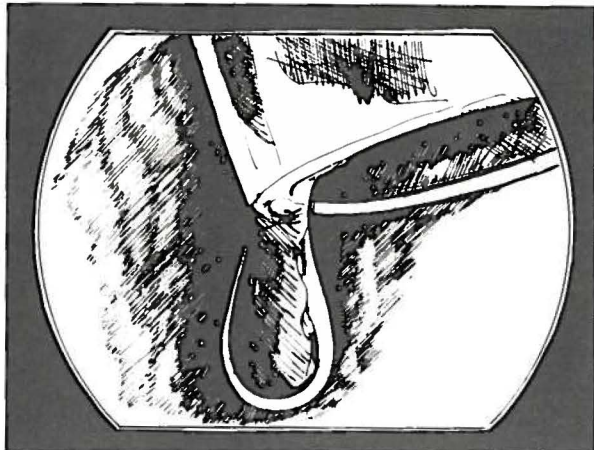
Radio announcements, based upon this material, were also distributed to stations throughout the state.

The radio and TV announcements were released in both English and Spanish-language versions.

SAMPLINGS OF THE 1977 PUBLIC SERVICE ANNOUNCEMENTS ARE SHOWN BELOW:

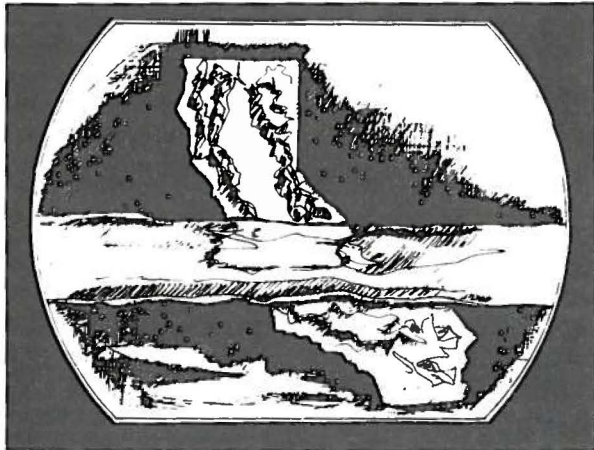
LAST DROP

As water constantly drips from a faucet, the narrator explains: "... small leaks add up to big losses ..."



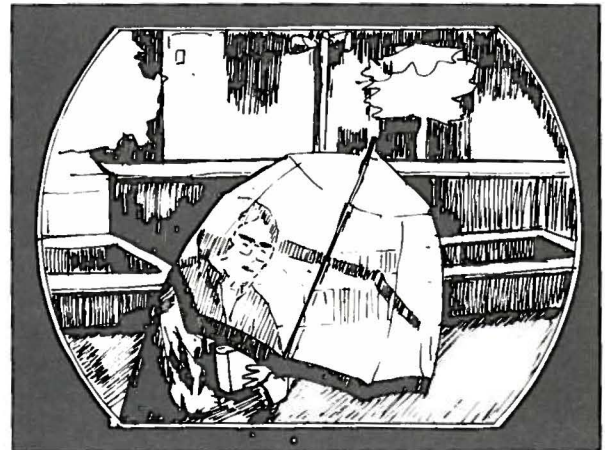
WATER BURGLAR

Water Waste is portrayed as a burglar stealing water, assisted by: "... dripping faucets, ... leaking fixtures ... wasteful habits ... wasteful people ..."



DRY STATE

With a map of the state as a background, water drains from the screen: "... there's only so much water in California. There's enough to use, but not enough to waste . . ."



IT'S RAINING AGAIN

Scenes of winter rains and flashbacks of drought-stricken reservoirs remind people to save water year-around: "... our reservoirs and groundwater basins were the lowest they had ever been ... save water -- even when it's raining ..."

LESSONS LEARNED

A number of valuable lessons about how to run future distribution programs were learned from the pilot studies. Although the pilot studies were conducted during a period of high drought awareness, most of the lessons should be applicable even during normal times. Some of the more important findings:

Toilet Dams Most Popular, Most Water-Saving

Of all toilet tank devices used in the program, the dams were the most successful in saving water. Other devices had lower acceptance due to difficulty of installation, and most of them saved less water than dams.

Dam Adjustment Important

Most difficulties reported with toilet dams were the need for double-flushing to make the toilets operate correctly. Since this is usually due to incorrect adjustment, it is important to adequately inform users about proper positioning of the dams. In some cases—inefficient or low-volume toilets—dams cannot be made to function properly.

Short Intensive Distribution Best

Householder interest and enthusiasm is greatest during the initial period of distribution. If mass or door-to-door distribution methods are chosen, the devices should be delivered in as short a time as possible. If the depot method is used, the program should be operated at the most for two to three months to capitalize on public interest with a minimum investment of staff time.

Telephone Hotline Essential

Householders must have an easy way to get information about devices or the program. A well publicized telephone hotline, staffed by knowledgeable, competent persons, is essential to the success of a program.

Program Promotion a Must

A carefully-designed promotional campaign should begin with education about the need for water conservation and the importance of individual participation. It should then promote changes in wasteful habits as a way to save energy and water in a manner that allows individuals to relate to the issue on a personal level. Promotion should then tell how,

where, and when the devices will be distributed in the community. Examples of public service television announcements used in 1977 are shown in this section. Householders should then be urged to install devices through an appropriate mix of methods—news releases, public service announcements, civic and school programs, and if necessary paid advertisements.

Finally, the distribution campaign should be followed by a continuing educational campaign to encourage continued, long-term and expanded conservation practices.

As noted elsewhere, in a nondrought situation the public awareness campaign assumes great importance. It must allow persons to understand the importance of water conservation to the community as a whole and to them as individuals in terms of water and energy costs.

Selling Devices—When and Where?

A survey of householders in El Segundo showed that, given a choice, governmental buildings were by far the most popular sales point. Supermarkets were second preference of those questioned.

Although the majority of respondents felt it didn't matter, of those who had a preference for day of purchase Saturday was the most popular; Monday and Tuesday were a close second.

Importance Of School Education Programs

A device distribution program provides an excellent opportunity for concurrent in-school education about water conservation. A curricular program built around water awareness materials (such as those offered in the cooperative Department program) will have lasting effects on the student attitudes, and will also affect the students' families.

Good Timing Vital

Programs should be planned to take place when most householders can be reached. The September-October period is good in most of California because school is in session (allowing educational program tie-ins) and the peak rainy season—which may lower motivation—has not yet begun. In agricultural communities crop harvesting seasons should be avoided.

Flexibility In Distribution A Must

If the depot method is used, staffing and hours of operations should be adjusted according to public response to reach as many householders as possible. Mobile distribution centers travelling to concentrations of persons (such as shopping centers) are also useful in generating interest in the program.

Good Devices Are Effective Conservation Promoters

Not only do water-saving devices save water directly, they help promote water conservation awareness in other areas of use. Because of this relationship, it is important that the devices work well. A device that does not work may discourage persons from other forms of water conservation.

Instructions: Clear and Simple

Easily understood written instructions for water saving kits are absolutely essential to smooth operation of a program. Well-translated bilingual instructions should be provided where needed. Instructions should not only show how to install devices, they should tell how to adjust them for satisfactory performance.

Good Program Management—Anticipate Problems

Because large scale kit distribution involves many activities outside the normal scope of water district or municipality operations, great care should be taken to anticipate problems that may arise.

Key points include allowing adequate lead times for device testing, selection, purchase, delivery, and—if needed—assembly into kits. Consideration should be given to use of professional kit assemblers and door-to-door distributors. Adequate and secure storage space must be available, and in all cases it is well to have ample materials in hand before the program begins. Plenty of lead time should also be allowed for ordering additional supplies once the program has begun. In the pilot studies it was found many vendors were unable to deliver materials on as short a notice as they originally said they could.

A public relations person should be assigned well in advance of device distribution to help design and execute the public awareness program.

Program Staff Training Vital

Members of the program staff—particularly those who will deal directly with the public—should be trained in areas of water conservation, the details of the distribution program, and human relations. Where installation service is provided, special training for two-person teams should be developed.

Entrust Local Agencies With Management

Because of their better understanding of local conditions, attitudes and geography, local agencies motivated toward water conservation can best manage distribution programs.

Devices Should Be Free

To achieve the highest percentage of installation rates, the devices should be offered free rather than sold. Even offering devices at a wholesale cost cannot compete with the free program.

Alternative Devices May Be Needed

Because of odd-shaped tanks, not all toilets can be fitted with dams, and alternative devices (such as plastic bags or bottles, even though less effective) should be available.

Make Instructions Clear, Simple

Although considerable pains were taken to make instructions for use in water saving kits clear and simple, sometimes communications broke down.

For example, in San Diego one resident called the telephone hotline number to report that he'd placed the dye tablet (designed to detect toilet tank leaks) in his shower head along with a flow reducer. Worked fine, he said. Blue shower.

THERMAL SHOCK STUDIES

Turning water on or off elsewhere in a home can often cause sudden changes in shower water temperature, a phenomenon known as thermal shock.

Normally this effect is only an annoyance, but serious burns can result if shower temperatures become too high. The severity of burn is related to temperature and length of exposure.¹ Water temperatures of more than 45°C (113°F) are considered dangerous. Five seconds exposure to water temperature greater than 60°C (140°F) can cause extremely serious skin burns.² (The time-temperature relationship is shown in Figure 10.)

In addition to the danger of scalding, thermal shock can be a hazard if the shower temperature changes suddenly to hot *or cold*, causing persons to react suddenly and slip or grab the faucet handle.

As part of the AB 380 pilot project, the Department attempted to determine if—and how—the use of shower flow restrictors or low flow shower heads can increase the amount of thermal shock and whether this could be a danger to the public.

The investigation included direct measurements of the effects of restriction of shower flows in 40 Sacramento area homes, and interviews with a sample of restrictor users in the San Diego project area.

The results are inconclusive and in some respects appear contradictory. However, they do indicate that increasing the restriction to flow at the shower head—either through use of restrictors or low flow shower heads—can create or increase thermal shock and cause potential hazards.

Results of DWR 40-Home Study

Measurements of fluctuations of home shower water temperatures—where they occurred—were made in a study by DWR of 40 homes in the Sacramento area. Tests were made with and without restrictors, and worst-case situations were sought—attempts were made to find the combination of simultaneous use of other water-using appliances that produced the greatest changes. Some of the conclusions from the study were:

- In 14 of the 40 homes shower temperatures could rise from a base of 38°C (100°F) to more than 45°C when flows were restricted to 9.5 litres (2.5 gallons) per minute or less. Only three of those 14 homes showed rises above 45°C without restrictors.
- Nine of the 14 homes that showed rises to more than 45°C were tested with the 11.4 litre (3 gallon) per minute restrictor used in the San Diego

project area.³ Six of the nine showed rises above 45°C with the higher flow restrictor. (In two cases the higher flow rate restrictor produced greater rises than the low flow rate restrictor, but these data are inconclusive because of the order of testing and the possibility that the temperature of the hot water supply had fallen off during some of the testing.)

- Shower temperatures in eight of the 14 homes showed rises to 54°C (130°F) or more. In five of these cases maximum temperatures of 60°C or more were recorded—well within the range of temperatures capable of causing serious skin burns.
- The hydraulic complexity of home plumbing systems, including such factors as pipe layout, age, and condition, makes it impossible to predict which homes will show thermal shock effects.
- Use of flow restrictors does not always enhance the thermal shock effect where it exists. Some houses tested showed no marked changes in temperature fluctuations with restrictors.

¹ *Hot Tap Water: A Significant but Unappreciated Hazard*, by Jerold Z. Kaplan, M.D., et al.; paper delivered at 1977 meeting of American Burn Association.

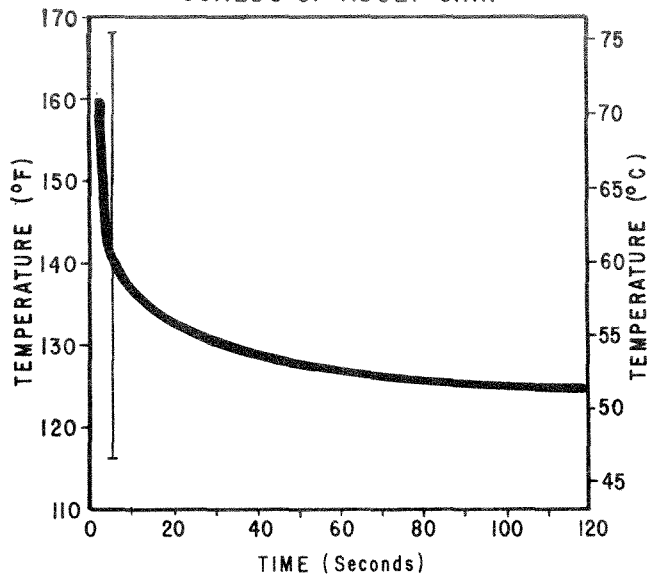
Prevention of Hot Tap-Water Scalds, by Matthew P. Maley; undated paper published by Burn Treatment Skin Bank of Phoenix, Arizona.

² Department communication with Dr. Kaplan, now director of Burn Unit, Alta Bates Hospital, Berkeley, Calif. Dr. Kaplan recommended the 45°C safety level because even long exposure to that temperature is unlikely to cause burns. He also suggested that home water heaters be set well below 60°C as a general practice.

³ Restrictor used was the Celcon plastic device produced by Water Save Inc. Rated 11.4 litre flow is at 310 kilopascals (45 pounds per square inch). Details of performance are found on pp. 324–331 of Appendix G.

Figure 10.

TIME REQUIRED FOR HOT-WATER EXPOSURE TO CAUSE FULL-THICKNESS SCALDS OF ADULT SKIN



Results of San Diego Study

In a follow-up survey of 323 householders in the San Diego project area who had installed shower flow restrictors, 279 (86 percent) reported they were still using them and felt the resulting flow was acceptable.

The respondents in this follow-up survey, conducted eight months after the project, were also asked if they had difficulty maintaining shower water temperatures before and after installation of the restrictors, and if so:

- Whether the temperature increased or decreased.
- Their assessment of the seriousness of the change.
- The type and age of the house.

Thirty-two of the respondents said they had difficulty with water temperatures *before* installing the restrictors, but only 27 reported such troubles *after* installation.

Of the 27 reporting post-installation problems, 20 said the unexpected changes were to colder water, one said the shower water became hotter, and six answered "don't know" or didn't respond.

Of the 27, one rated the post-installation problems "serious" and five termed it "somewhat serious." These six reported their shower temperatures became unexpectedly colder rather than hotter.

One of the group reporting changes in shower water temperatures said the change was to hotter water, and only occurred *before* installing a restrictor. Another reported the change to hotter water occurred only *after* installing a restrictor.

Most of the householders reporting problems with shower temperature changes had single-family homes 11 or more years old. (In the DWR 40-home test, most of the homes where thermal shock effects were found were more than 11 years old. However, the effect was found in homes as new as one year old.)

Other Studies

In a related area, the American Society of Testing Materials' Committee F-15 on Consumer Product Safety has been considering a set of standard consumer safety specifications for devices to prevent scalds and thermal shock by preventing temperatures of more than 49°C (120°F) and also limiting rapid temperature changes to plus or minus 2°C (5°F).

Background materials developed for the Committee suggest that reducing water heater temperatures to a maximum of 49°C is "a useful and cost effective countermeasure" to dangers of hot water burns of all kinds, including thermal shock.

In the DWR study of 40 homes, 21 had maximum water temperatures greater than 60°C (140°F), eight had temperatures of more than 65°C (150°F), and two were measured at 74°C (165°F) and 75°C (167°F) respectively.

As the use of shower flow restrictors increases, the thermal shock problem is beginning to gain some attention in the literature. However, most sources found by DWR have generally considered all classes of water burn hazards rather than dealing specifically with the thermal shock issue in relation to shower head flow restriction.

Again, in general, recommendations are for moderate settings of home water heaters, use of pressure-balancing shower controls, antiscald devices, or care when using shower heads with restricted flows.

In the first reported legislation in this area, Rhode Island has amended its building code to require automatic shower mixing valves that can be set for maximum

temperatures and which must prevent sudden temperature changes. Rhode Island also added the same requirement for bathtubs to its code.



STATE OF RHODE ISLAND AND PROVIDENCE PLANTATIONS

Department of Community Affairs
BUILDING CODE STANDARDS COMMITTEE
150 Washington Street
Providence, R.I. 02903
(401) 277-3033

Proposed Code
Change No. P4-77

Committee
Recommendation

(Check One) Building Code One-Two Family Code Plumbing Code
Mechanical Code Electrical Code Recreation Vehicle Standard Section No. P-1209.5

Proponent (Name) Building Code Standards Committee

(Address) 12 Humbert Street, No. Providence, R.I. 02911

(Check One)

Change Sub-Section
to read as follows

Delete Sub-Section and
substitute as follows:

Add new Sub-Section
as follows.

Delete Sub-Section
without substitution

Code Change:

P-1209.5 All showers shall be equipped with a single handle automatic mixing valve, either pressure balancing or thermostatic type. Said automatic mixing valve shall contain means to set the maximum temperature and shall be designed to prevent sudden temperature changes when used at a normal shower setting.

Conclusions

Although the lack of indication of troublesome thermal shock effects in San Diego is puzzling when compared to the experimental results of the 40-home study, one answer may be that most persons are familiar with the phenomenon and other water uses in the home are avoided during showering.

There are some theoretical connections between the amount of shower flow restriction and the degree of thermal shock—that is, the greater the restriction, the greater the shock—but this was not a universal rule that could be drawn from the 40-home tests.

As use of low flow shower heads and restrictors widens, it is expected that this relationship will be studied in greater detail.

SAN DIEGO METROPOLITAN AREA



The San Diego pilot area, located along California's southern coast and primarily metropolitan in nature, contained about 370,000 households with a population of over 1 million. Although the area was experiencing some water shortages, there was no mandatory rationing. The program tested public acceptance of devices and three methods of device distribution.

In the San Diego program free water saving devices were distributed in a metropolitan area containing about 370,000 households with a population of more than one million. The test area is on California's southern coast; it had some water shortages but no mandatory rationing. The purpose of the program was to test public acceptance of the devices and three methods of device distribution.

It was a State-managed program with major assistance and advice from the County and City of San Diego and from the California Conservation Corps.

Device distribution began July 25 and ended September 3, 1977. Devices were distributed in kits, each containing a toilet flush volume reducing device, two internal shower flow reducers, two dye tablets to check toilets for leaks, installation instructions, and a pamphlet encouraging water conservation and giving water saving tips for the home. An order form was also included so residents could ask for low-flow shower heads, external shower flow reducing devices (restrictors that fit between shower head and outlet pipe), and additional toilet devices.

Five types of toilet devices (shown on page 32) were distributed in order to monitor differences in public acceptance and use. These were two basic types of toilet dams, a plastic displacement bag, two plastic displacement bottles, and a float adjuster.

How Serious The Water Problem?

Follow-up interviews in San Diego during the drought showed that 10 to 12 percent of the residents thought the water use problem was more important than other major concerns such as unemployment, housing costs, and energy shortages.

But as a whole most put water use third in importance—unemployment and housing costs were ranked one and two, and energy shortages were placed fourth.

The kits were packaged in plastic bags suitable for doorknob hanging and color coded for identification of the types of devices.

The kits were distributed through more than 30 neighborhood depots in an area of 270,000 homes (depot area), placed on front doorknobs in another area of about 60,000 homes by a commercial delivery service (mass area) and delivered through door-to-door personal contacts in a third area of about 40,000 homes (door-to-door area).

A professionally produced advertising campaign was conducted using direct mail, newspaper, radio and television advertisements. Because one advertising campaign was conducted for all three methods of distribution, it stressed *"The free water saving kit. If you've got it, use it! If you haven't got it... get it."* All news releases, news conferences, and other media activities were coordinated by the County of San Diego.

To answer questions about the program and to

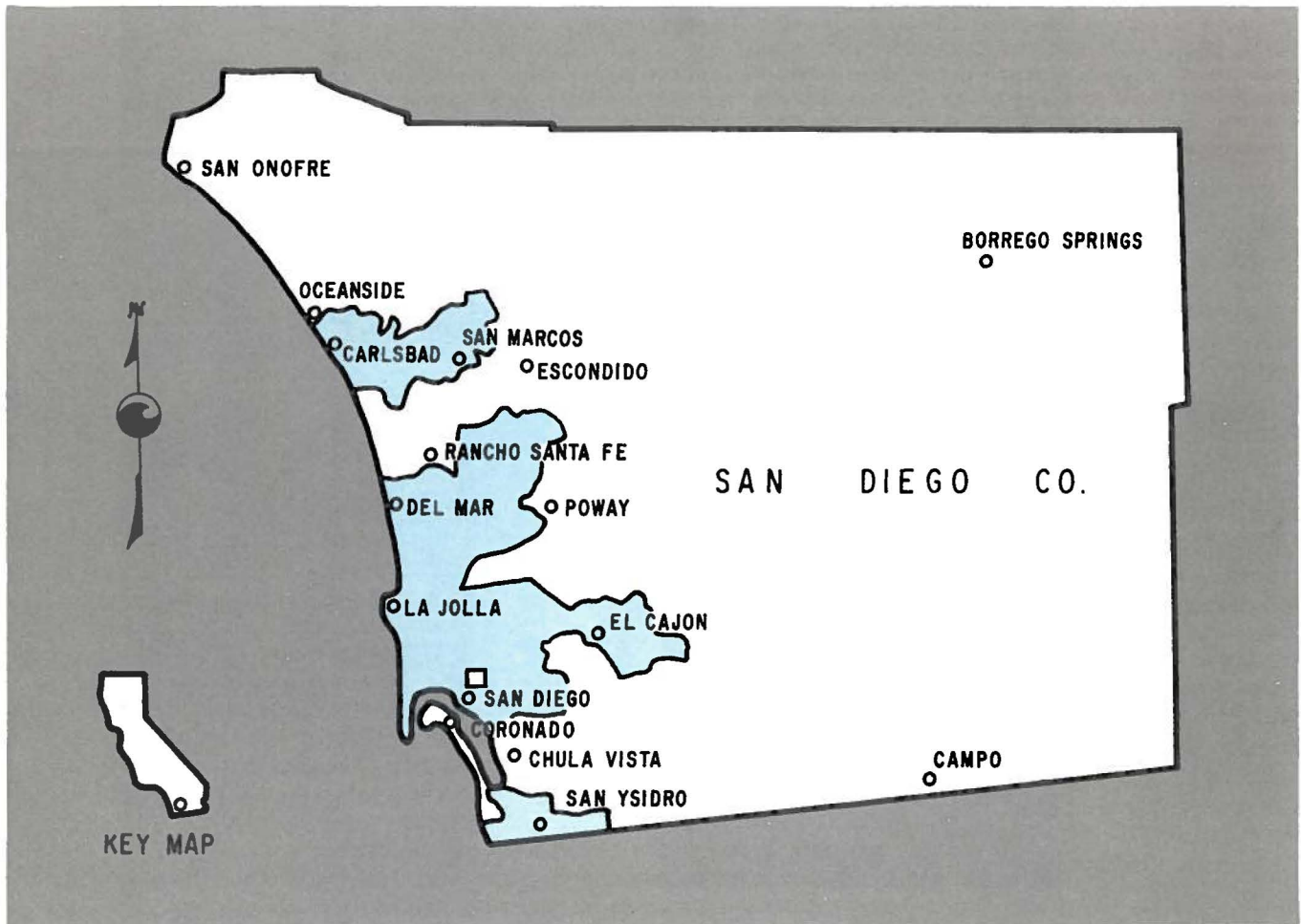
provide information about water conservation in general, a hotline telephone system was operated by the County of San Diego. During the six weeks of the program nearly 20,000 calls were answered, most of them about ways to obtain kits.

About 180,000 kits were distributed during the program. About 100,000 of these were picked up at the depots, 60,000 were allocated to the mass area, and 20,000 were distributed door-to-door.

In addition, the County of San Diego arranged for distribution and installation of more than 1,800 toilet devices and 750 shower devices to the owners or managers of apartment and condominium complexes containing more than 1,900 living units.

After distribution of the devices, an independent market research organization conducted a telephone survey of more than 5,500 persons in the pilot program area. The primary purpose of the interviews was to determine incidence of use of the water saving devices.

Figure 11.



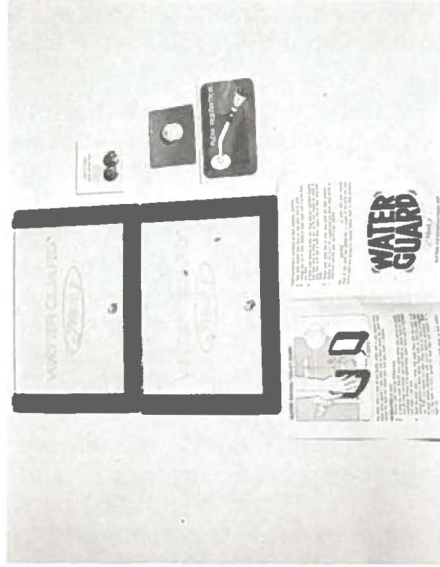
TYPES OF KITS



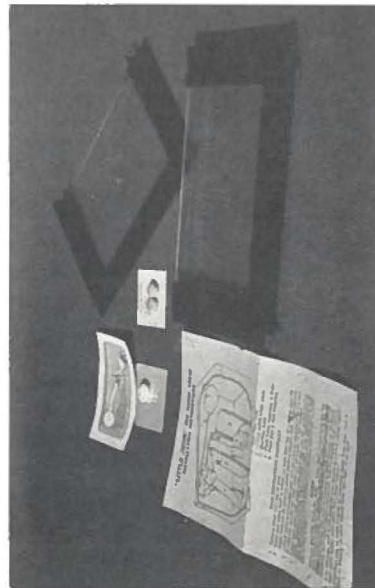
Plastic bag



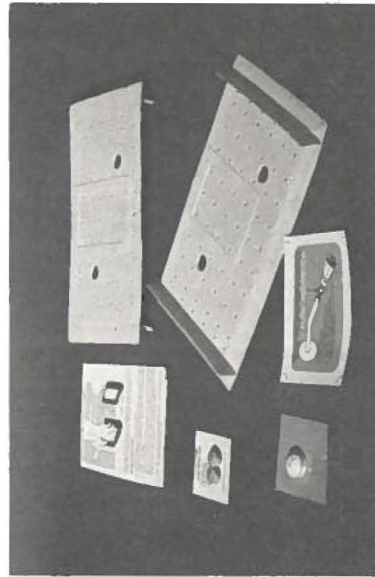
Plastic bottles



Single-edged seal toilet dam



Double-edged seal toilet dams



Float adjuster



Figure 12.

FREE KIT!



**IT SAVES MONEY.
IT SAVES ENERGY.
IT SAVES WATER.**

A pilot water conservation program is now in progress in San Diego and selected areas of the county. If you live in one of these areas, you can help the water shortage from becoming a water crisis. Just by using a free water-saving kit. Each kit contains a simple device to restrict

the flow of shower water. And another little device that saves water with every toilet flush. Plus dye tablets to show if your toilet is leaking. If you already have a kit, use it. You'll save water, energy and money. If you don't have a kit, get one. Free. **Check your zip code now.**

FREE KITS HERE

92008
Holiday Park, Chestnut Ave and Pio Pico Drive, Carlsbad

92014
Del Mar City Hall, 1050 Camino del Mar

92020
Fletcher Hills Town & Country Shopping Center Fletcher Parkway and Navajo Road

92021
El Cajon Shopping Center, 391 N. Magnolia Ave

92024
Kennedy Park Recreation Center, 1675 E. Madison Ave

92037
7877 Herschel Ave

92069
San Marcos Recreation Center (The Barn), 149 W San Marcos Blvd

92101
City Administration Building, 202 C Street

92103
2870 Fifth Avenue

92105
2850 Fifty-fourth Street

92107
4711 Voltaire Street

92108
Mission Valley Shopping Center Mall

92109
4402 Mission Boulevard

92110
1972 Chicago Street

92111
2190 Comstock Street

92114
484 Briarwood Road

92115
4206 Chamoune Ave
4605 62nd Street

92117
Clairemont Square 3902
Clairemont Mesa Blvd
Clairemont Friendship Center
Clairemont Village 3061
Clairemont Drive

92121
Mira Mesa Mall

92123
3880 Kearny Villa Road

92124
4949 La Cuenta Drive

92126
Mira Mesa Mall

92128
Von's Market Shopping Center, 11986 Bernardo Plaza Drive

92127 92129 92131
Von's Market Shopping Center, 11986 Bernardo Plaza Drive

13492 Rancho Penasquitos Blvd.

92154
MAAC Project, Imperial Beach Service Center, 1013 19th

92173
179 W. San Ysidro Blvd.

Kits will be delivered to the following zip code areas as soon as possible.

92104 92106 92113 92119 92045



**The free water saving kit.
If you've got it, use it!
If you haven't got it... get it.**

WATER CONSERVATION HOTLINE NUMBER 236-4949

Newspaper advertisements were used to deliver a comprehensive program message. Over a three-week period, ads listing the specific addresses and zip codes of neighborhood pick-up stations were placed with the San Diego Union/Tribune, the area's major newspaper, and 12 more localized papers. A typical newspaper announcement is shown above.

Figure 13.

San Diego Ecology Centre
340 Katma Street, San Diego, CA 92101

Non Profit Organization
U.S. Postage
Paid
San Diego, CA
Permit No. 426



**We have a
FREE
Water Conservation Kit
for you.**

DEAR SAN DIEGO RESIDENT:
Water costs you money. The energy it takes to get it to you costs even more. Now there's a way to save water and money. And it's free. Soon you will be getting a free Water Conservation Kit—which can save up to 10% of the water you use now. The Water Conservation Kit contains devices to reduce waterflow in showers and toilets. You can put it to work as soon as you get it.

This kit is being made available by the California Department of Water Resources, the City and the County of San Diego with the assistance of the San Diego Ecology Centre. This effort will conserve our limited water resources and save you money. Watch for your free Water Conservation Kit. It'll soon be at your door. When you get your kit, use it. Saving water saves energy, too.

Sincerely,
Molly Jean Featheringill
Molly Jean Featheringill - Executive Director, San Diego Ecology Centre

Roger Hedgecock *Ronald B. Robie* *Leon Williams*
Roger Hedgecock - Supervisor, County of San Diego Ronald B. Robie - Director, California Department of Water Resources Leon Williams - Councilman, City of San Diego

**If you have any questions, please call the local
WATER CONSERVATION HOTLINE number 236-4949**

DEAR SAN DIEGO RESIDENT:
Water costs you money. The energy it takes to get it to you costs even more. Now there's a way to save water and money. And it's free. Soon you will be getting a free Water Conservation Kit—which can save up to 10% of the water you use now. The Water Conservation Kit contains devices to reduce waterflow in showers and toilets. You can put it to work as soon as you pick up your kit at a neighborhood location. This kit is being made available by the California Department of Water Resources, the City and the County of San Diego with the assistance of the San Diego Ecology Centre. This effort will conserve our limited water resources and save you money. Watch your local newspapers for the time when you can get your free kit in your neighborhood at the location shown below. Pick up your kit, use it. Saving water saves energy, too.

Pick up your kit at:

Sincerely,
Molly Jean Featheringill
Molly Jean Featheringill - Executive Director, San Diego Ecology Centre

Roger Hedgecock *Ronald B. Robie* *Leon Williams*
Roger Hedgecock - Supervisor, County of San Diego Ronald B. Robie - Director, California Department of Water Resources Leon Williams - Councilman, City of San Diego

**If you have any questions, please call the local
WATER CONSERVATION HOTLINE number 236-4949**

To help create public awareness of the program, two versions of a jumbo post card (actual size 8½ x 5½) were mailed prior to start of the kit distribution. One version was mailed to residents in the mass and door-to-door areas informing them that the kits would soon be delivered to their doors. The other, which was for residents in the depot area, gave the address of one of 30 neighborhood depots where kits could be obtained.



In San Diego, zip code areas were used to keep track of publicity, kit distribution, and post-project evaluation. The boundaries of the program included all of the City of San Diego, plus Lemon Grove, El Cajon, San Marcos, Carlsbad, and Del Mar.

Missed Households

In the San Diego program the mass distribution method called for hanging kits on each residential doorknob in one area. In fact, only 62 percent of householders in the mass area reported receiving kits in that way; another five percent said they went to kit distribution depots to get devices.

Analysis of the mass area by subareas showed that the percentage who actually got kits by the doorknob method ranged from a low of 49 to a high of 76.

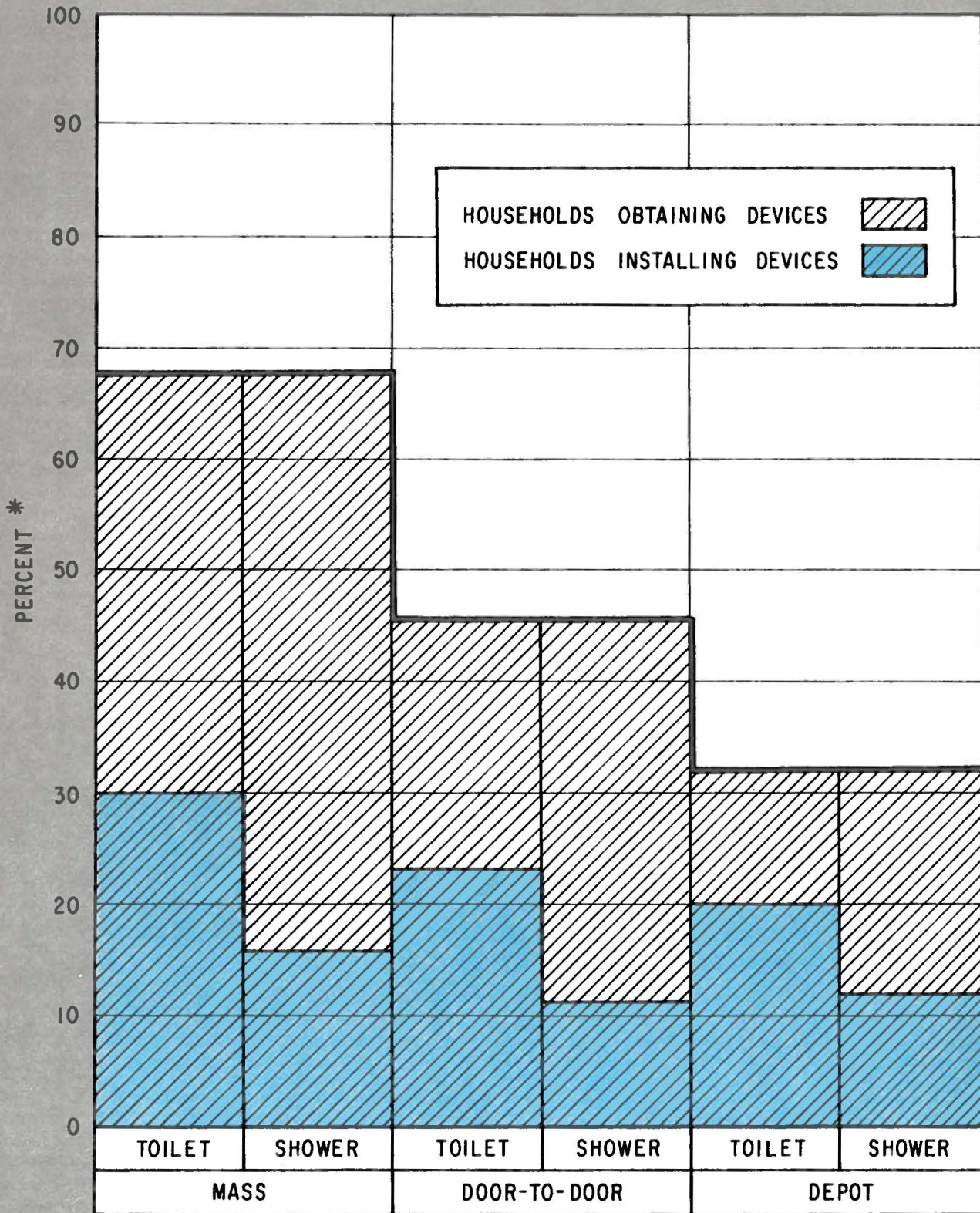
Follow-up studies showed that those most likely to be missed were low income, minority households in rented quarters in the older sections of the city.

Among explanations developed by researchers were unrecognizable households (those behind others on the same lot, for example), security buildings where delivery was difficult (apartments), confusion over delivery crew boundaries, and skipping where delivery crews felt threatened by the neighborhood. In some cases, householders reported getting as many as five kits.

Improvements in the mass delivery performance would have increased the effectiveness of this method.

Figure 14.

SAN DIEGO METROPOLITAN AREA HOUSEHOLDS OBTAINING AND INSTALLING DEVICES



* BASED ON TOTAL HOUSEHOLDS IN DISTRIBUTION AREA

Findings and Conclusions

- The total annual water saving in the San Diego area is 3.7 cubic hectometres (3,000 acre-feet). At a cost of \$80,000 per cubic hectometre the value of water saved is about \$300,000 per year.
- Annual energy savings, mostly from reduced water heating, is equivalent to 57,300 barrels of oil with a total value of \$860,000 at \$15 per barrel.
- The combined annual benefits are about \$1,160,000.
- The net annual benefits per household ¹ for each distribution method are \$2.85 for the mass area, \$2.80 for the depot and \$2.08 for door-to-door.
- The mass distribution method is the most cost effective way to distribute kits, with the depot method a close second. ²
- Installation rates based on total households in each distribution area were:

Distribution Method	Toilet Devices	Shower Devices
Mass	30 percent	16 percent
Door-to-Door	23 percent	11 percent
Depot	20 percent	12 percent

- Installation rates calculated as a percentage of those who received the devices in each area were:

Distribution Method	Toilet Devices	Shower Devices
Mass	45 percent	23 percent
Door-to-Door	52 percent	25 percent
Depot	62 percent	38 percent

- Households with these characteristics were most likely to receive and install kits:
 - Head of household male.
 - Head of household from 25 to 64 years old.
 - Household contained three to five residents.
 - Head of household white collar or skilled worker.
 - Income between \$10,00 and \$30,000.
 - Residents believed there was a water shortage.
 - Age of residence between 4 and 10 years.
- More than 80 percent of those installing devices believed the devices were saving water.
- About 77 percent of those installing toilet devices and about 88 percent of those installing shower devices reported the devices were working effectively.
- More persons reported taking shorter rather than longer showers after device installation; most reported no difference.

¹ Based on standard methods of calculating cost effectiveness. Annual costs are subtracted from annual benefits and divided by the number of households in the distribution area.

² As noted elsewhere, all costs associated with the delivery of kits in the mass distribution area were included in the benefit-cost calculations. However, the value of donated labor and that paid by other programs used in the depot and door-to-door methods were not included, which made them appear more cost effective than they would otherwise be.

- The relative effectiveness of the toilet devices is shown by this ranking:

Type of Device	RANKING	
	Largest Water Saving	Most Cost Effective
Single Seal Toilet Dam	1	1
Double Seal Toilet Dam	2	2
Plastic Bottles	3	3
Float Adjuster	4	4
Plastic Bags	5	5

- Installation rates of the five different toilet devices by those receiving kits were:

Type of Device	Percent receiving kit who installed device	Of installers, percent planning to leave installed
Double Seal Toilet Dam	67	89
Single Seal Toilet Dam	65	88
Plastic Bottles	61	94
Plastic Bag	57	91
Float Adjuster	45	96

- The independent market research study showed that when asked about the program, from 85 to 89 percent of the householders in the test areas recalled hearing or seeing something about the effort to distribute water saving kits.
- The same study showed that from 34 to 40 percent of the householders in the test areas said they knew about the program without being asked specifically about it.
- The impact of the promotional campaign was also reflected in a sharp influx of hotline calls after an informational postcard was mailed, and by the high initial rate of kit distribution at the depots.
- After the first two weeks of kit distribution the rate of kit pickup at depots levelled out and remained relatively constant until the distribution period ended. This shows the promotional message was effective in establishing and maintaining the awareness and sense of need for the program. Effective use of a promotion budget should entail heavy initial public relations and publicity followed by a sustained lower level program.
- The hotline telephone system is an essential element in the program.
- Because of the requirements for testing a variety of devices from different sources, kits were assembled from components in San Diego. Use of preassembled kits would have greatly reduced storage and delivery problems.
- Programs using volunteers should be scheduled at some time other than summer to achieve greater participation.
- Reliability of the mass delivery service is very important in that type of distribution program.

SANTA CRUZ COUNTY



In the Santa Cruz pilot program free water saving devices were distributed throughout the county, a coastal area with a mix of urban and rural housing. The county—located south of the San Francisco Bay Area and touching the northern half of the Monterey Bay shoreline—had 158,600 residents living in 60,400 households. The northern portion of the county had greater water shortages in 1977 than did the southern portion. The City of Santa Cruz and the San Lorenzo Valley Water District, which contains 45 percent of the county's population, were under mandatory water rationing.

The program was locally managed in cooperation with DWR. A total of 66,784 toilet tank devices and 57,518 shower devices were distributed during the program.

The distribution period was from April 12 to September 30, 1977. A variety of household water saving devices were offered free to the public. These were accordion type displacement units for toilet tanks, four kinds of toilet dams, an adjustable replacement flush valve, dye tablets for testing toilet leaks, two kinds of low-flow shower heads, and internal shower flow reducers.

The devices were distributed both in kits and individually, according to household needs. The kits contained a toilet dam, two standard and two ball-joint internal shower flow reducers, dye tablets, and installation instructions.

Kits were distributed through depots (87 percent) and an installation delivery service (13 percent).

Along with a number of neighborhood depots, two main centers were established—one in Watsonville and the other in Santa Cruz.

After the first six weeks of distribution the demand for devices fell off considerably. To counteract the drop, mobile distribution units were established in high density foot traffic areas for periods ranging from several days to several weeks. When mobile unit distribution rates fell the units were relocated. In all, 45 distribution centers and mobile units were established during the program.

To achieve maximum participation the Santa Cruz County Conservation Project staff conducted a broadly based promotion and education campaign.

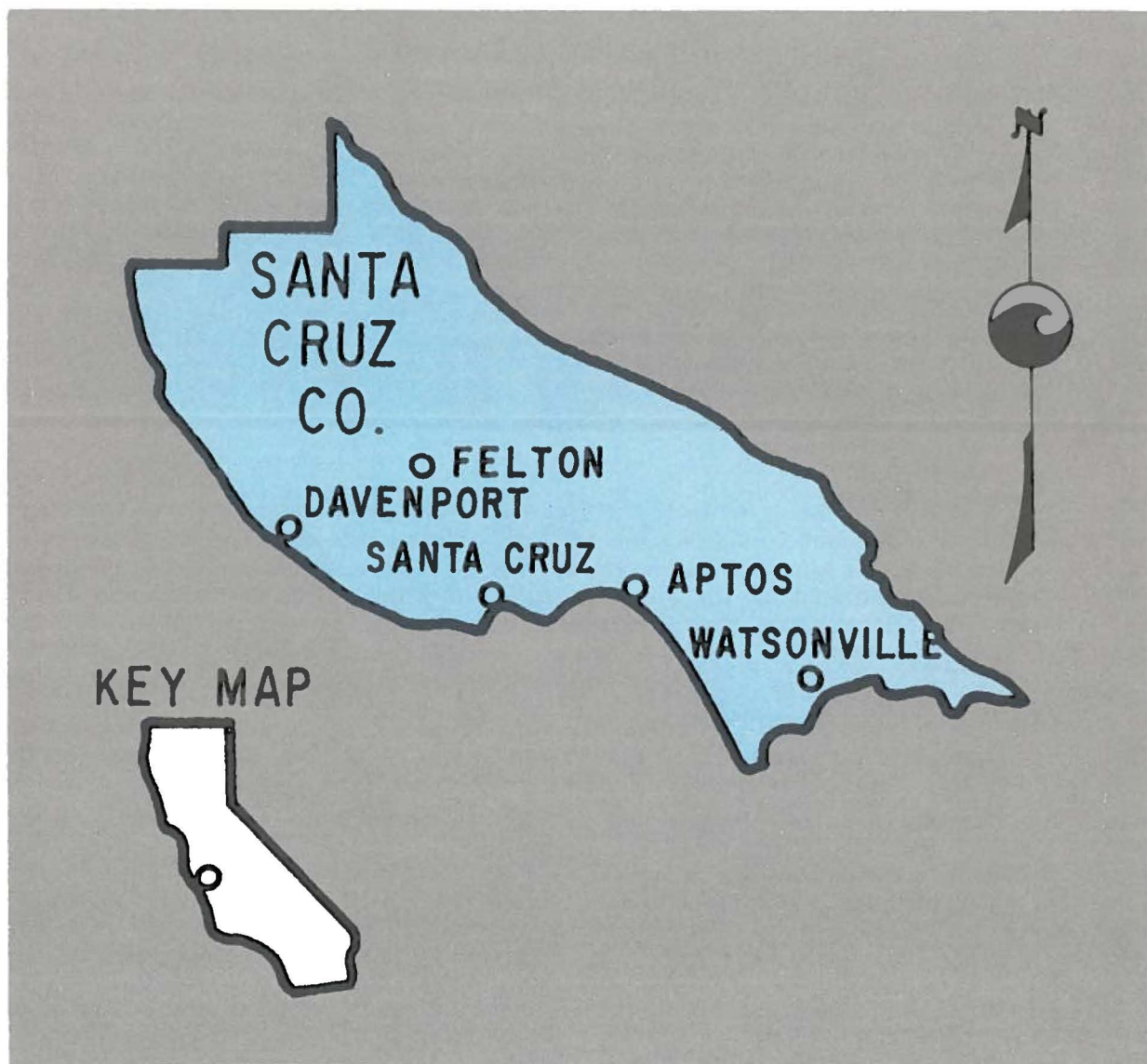
News stories, water stories, and photographs were generated for daily and weekly newspapers and radio and television stations. Public service announcements prepared by DWR were broadcast by television and radio stations. Education efforts included presentations to schools and public service organizations, distribution of printed material (such as pamphlets, bumper stickers, posters, and coloring books), a school poster contest, and a county fair exhibit.

A telephone survey of 1,379 households was made

in late August and early September of 1977 to assess the effectiveness of the program.

Telephone information centers were located in both the north and south county main distribution centers and operated throughout the program. An estimated 10,000 calls were answered on these hot-lines. About 35 percent of the calls were requests for information on location of device distribution centers and for installation service. The rest were general questions about water conservation and the drought.

Figure 15.



Findings and Conclusions

- The total annual water saving as a result of this program is 1.2 cubic hectometres (960 acre-feet). At a cost of \$80,000 per cubic hectometre, the value of the saving is \$96,000 per year.
- Annual energy savings, mostly from reduced water heating is equivalent to 16,000 barrels of oil worth \$240,000 at \$15 per barrel.
- The combined annual benefits are about \$336,000.
- Forty-two percent of the householders in the test area installed toilet devices obtained through the program. Another eight percent used devices obtained elsewhere.
- Twenty-eight percent of the householders in the test area installed one of the shower devices obtained through the program. Another five percent used devices obtained elsewhere.
- Eighty-seven percent of the toilet tank devices and 78 percent of the shower devices obtained from the county were installed.
- Ninety-one percent of both the installed toilet devices and shower devices were still in use at the time of the survey.
- About 79 percent of the toilet devices and 86 percent of the shower devices installed caused no problems.
- Most of the problems reported with toilet devices involved double-flushing, believed in most cases to be the result of poor adjustment.
- Eighty-nine percent of those surveyed reported hearing about the program. Forty-three percent said they first learned of it through the newspapers, 15 percent when they saw a device distribution center, and 15 percent through radio or television. Ten percent heard about it from friends, one percent reported seeing the single billboard used in the program, and the remainder were "other".
- More than 51 percent of the devices distributed through distribution stations were handed out during the first two months of the project. After the initial period, rates of distribution showed a downward trend except for an increased demand in the south county area during July and August.
- Households with these characteristics were most likely to install kits:
 - Head of household from 46 to 55 years old.
 - Head of household professional, technical or clerical worker.
 - Head of household a college graduate.
 - Household located in northern part of county.
- Mobile units were effective in boosting distribution in hitherto low response areas.
- The telephone hotline service was vital to the program.
- The distribution program was invaluable in promoting awareness and involvement in the community's overall water conservation effort.
- Program credibility was threatened at various stages by shortages of certain water saving devices. Such shortages should be avoided if at all possible in future programs.
- Installation teams consisting of one male and one female were well received by householders. (This bears out an earlier experience by the North Tahoe Public Utility District, where all-male teams did not obtain as good a response as a male-female combination.)

SANGER



The City of Sanger is a small agricultural community in the central San Joaquin Valley in Fresno County about 20 miles southeast of Fresno. It has a population of about 10,700 living in about 3,000 households. There was no water rationing in 1977, and the community was not seriously affected by the drought.

The pilot program in Sanger was a cooperative effort of DWR and the City of Sanger; the City distributed devices supplied by DWR, and DWR conducted follow-up work.

Device distribution took place August 13, 20, and 27, 1977. All residential customers with water meters were sent combination post cards and prepaid return mailers to indicate the number of toilet and shower devices they wanted and the kits were packaged accordingly.

The kits contained combinations of two kinds of toilet dams, plastic bottles, leak-detecting dye tablets, and chrome-plated low-flow shower heads. Internal shower flow reducers (for households with ball-joint shower arms) were also available, but were not included in kits.

The devices and kits were delivered on August 13 and 20 by members of a volunteer youth group—the

Sanger police cadets—who were driven to residences by city employees. If no one was at home when the cadets called, they left a door knob hanger informing residents that kits were available at City Hall.

On the third and final delivery date, so few kits remained that two city employees made all the deliveries.

Local publicity for the Sanger project was mostly newspaper articles and editorials in the city's weekly newspaper, the *Sanger Herald*, and in the daily *Fresno Bee*. There was also television coverage by three Fresno stations and a Spanish language station in Hanford.

A brief opening ceremony for the program was held at Sanger City Hall on the morning of August 13, before the deliveries began. State, county, and city officials took part in the ceremony.

Most of the community awareness of the program, however, came from the combination post card and prepaid return mailer sent to all households in the City. Printed in both English and Spanish, it asked each resident to indicate the number of toilets and showers in the household for which devices were desired.

Of the 2,875 mailers sent, 835 were returned, a response of 29 percent. A total of 782 kits were delivered to homes or distributed at City Hall. The rest of those asking for them were not home at the time of delivery and did not pick them up.

After the distribution program ended, the Department conducted a follow-up survey involving 411 households.



Sanger police cadet delivers kit to householder who used mailer to request free water-saving toilet and shower devices.

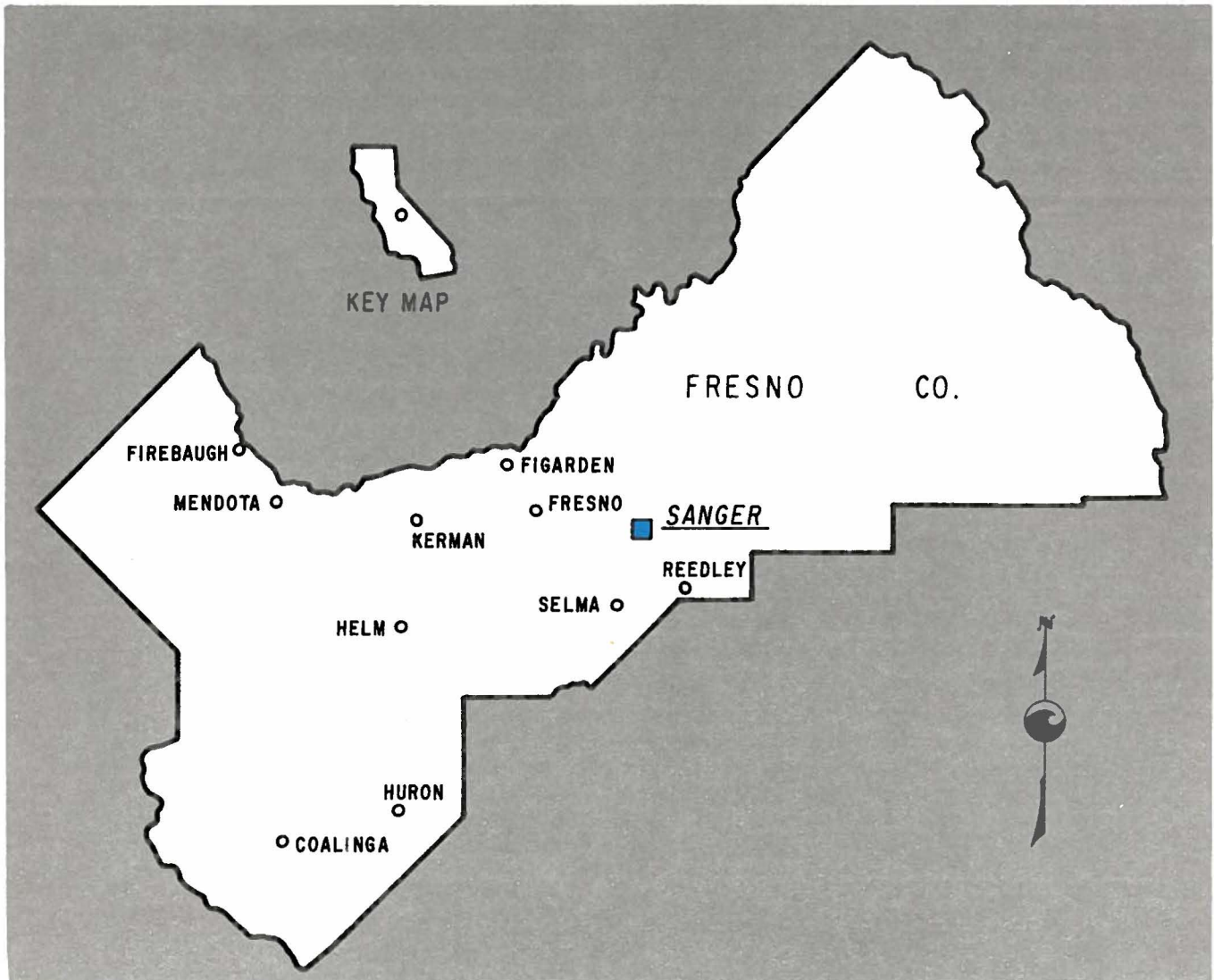


Figure 16.

Findings and Conclusions

- Annual water savings as a result of the program is 38 200 cubic metres (31 acre-feet). At a value of 3.9 cents per cubic metre, this saving is worth \$1,500 per year.
- Annual energy savings, mostly from reduced water heating, is equivalent to 544 barrels of oil worth \$8,200 at \$15 per barrel.
- Total annual saving as a result of the project is \$9,700.
- Thirty percent of the householders received water saving devices, and 24 percent of all householders in the test area installed them in their toilets. Of those, 24 percent made additional toilet adjustments or changed use habits, such as lowering the float ball level or flushing less often. Of those who did not install devices, 37 percent reported making some water saving adjustment to their toilets.
- No significant difference was found between installation rates of the three types of toilet devices.
- Low-flow shower heads were installed by 14 percent of all the householders. Of those, 42 percent reported making additional changes such as showering less frequently or taking shorter showers. Of those who did not install low flow shower heads, 40 percent made other use changes.
- Seventy percent of Sanger householders reported conserving water through other means, such as watering outside less often or recycling water.
- The August delivery dates conflicted with the local harvest season, and program managers concluded that this factor was responsible for many of the missed deliveries. Similar future programs should avoid seasons when agriculture—or other local industries—has a high labor requirement.

EL DORADO IRRIGATION DISTRICT

The El Dorado Irrigation District (EID) serves about 13,300 households with a population of about 40,400. Most of its service area is in El Dorado County, but it also includes Rancho Murieta in Sacramento County. This semi-rural area varies from the valley floor to grassy foothills to forested upland.

The pilot program was conducted by EID from February through August 1977; in this test area the water saving devices were sold at cost. DWR's role in this test was limited largely to surveys and analysis of results.

EID, facing the worst water supply situation in El Dorado County in 103 years, began a drive in 1977 to reduce water use by 50 percent. Among other measures, EID prohibited nonessential water use, instituted an increasing block rate structure (charging more for each successive unit of water use), and raised the cost of agricultural water.

The pilot program tested public acceptance of the sale of water saving devices in a rural-agricultural area that was experiencing a critical water shortage and was undergoing severe rationing.

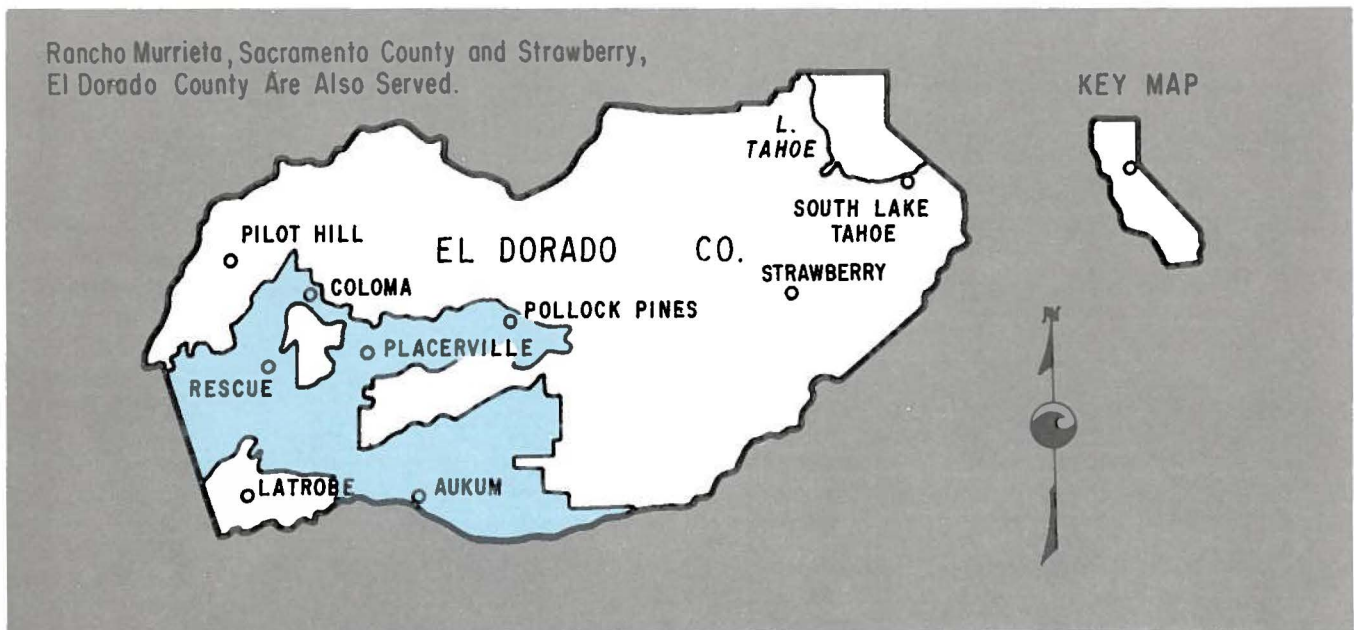
The devices were selected and purchased by EID, which sold 5,689 kits at cost, which was \$1.50 each. Of these, 217 were for use outside the EID service area. Each kit contained a Watergate toilet dam, two shower flow reducers, and installation instructions.

Kits were sold by the depot method at 11 public facilities, including fire stations. About half were sold during the first month of the program.

Program promotion included television interviews featuring EID staff members, and spot TV announcements demonstrating water saving devices. A local newspaper and others covering the area carried feature articles on the program. EID prepared news releases, bill inserts, and other written material to publicize water conservation, and gave hints on water saving practices. Program personnel also gave talks at schools and clubs to explain the project.

In September 1977 DWR, assisted by EID, conducted a follow-up survey consisting of telephone interviews with 539 householders.

Figure 17.



Findings and Conclusions

- Annual water savings as a result of the program is 175 000 cubic metres (142 acre-feet). At a value of 20 cents per cubic metre, this saving is worth \$35,000 per year.
- Annual energy savings, mostly from reduced water heating, is equivalent to 2,000 barrels of oil worth \$29,000 at \$15 per barrel.
- Total annual savings equal about \$64,000.
- Toilet dams were installed in about 23.7 percent of the households in the pilot area and shower flow reducers were installed in about 13.5 percent of the homes.
- The survey revealed no significant correlation between types of dwellings and the occupations or incomes of the residents and the likelihood of device installation.
- Of those who installed devices, about 90 percent of the toilet dam installers and about 78 percent of the shower insert installers believed they were saving water.
- Of those who installed devices, 75 percent reported that the toilet dams were working satisfactorily, and 79 percent were satisfied with the shower inserts.
- At the time of the survey 88.3 percent of the EID residents knew about the pilot program.
- Most of the device installers said they would leave them in place—89.7 percent for toilet dams, 83.6 percent for shower inserts.
- Nearly 80 percent of all EID householders tried to save water in areas other than toilet and shower use.

EL SEGUNDO



El Segundo, a well defined community of 16,000, is in the Los Angeles metropolitan area. With the Pacific Ocean to the west, Los Angeles International Airport to the north, an industrial complex to the south, and a major highway to the east, El Segundo provided an ideal setting for an urban pilot program.

The City of El Segundo is an urban area on the Southern California coast in the Los Angeles metropolitan area. About 16,000 persons live in 6,000 households in the city.

The pilot program was managed by the city in cooperation with the Department. The purpose was to test the willingness of the public to buy water conservation devices at wholesale prices in an area not seriously affected by the drought.

In 1977 the Metropolitan Water District of Southern California levied a surcharge against the city on water used in excess of 90 percent of 1976 consump-

tion levels. In turn, the city on June 7, 1977, called for a 10 percent reduction in residential water consumption, and imposed penalties for nonessential uses. It

also imposed surcharges on water consumed in excess of 90 percent of 1976 uses.

Devices were sold from August 1 through October 29, 1977. Five different kinds of kits, as well as individual devices, were sold through a "roving" depot. Kit costs ranged from \$2.01 for one containing double-edged stainless steel toilet dams, four internal shower flow reducers, and a package of dye tablets to 31 cents for one containing plastic bottles instead of the dams. Other kits contained different types of flush reducers—plastic single-edged dams, a displacement bag, displacement bottles, or a bracket to lower the toilet float ball. These devices were also sold individually as were a toilet valve replacement device, two types of external shower flow reducers, three types of low-flow shower heads, and three kinds of faucet flow control devices.

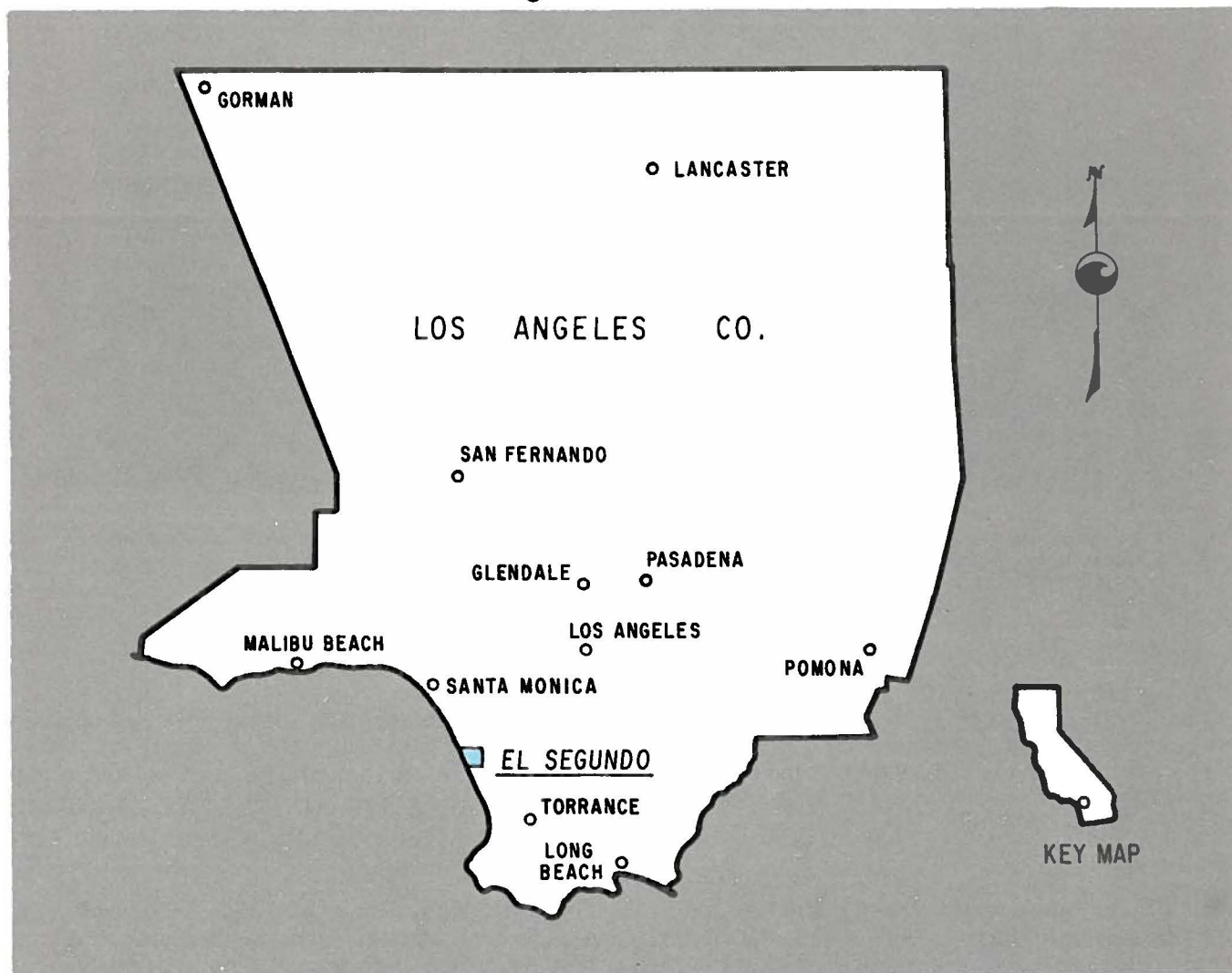
A pickup truck was used to carry devices, a demonstration toilet, and a display board to the temporary depot areas. The sales depot operated at City Hall in the mornings and moved to shopping areas, the library, banks, and large industrial concerns in the afternoons.

Program publicity consisted of a radio broadcast by the Director of the El Segundo Public Works Department, press releases, posters, and a newsletter sent to all households.

A total of 2,054 kits and devices were sold; 1,096 of these were to El Segundo residents and the remainder to nonresidents. About 80 percent of the sales were of individual devices rather than kits.

The Department conducted a telephone survey of 556 El Segundo households after the sales program.

Figure 18.



Findings and Conclusions

- Annual water savings as a result of this program is 15 500 cubic metres (12.5 acre-feet). The value of this saving is about \$1,250 at a water cost of 8.1 cents per cubic metre.
- Annual energy savings, mostly from reduced water heating, was equivalent to 175 barrels of oil worth \$2,600 at \$15 per barrel.
- Annual savings from the program totalled about \$3,850.
- Installation rates based on total households in the pilot area were 5.6 percent for the toilet devices and 2.5 percent for the shower devices—by far the lowest of the pilot areas.
- About 61 percent of those who did not purchase devices said they were saving water in their toilets by using improvised displacement devices (37 percent), less frequent flushing (26.8 percent) and adjustment such as bending the float arm (14 percent).
- About 70 percent of those who did not purchase devices said they were conserving in the shower through shorter showers (66 percent) and installation of other devices (12 percent).
- Where a more expensive device (such as a toilet dam) saved more water than a cheaper item (such as a plastic bottle) purchasers tended to buy the more expensive device.
- Most buyers tended to purchase the cheapest shower flow restricting device; all the devices offered produced comparable savings.
- About 65 percent of all householders in the area were aware of the pilot program.
- The following were more likely to buy devices:
 - Homeowners rather than renters.
 - Householders paying their own water bills.
 - Heads of household more than 40 years old.
 - Residents living in the same home for more than four years.
 - Heads of households with some college education.
- About 95 percent of the installers thought their devices were saving water.
- Eighty-eight percent of the toilet device installers and 97 percent of the shower device installers plan to leave the devices installed.



Oak Park, a section of Agoura in Ventura County, is a suburban area that had no critical water shortage at the time of the study. This photo shows some of the 753 homes that were contacted. Of these, 667 occupants agreed to device installation, an almost 90 percent installation rate.

Oak Park is a Southern California residential community in Ventura County just west of the Los Angeles County boundary. The community is composed of relatively new homes. At the time of the pilot project there were 753 homes and a population of about 2,500.

The pilot project was a cooperative effort involving the Department, the Las Virgenes Municipal Water District (LVMWD) and the Metropolitan Water Company (MWC).

It was designed to test acceptance of devices in a suburban area with no critical water shortages and no rationing, and in which free devices were installed for the homeowners.

LVMWD selected and purchased the devices, and was later reimbursed by DWR. The district also provided data on waste water flows from the community before and after the project.

MWC purchased water conservation curriculum materials (Captain Hydro and Waterplay; see illustrations) for each child attending Brookside Elementary School. It also provided data on water consumption in the project area before and after device installation.

DWR conducted the follow-up study.

Device installers (provided by all participating agencies) visited every home in the community between May 14 and June 9, 1977, asking householders to let them install toilet and shower water saving devices. Canvassing and installation was completed in 15 working days.

Devices were installed in 667 of the 753 homes for an 88.6 percent acceptance rate. In all, devices were installed in 1,555 toilets and 1,266 showers. Fewer showers than toilets were involved, mostly because some homes had pulsating "massage" or other units that homeowners did not want replaced or modified.

Newer shower assemblies were fitted with a plastic flow control insert, and older ones with a brass disc with a restricting hole.

Civic and educational groups and the news media cooperated very well in the publicity campaign. Project workers made appearances before civic groups and at the elementary schools. Local and Los Angeles newspapers carried stories about the program, two Los Angeles television stations covered the installation, and local radio stations reported the program during the first week of installation. The three agencies sent representatives to the Brookside Elementary School Science Fair to answer questions, and DWR also displayed the devices and distributed water conservation informational materials at the fair.

LCMWD operated a telephone hotline for residents who were absent when installers first visited their homes and made appointments for subsequent visits. (Project personnel concluded that one line should be established for appointments and another to answer trouble shooting and water conservation calls.)

In August a follow-up questionnaire was sent to homeowners who had accepted device installation; it was included with a bill mailed by the Metropolitan Water Company. A total of 667 questionnaires were sent; 485 responded, or 72 percent.

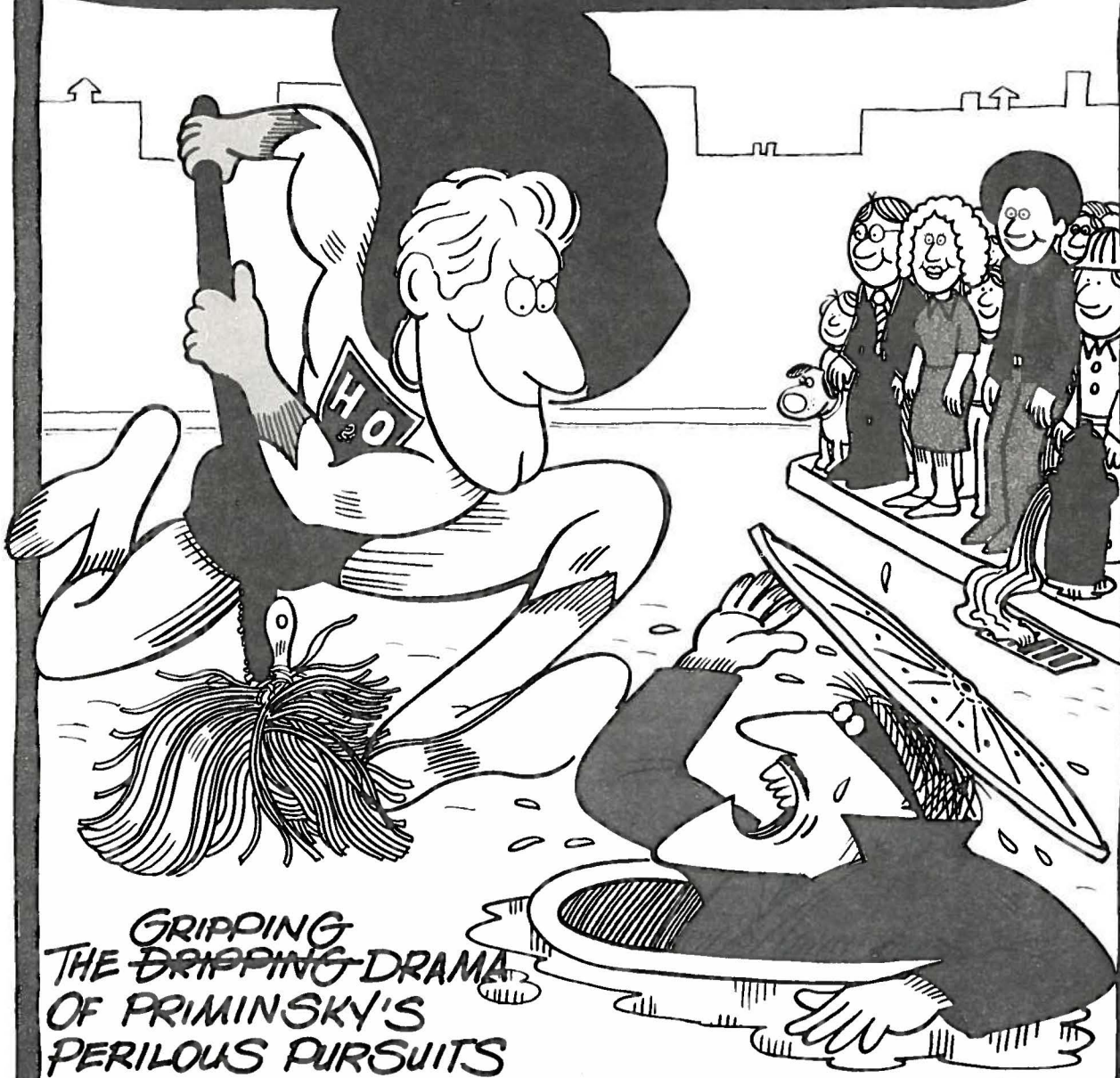
Figure 19.



Findings and Conclusions

- Annual water savings as a result of this program is about 55 500 cubic metres (45 acre-feet). At a cost of about 8.2 cents per cubic metre, the value of the water saved is \$4,500.
- Annual energy savings, mostly from reduced water heating, is equivalent to 825 barrels of oil worth \$12,375 at \$15 per barrel.
- Combined annual benefits are about \$17,000.
- Only 75.9 percent of the showers were fitted with low-flow devices compared to 88.6 percent of the toilets.
- After two months, 93 percent of the toilet installations remained and 96.5 percent of the shower flow reducers were still in place. This represents 82.5 percent of the total toilets in the community and 73.3 percent of the showers.
- Most of the toilet device removals were due to the need for double flushing.
- Water deliveries to the community decreased as much as 48 percent and waste flows as much as 31 percent compared to the same month of the previous year. Part of the reduction was probably due to the education program and general drought consciousness.

CAPTAIN HYDRO



CAPTAIN HYDRO, student water conservation workbook for 4-6 graders. Developed by East Bay Municipal Utility District, Oakland, CA, the workbook is one segment of curricular materials offered through a cooperative Department of Water Resources-Department of Education program involving local school and water districts.

WATER CONSERVATION PROGRAMS BY OTHER AGENCIES

In addition to the pilot programs discussed in this report, many other California water agencies have undertaken water conservation programs. Because of their importance, some of them are summarized here.

Marin Municipal Water District

Marin Municipal Water District (MMWD) serves 80 percent of Marin County, just north of San Francisco, and has been largely dependent on limited in-District sources for its water supplies. Even before the drought, voluntary water conservation was a vital part of MMWD water supply management.

MMWD began a program to install water saving devices in toilets and showers in the summer of 1975. Teams of distributors went door-to-door in part of the District's service area talking to residents and giving away kits. The kits were composed of toilet bottles (not weighted), low-flow shower heads and shower flow reducers, informational brochures, and order forms for additional water saving devices.

Within the beginning of the drought and imposition of a rationing ordinance, MMWD in February of 1976 expanded its efforts to include all customers. It offered free devices with mail order forms inserted with bills and through neighborhood depots at locations such as fire stations, government buildings, and nurseries.

As water shortages worsened in 1977 more severe rationing was imposed, kits and other devices were made available at the water district headquarters. Demand for the devices was heavy from January through March of 1977. Water saving kits have remained free to district customers, and installation services has been provided for the elderly and handicapped unable to install them themselves.

District records indicate that as of the end of March 1977 there were about 120,000 tank toilets and 160,000 showers in its service area. About 110,000 bottle kits and 110,000 shower devices had been distributed, enough for 90 percent of the toilets and 70 percent of the showers. Of the shower devices distributed, about 60 percent were low flow shower heads and the rest were shower flow reducers.

A DWR survey on the effects of the drought in Marin County indicates that about 17 percent of householders installing devices were not satisfied with the performance of at least one of the devices. Of those who installed and were dissatisfied, a little more than half removed the unsatisfactory devices.

If normal water using habits had prevailed—that is,

if Marin County had been in a normal water year—and the distributed devices were all installed, the District would have saved about 3.33 cubic hectometers (2,700 acre-feet) of water per year, or 8.4 percent of normal average water use.

North Tahoe Public Utility District

The North Tahoe Public Utility District (NTPUD) serves an area on the north shore of Lake Tahoe. It supplies water to 2,300 customers and collects and treats waste water from 4,200 customers.

The District's water conservation program is aimed at reducing the amount of water flowing to its treatment facilities. Because of the large transient recreation population and the difficulty of educating such a group, one program objective was to achieve conservation with devices that save water without conscious effort on the part of users.

In June, 1976, the District enacted an ordinance establishing water conservation requirements. It applies to all new and existing structures and requires that they be equipped with water saving shower heads, water saving aerators on kitchen sinks and lavatories, and water saving toilets or toilet devices no later than January 1, 1978. The District offers to supply and install devices free.

The first target was installation of toilet and shower devices in all motels, condominiums, and commercial structures by July 1, 1976. Faucet aerators were scheduled for installation in the second and third years of the program so that installers could check on the operation of the toilet and shower devices.

Installation in motels and condominiums was quickly completed, and householders were reached through bill inserts, radio announcements and press releases, and door-to-door canvassing. A major theme of the campaign was savings due to reduced water heating costs.

By August of 1978 devices had been installed in showers and toilets in all motels and businesses in the District, and 85 percent of the householders had been contacted.

The District reported that few complaints were received about the program. About 10 percent of the

dwellings required return calls to adjust or replace a device with a different type; in less than 1 percent of the cases were installation teams refused admittance.

The program cost was estimated at \$14.18 per dwelling.

Water use in 13 motels was monitored to determine the savings resulting from the program. An average reduction of 26 percent was realized from 1975 to 1976; from 1976 to 1977 use decreased another 18 percent. Sewage flows in the District went down by 28 percent from 1975 to 1976, then increased by 8 percent from 1976 to 1977.

Los Angeles Department of Water & Power

The Los Angeles Department of Water & Power (LADWP) conducted a water conservation program that was very similar to DWR's AB 380 pilot program.

Between July 11, 1977, and January 20, 1978, LADWP assembled and dispensed 644,000 water conservation kits within its service area.

The kits, available without charge to customers at 20 neighborhood depots, contained shower flow reducers, toilet leak detection dye tablets, and water saving devices for toilet tanks.

The program was promoted through news releases, paid newspaper announcements, and advance notification mailed with water bills. Each depot displayed signs to explain the program. A telephone hotline was established to answer inquiries.

Personnel from LADWP's Water Engineering Design Division and workers from the federally-funded Special Program for Economically Disadvantaged Youth (SPEDY) assembled the kits.

Cost for the kits using plastic bag toilet displacement devices was 16 cents for material and 14 cents for labor; the bottle kit costs were 31 cents each for labor and materials.

These costs include labor for packing and delivery to the depots, but not for distribution at depots. Labor for the plastic bottle kits was more expensive because a small bag of pea gravel was made up to go with each kit for later addition to the bottles by the user to keep them from floating. Most of the kits—455,000—were of the less expensive displacement bag variety.

Owners or managers of large apartment buildings asking for 100 kits or more were allowed to pick them up at the building where they were assembled. Field offices of some Los Angeles city councilmen also asked for large numbers of kits for distribution from those offices; in some cases the offices asked for unassembled components for assembly by others.

Here is a tabulation by months of kits distributed:

1977	
July	238,500
August	196,500
September	54,750
October	66,450
November	19,750
December	21,400
1978	
January (through 20th)	5,000
Unassembled components (through entire period)	<u>42,000</u>
	644,450

LADWP has 520,000 domestic water services; there are about 30,000 apartment buildings in the city and about 1.2 million households in total. Because of multibath homes and because there was no limit on the number of kits available to each customer, it was impossible to determine the percentage of house holders installing devices.

INTERAGENCY COOPERATION

During the 1976–77 drought most State agencies joined with the Department to promote water conservation. This chapter summarizes major interagency effects that related to the AB 380 pilot projects.

California Conservation Corps

The California Conservation Corps (CCC) made 29 Corpsmembers available to help with the San Diego portion of the pilot studies. These Corpsmembers distributed thousands of water conservation kits and—although originally were planned to be used only in distribution—worked in other areas of the program as well. They helped locate and set up distribution depots, coordinated activities of Boy Scouts involved in home delivery of kits, scheduled depot staff members, and answered many of the public's questions on water conservation.

California Energy Commission

The California Energy Commission contributed \$50,000 toward the costs of the pilot studies conducted under AB 380 because of the connection between saving water and saving energy.

In late 1977 the Commission adopted efficiency standards for new shower heads and lavatory and sink faucets sold in California. If the shower heads and faucets are manufactured before December 22, 1978, they may be sold until December 22, 1979. If manufactured after December 22, 1978, they must meet the standards. All new construction after January 1, 1979 must have shower heads and faucets meeting the new standards.

The standards require a maximum flow of 10.3 litres (2.75 gallons) per minute from faucets at pressures from 138 kilopascals (20 pounds per square inch) to 552 kilopascals (80 pounds per square inch). Showerheads are allowed a maximum flow of 10.3 litres per minute up to 310 kilopascals (45 pounds per square inch) and 11.4 litres (3 gallons) per minute from 310 to 552 kilopascals.



LOW-FLOW SHOWER HEADS will be required in all new construction after January 1, 1979, under efficiency standards adopted by the California Energy Commission. The Commission standards also require use of water conserving lavatory and sink faucets.



An "appropriate technology" van, sponsored by the State Office of Appropriate Technology, travels statewide promoting water and energy conservation.

The van includes a low-water-use toilet and sink and a drought-tolerant plant display prepared by the Department of Water Resources. The van toured San Diego during the pilot water conservation program there.

Department of Housing and Community Development

Health and Safety Code Section 17921.3, Chapter 91, prohibited use of tank-type toilets using more than 13.25 litres (3.5 gallons) per flush in hotels, motels, apartment houses and dwellings built after January 1, 1978.

The Department of Housing and Community Development (HCD) is charged with approval of toilets that meet the new standards and with implementing the law. DWR is cooperating with HCD to ensure compliance with the legislation.

Assembly Concurrent Resolution 165 Activities

In July 1976 the Legislature adopted Assembly Concurrent Resolution 165 (ACR 165) asking all State agencies to use water conservation practices and directing the Department to "confer and advise" with the agencies.

ACR 165 activities were numerous, and in summary resulted in:

- Direct saving of about 37 cubic hectometres (30,000 acre-feet) of water in State facilities during 1977.

- Education of 185,000 State employees and higher education staff and faculty about water saving methods.
- Conservation information given to about 5 million Californians.
- Fitting of 1,800 State-owned rental housing units with water saving devices.
- Amendment of the California Administrative Code to expedite water rights hearings.
- Modification of Clean Water Grant regulations and guidelines to require analysis during sewage treatment plan design of the possibilities of reducing waste water flows through water conservation.
- Modification of State Lands Commission leases to require water conservation practices by lessees.
- Preparation of a special issue of the Department of Conservation's magazine *California Geology*, scheduled for publication in the fall of 1978.



Several of the plant displays (left) are in constant use at garden shows, conventions, and local conservation meetings. Information on drought-tolerant gardens and water-conserving landscape maintenance is provided.



Photograph by Tom Tracy

Office of Appropriate Technology

The Department, in cooperation with the Office of Appropriate Technology (OAT) sponsored a landscape water conservation project in Sacramento to demonstrate ways to save water in typical home landscaping and vegetable gardening. DWR also developed an educational display showing water conserving plants and landscapes for OAT's travelling "appropriate technology" van.

Other Agencies

DWR also worked with the Departments of Parks and Recreation and General Services and the Office of the State Architect in acquiring land and implementing the Sacramento demonstration garden project mentioned above.

The Department is also working with the State Water Resources Control Board and the Department of Health to develop a state-of-the-art report on gray water systems and to promote future research and pilot projects concerning on-site water recycling.

Department of Education

DWR and the Department of Education worked in close cooperation in 1977 and 1978 to create and put into operation a statewide water conservation education program in the elementary schools. This program, which also involves cooperation of local water agencies and schools, provides low-cost curriculum materials and a teacher training program operated through county schools offices.



TABLE 3
DEVICES USED IN PILOT PROGRAM AREAS

<i>TOILET DEVICES</i>	<i>San Diego</i>	<i>Santa Cruz</i>	<i>Sanger</i>	<i>El Dorado</i>	<i>El Segundo</i>	<i>Oak Park</i>
<u><i>Displacement Devices</i></u>						
Polybag displacement G&E Products, Inc. (formerly G&E Management)	x					
Polybag Displacement Blue Water Associates	x				x	
2 one-quart bottles Stewart-Walker Inc.	x		x		x	
<u><i>Toilet Dams</i></u>						
Double edge toilet dam Watergate JKW 5000 LTD				x		
Double edge toilet dam Little John Metropolitan Water Saving Co., Inc.	x					
Double edge toilet dam Mini Flusher Key Marketing Corp.	x	x	x		x	
Single edge toilet dam Moby Dike C.E.E. Co. Products		x				
Single edge toilet dam Water Guard Mark II Eden Enterprises	x	x	x		x	
Single edge toilet dam Long Life Water Savers G&E Products, Inc.		x				
Single edge toilet dam Water Miser Baron Industries						x
<u><i>Other</i></u>						
Valve replacement Dial-A-Flush Carlton Industries	x	x			x	
Flush valve control (change of habit) National Water Saver Co.	x				x	
Float adjuster Big Dipper Cecil G. Cox Enterprises	x				x	

TABLE 3
DEVICES USED IN PILOT PROGRAM AREAS (Contd)

<i>SHOWER DEVICES</i>	<i>San Diego</i>	<i>Santa Cruz</i>	<i>Sanger</i>	<i>El Dorado</i>	<i>El Segundo</i>	<i>Oak Park</i>
<i>Showerheads</i>						
Beige plastic; chrome plated plastic JKW 5000 LTD		x				
Chrome plated plastic Keenan Pipe & Supply Co.	x		x		x	
White plastic Ny-Dei Corporation	x	x			x	
Plastic and chrome plated brass American Standard Colony					x	
<i>External Flow Reducers</i>						
Chrome plated plastic Keenan Pipe & Supply Co.	x				x	
Chrome plated brass Omni Products, Inc.	x				x	
<i>Internal Flow Reducers</i>						
1 plastic & 1 stainless steel JKW 5000 LTD				x		
Stainless steel Crest/Good Mfg. Co. Inc.	x		x		x	
Celcon plastic Water Save Inc.	x					
1 plastic and 1 epoxy glass Eden Enterprises		x				
Plastic G&E Products, Inc.		x				
Internal ball joint restrictors (two models) Price Pfister						x
<i>OTHER ITEMS</i>						
<i>Dye Tablets</i>						
Eden Enterprises		x				
G&E Products, Inc.	x	x	x		x	
<i>Faucet Flow Controls</i>						
Male/female Omni Products, Inc.					x	

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