TECHNICAL MEMORANDUM

ORLANDO RETROFIT WATER CONSERVATION PROGRAM- EVALUATION BY THE SOUTH FLORIDA WATER MANAGEMENT DISTRICT

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This publication was produced at an annual cost of $262.50 or $.53 per copy to inform the public.
500 390

March 1988

Water Use Planning & Management Division
Resource Planning Department
South Florida Water Management District

EXECUTIVE SUMMARY

Faced with continued rapid population growth and a threatened shortage of wastewater treatment capacity, the City of Orlando implemented a citywide retrofit program in mid-1982. Installation of water saving showerheads, faucet aerators and toilet tank dams in existing single and multi-family residential dwellings was intended to serve as an interim solution until treatment capacity could be increased by the expansion of existing facilities and completion of a planned, new facility. The direct cost of the program approached $700,000.

Given its desire for quick implementation, the City had relied on past results of other retrofit programs in its projection and expectations of program effects. Accordingly, the Program incorporated only a limited, short-term evaluation of change in water use for the residences that were retrofitted during the pilot phase of the effort. The City's evaluation was further limited since it did not employ a control group methodology as a basis for comparison in the measurement of pre- and post-program water use. Further, the evaluation relied on measurement of a short time interval during which water use may have been affected by other determinants, such as significant variation in rainfall and water rate increases.

Consistent with its responsibilities to meet the objective of promoting cost effective water conservation measures, the South Florida Water Management District has undertaken a retrospective evaluation of the Orlando Program. The Orlando effort was selected for evaluation since it has been the most extensive and thorough effort of this type to date in the state of Florida. The primary goal of the evaluation was to determine the Program's cost-effectiveness in water use reduction, both in the short and long term, by employing an evaluation design based on experimental principles. The effort incorporated three major components.

The first component was a post-program survey of a randomly selected sample of the retrofitted population to determine long-term public acceptance of the devices and to ensure the fixtures were in fact used over the period of measurement. The second component was an evaluation of program effects in the single-family sector employing a matched control group methodology and 48 monthly billing periods. The third component was an evaluation of program effects in the multi-family complexes retrofitted, analyzing pre- and post-program water use.

To measure long-term public acceptance of the devices, a post-survey of the retrofitted population was designed and conducted by the SFWMD two and a half years after implementation of the program. It was determined that, 30 months after completion of the installation of the devices, 87 percent of all devices were still in place. The retention rate ranged from a high of 94 percent for the aerators to a low of 80 percent for the toilet dams. The stringent performance and appearance criteria established and utilized by Orlando for program plumbing fixtures, as well as the selection process adopted, were clearly effective as evidenced by the measured high retention rate and favorable public attitudes towards the program.

The evaluation to determine single-family program effects, defined as a statistically significant reduction in water use for retrofitted units compared nonretrofitted units, was then undertaken. The evaluation was based on a matched control group design in the measurement of water use in the pre- and post-program periods. It incorporates a longer time interval of measurement, 48 monthly billing periods, than that used by the City of Orlando. Evaluation for program effects for the multi-family sector also incorporated a measurement of 48 monthly billing periods. While a control group methodology was not feasible for the multi-family evaluation, it is, however, an important component of the analysis since multi-family units provide some control for water rate increases since they are not charged directly to tenants and for variation in outdoor irrigation, since the meters covered only indoor use.

The evaluation of the single-family residential sector failed to find a statistically significant difference in water use between the retrofitted and control samples in the post-program period. These two groups had been tested and found to be statistically equivalent in water use during the pre-program period. Methodological limitations of the design, however, require that this finding be interpreted conservatively and that it does not necessarily indicate that there were no program effects. It does, however, indicate the need for further research and documentation of the cost effectiveness of this approach to water conservation in south Florida by incorporating evaluation strategies and data collection requirements from the inception of programs.

The methodological limitations of the evaluation are primarily a result of its retrospective nature and the lack of available cross-sectional data. Since no pre-program survey had been conducted to collect cross sectional data on household determinants of water use, it cannot be verified that the single-family control group was statistically equivalent to the retrofitted group on any characteristic other than pre-program water use. A further limitation of the methodology is that it incorporates a matched control sample drawn from a group that either refused the devices or were not available for contact by the Program staff. It cannot be determined, therefore, that the control group was equivalent to the retrofit group in terms of attitudinal variables which may have had an effect on changing water use patterns.

In addition, the primary program goal was an increase in the number of units that could be serviced by then existing wastewater treatment capacity through reduction in indoor residential water use and, therefore, wastewater generation. As described in the report, technical difficulties precluded direct measurement of the change in wastewater levels and actual water use data supplied by the Orlando Utilities Commission for the selected samples were substituted. A more comprehensive review of methodological limitations is provided in the Section on Evaluation of Program Goals.

While the finding of no statistically significant difference in water use between the treatment and control groups during the post-program period should be interpreted conservatively in light of the methodological imitations, it does raise a question regarding real program effects. This question is underscored by the overall pattern of water use for all single-family residences in Orlando over the period of measurement. This overall pattern is strikingly similar to that of the treatment and control samples. (See Chart on page 45).

Further, the results of the single-family analysis were repeated by the results of the multi-family evaluation. While a control group methodology was not feasible and the evaluation relied primarily on pre-and post-program measurement, the lack of measured significant reductions in water use of retrofitted multi-family dwellings after installation of the devices reinforces the need to more carefully consider the question of real program effects in a planned and systematic manner.

Again, limitations of the methodology require a conservative interpretation of the findings of this evaluation. At the same time, these findings give rise to a concern for the need for more stringent evaluation criteria and designs to be incorporated into water conservation programs from the beginning.

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ABSTRACT

The Orlando Retrofit Program Evaluation documents efforts of the South Florida Water Management District to systematically and quantitatively determine the cost-effectiveness of the 1982 program for installation of water conserving plumbing devices implemented by the City of Orlando. This retrospective evaluation was undertaken by the South Florida Water Management District nearly three years after completion of the program by the City.

The evaluation failed to find evidence of statistically significant reductions in water use attributable to the program for either the single-family or the multi-family residences retrofitted. Lack of pre-program cross-sectional data and methodological limitations, however, require that this result be interpreted conservatively, placing emphasis on the need to document the cost-effectiveness of this approach in South Florida by incorporating evaluation strategies and required data collection into programs from their inception.

The evaluation has brought into focus the need for designs and methodologies to be based on established principles of experimental design. This evaluation faced methodological limitations primarily due to its retrospective nature and unavailability of pertinent pre-program household data on determinants of water use. As a result, guidelines and statistical modeling approaches have been established which, it may be hoped, will prove useful for future water conservation efforts undertaken in South Florida.

INTRODUCTION

In 1982, the City of Orlando undertook a citywide water conservation program for the primary purpose of increasing the number of units that could be serviced by existing sewage treatment capacity. The program was a direct result of the extremely rapid population growth Orlando had experienced. Notwithstanding that the planning of a new sewage treatment plant, as well as expansion of then existing plants, was underway, an immediate increase in unit service capacity was needed.

It is important to note that the Orlando Program was not intended as an experimental demonstration project with a formal evaluation component. Rather, it was intended as an interim solution to an immediate sewage treatment capacity shortfall. Since no formal, long-term evaluation component was incorporated into the original program plan, evaluation efforts undertaken by the South Florida Water Management District two and a half years after its completion proceeded on a retrospective basis. The focus of the evaluation centered on program results for which accurate historical data could be obtained. The primary purpose of the evaluation was to provide guidelines for the planning, development, implementation and formal evaluation of future retrofit programs (and program components) undertaken either within or by the South Florida Water Management District.

While the primary goal of the program was to increase the number of residential units which could be serviced efficiently by existing capacity and lift the sewer connection moratorium declared in 1981, this goal was to be accomplished through citywide installation of water saving plumbing fixtures in existing single- and multi-family residences. Acceptance of these fixtures was on a voluntary basis. All program costs were paid for by the City of Orlando. City crews actually installed water saving showerheads, toilet tank dams and faucet aerators in single-family dwellings and provided technical oversight and follow-up inspection for multi-family complexes.

Although the program focused on installation of water saving plumbing fixtures in existing homes, an amendment to Orlando's Plumbing Code was drafted to ensure the installation of such fixtures in all new construction of residential developments and commercial buildings. Another anticipated, program-related result was the positive environmental impact on Orlando's water resource--the Floridan Aquifer. Reduced rainfall in the years immediately prior to implementation of the Water Conservation Program gave rise to increasing concern over the resource. A successful water conservation effort would reduce (caeteris paribus) Orlando's demand on the aquifer. While evaluation of these program-related goals and outcomes are beyond the scope of this analysis, they are mentioned as essential considerations in long-term water use planning.

A brief summary of program implementation is in order before proceeding. Installation of indoor water saving plumbing fixtures began in June 1982 and occurred in two phases. The pilot program, which involved retrofitting 3,500 residential units, took place from June 1982 through October 1982. The citywide effort was undertaken in November 1982, after a short-term evaluation of the pilot, and was completed by September 1983. The combined efforts yielded overall installation results as follows.

	Installed &/ or delivered*	Total Units in Orlando**	Installed as % of Total
S.F.	15,098	27,000	56
M.F.	17,812	23,000	77
Total	32,910	50,000	66%

Source: *City of Orlando, Retrofit Program Office
**Orlando Utilities Commission

Orlando's program objectives and expectations of 1) a reduction in indoor water use and, therefore, a decline in wastewater generation, 2) preservation of freshwater resources and 3) a reduction in the utility bills of residents occupying existing dwellings were based on Environmental Protection Agency (EPA) findings from several studies that specified water saving plumbing fixtures reduce inside residential water use by approximately 25%. This figure is based on EPA estimates of the distribution of inside water use for varying purposes.

Directly related to the goal of "significant" reduction in residential water use was acceptance of the program by Orlando residents. Obviously, without a high degree of public acceptance, a successful retrofit program would have been precluded from the outset. An active public information/awareness campaign conducted by the City of Orlando accompanied the early stages of the installation program.

The immediate goal was to create widespread acceptance of the water saving fixtures. The longer-term goal was to instill a water conservation ethic which would positively influence attitudes in relation to maintaining the devices once installed. The program also emphasized, but to a far lesser degree, a general long-term water conservation ethic. Program success was primarily dependent upon the hardware installed rather than promotion of a conscious behavioral change on the part of residential consumers. While public acceptance may be defined as a secondary program goal, it is of such importance as to warrant separate consideration within the scope of this effort.

Again, the South Florida Water Management District evaluation of the Orlando Water Conservation Program has been conducted independently of the City of Orlando. Its primary emphasis is evaluation of program results in two areas: 1) the change, over time, in residential water use attributable to program effects; and 2) short and longer-term acceptance of the retrofit devices by Orlando residents.

PROGRAM GOALS

Program goals, as defined herein, relate first of all to what the program is intended to accomplish. These are termed primary goals. Goals may also be defined in terms of the manner, procedures and methods by which the primary goals are achieved. These goals are classified as secondary.

Primary goal

1) To conserve water, by implementing a citywide retrofit installation program for existing residential units,
    a) to reduce residential wastewater generation so that the operating capacity of existing sewage treatment facilities would not be exceeded until the new treatment plant came on-line and expansion of existing plants was completed. (Implied within this goal is a reduction in indoor residential water use which would, in turn, reduce wastewater generation)
    b) to preserve freshwater resources.

Secondary goals

1) To achieve a high rate of acceptance of the retrofit devices from the targeted market -- existing single- and multi-family residential unit occupants.
2) To develop continuing public acceptance and use of water saving plumbing fixtures.
3) To reduce utility bills of the targeted market.

In this study, an evaluation is made of the primary goal and secondary goals number 1 and 2. The evaluation covers both short-term and longer-term program effects.

PROGRAM INPUTS

This section contains both a chronological account of the major events in Orlando's water conservation efforts and a detailed account of the activities during the period of the major conservation effort, June 1982 through September 1983.

Major inputs into the water conservation program have been divided into several categories:

1. Staff and overhead requirements
2. Water saving plumbing devices and other inventory utilized.
3. Implementation plan (including Orlando's short-term evaluation study).
4. Public information/awareness input.

A chronology of the major events in Orlando's water conservation efforts is presented in Exhibit I on page 15. From the chronology, it is apparent that the major efforts (the installation phases) occurred between June 1982 and October 1983.

1. Staff and Overhead Requirements

The Program was developed and administered under the auspices of Orlando's Public Works Department. The hiring of professional, technical and clerical staff for program planning and implementation was undertaken immediately after authorization of funds.

Direct program staff levels for the full citywide program were as follows:

Program Manager Full time Feb/82 - Oct/84

Assist. Managers (2) Full time Feb/82 - Oct/84

Installers (9) Full time

Appointment Clerks (2) Full time

Public Info Coordinator (1) Part-time

Due to the high degree of public acceptance that was required for program success, the following criteria were established in the selection process of technical and clerical staff.

a) neat and presentable appearance

b) ability to communicate effectively

c) ability to deal with the public

d) some mechanical aptitude (applies to installers only)

2. **Water Saving Plumbing Fixtures and Other Inventory Utilized**

The City of Orlando performed substantial research on the performance and acceptability of appearance of water saving plumbing fixtures. Both criteria were used in the establishment of technical specifications the hardware had to meet for use in the Water Conservation Program. Bid specifications were established accordingly.

Only new materials, equipment and parts were to be used in the Program. The units were to be of current manufacture, highest quality, and guaranteed not to rust or to create electrolytic conditions.

Flow control devices limited the maximum specified flow rate at any supply pressure of 15 to 120 Pressure per Square Inch (psi) and at any water temperature not to exceed 160° F. Actual flow must be within (+ or -) 10% of the maximun flow rate specified.

Flow control devices were to control the fluid stream and distribute the stream mass over a sufficient area while preventing undesirable noise generation.

Flow control devices were self cleaning and able to function properly with use of "hard" of "soft" water. Hard water particles did not disrupt the water flow. Further, the devices had provision for ease of manual cleaning should extreme conditions warrant.

Performance Standards Required (Bid Specifications)

A. Shower Heads

1. Restricted the flow rate to a maximum of 3.0 GPM and minimum of 2.0 GPM.
2. Functioned over a normal range of domestic water pressure and temperatures.
3. Were made of chrome plated brass or high quality plastic.
4. Fit all 1/2" threaded pipe shower arms.
5. Had swivel capabilities.

B. Pipe Inline Shower Flow restrictors

1. Restricted the flow rate to a maximum of 3.0 GPM and a minimum of 2.3 GPM.
2. Functioned over a normal range of domestic water pressures.
3. Were made of chrome plated brass cylinders.

C. Faucet Aerators

1. Restricted the flow rate to a maximum of 3.0 GPM and a minimum of 0.5 GPM.
2. Were made of chrome plated brass.
3. Included a universal adapter (male/female threads).
4. Fit all 1/2" threaded pipe shower arms.

D. Water Closet Dams

1. Dimensions were appropriate to fit most water closets.
2. Allowed for evacuation of waste from the toilet bowl with a single flush.
3. Functioned over a normal range of domestic water pressures and temperatures.
4. Were durable and did not support fungus type growth.
5. Were constructed of stainless steel or high quality plastic with rubber edges.

The City of Orlando's invitation to bid for sale of water conservation plumbing fixtures was mailed to approximately 80 manufacturers and/or distributors. The invitation to bid package included the technical specifications, request for sample fixtures, and a fifty percent reorder clause. The reorder clause guaranteed the original purchase for reorder of up to fifty percent of the total number of fixtures initially purchased.

To aid in the selection of the water conservation fixtures, a Technical Advisory Committee was established. This Committee was comprised of the city and county chief plumbing code inspectors, an energy conservation consultant, and two Orlando citizens. The Committee made its recommendations based on price, quality, appearance, and performance of the fixtures. The Committee's recommendations, as well as those of the Program Staff, were submitted to the Orlando City Council for approval. The fixtures that were actually purchased for the Program and a brief description are shown in Exhibit II on pages 20 through 24.

3. Implementation Plan

Orlando's Public Works Department, the Department charged with responsibility for the Program, hired a Program Manager in February 1982 to plan and direct the effort. The Program Manager immediately hired two Assistant Managers as technical advisors.

The Program Manager next hired installers to perform the actual installation of the retrofit devices in households that were receptive to them. The main requirements for the installers were a neat and presentable appearance, the ability to communicate effectively and the ability to deal well with the public.

Appointment clerks were the other category of Program staff. It was their responsibility to make the initial contact with the targeted public and secure appointments for the installers. Qualifications for these staff positions were the ability to communicate effectively with the public.

Distribution and Installation

Since the potential market for the retrofit devices totalled 50,000 dwelling units, of which 27,000 were single-family residences, a systematic plan of distribution and installation was designed. The neighborhoods that comprised the targeted market of single-family units were defined by logical borders drawn on the City's subdivisional map. Listings of names, addresses and telephone numbers of the homes in each respective area were compiled. These listings were used in geographical sequence by the program clerks in securing appointments with receptive single-family households. Prior to any telephone calls into a targeted neighborhood, program flyers that described the effort and its sponsor were distributed within that area. This practice reduced the potential for residents mistaking the city-sponsored telephone call for a telephone solicitation. Records were kept of households that the staff were unable to reach in order to follow up with them as program resources and deadlines allowed.

The installation of the plumbing fixtures took approximately fifteen minutes for a two bathroom house. Installers worked in teams of two per household. The primary reason for this approach was to minimize the potential liability on the part of the City for claims made by the participating households of alleged plumbing damage and/or theft. By working in teams of two, installers were less vulnerable to either claim.

The approach was successful since there were no incidents throughout the entire program of alleged theft by the installers. Plumbing damage, however, posed a more serious concern. In order to minimize the problem, plumbing inspection sheets were used by the installers to keep records of existing plumbing leaks and advise the affected residents of these leaks prior to installation of the retrofit devices. Written acknowledgement by residents of these existing leaks protected the City from repairing damage that was not caused by the Program staff.

Plumbing damage that did occur as a result of the installations was less than one percent of installations (measured by total number of fixtures installed). The most common damages encountered were broken shower arms, faucet damage caused by aerator installation and toilet fill valve damage. One Assistant Manager of the Program was experienced in minor plumbing repairs and was able to repair the majority of Program damage, keeping repair costs low.

The City assumed no liability, however, for installation of water saving fixtures that were delivered to multi-family buildings and/or complexes. Apartment complex maintenance crews were instructed by Program Staff on proper installation procedures but the installations were actually performed by the private crews. A follow-up visual check was conducted by the Program staff to determine if the fixtures had in fact been installed and whether they had been installed properly. Most multi-family complexes completed the installation in a timely fashion and with minimum assistance from the City.

To reiterate, the Program was conducted in two stages, the pilot and the citywide. The pilot program provided the opportunity to assess and refine the approach before the citywide program was initiated. It was possible to conduct a limited, short-term evaluation of the pilot program prior to and concurrent with the early phases of the citywide effort.

One immediate issue that was encountered in the pilot was the inadequacy of the measurement instrument. It became apparent to the Program staff that accurate measurement of wastewater flows was not possible since many of the sewage pump station service areas experienced inflow and infiltration into the sewage collection system, resulting in increased sewage flows during periods of rainfall and/or high groundwater tables. Residential wastewater reductions due to retrofitting would not be identifiable under such conditions.

The best alternative measure for evaluation of primary program goals was actual water use data provided by the Orlando Utilities Commission. The Program staff used this measure in its short-term evaluation of program effectiveness. (See Appendix A.) Water use data were also used by the SFWMD in its retrospective evaluation.

One program-related result that should be noted was the establishment by Orlando of a comprehensive Sewer System Evaluation Survey (SSES) that was conducted by a newly established section within the Wastewater Bureau. The purpose of the Evaluation Survey was to establish an oversight on the sewer system infrastructure and provide a preventative maintenance program to detect potential problems before they evolved into major repairs. The goal was to reduce infiltration inflow into the system which robs it of its full treatment capacity. (While coverage of the SSES is beyond the scope of this report, SSES project information is available from the City of Orlando, Wastewater Bureau.)

4. Public Information/Awareness

Although the Program was free to Orlando residents of existing single- and multi-family homes, a high degree of public acceptance was needed to insure installation in the majority of these residential units. A corresponding public information/awareness effort was undertaken and conducted concurrently with the pilot and the early phases of the citywide. (Informational flyers used by the Program staff, however, continued to be distributed by neighborhood throughout the citywide effort.)

The public information/awareness component concentrated in two areas:

a) Primary emphasis was awareness and promotion of the Program to achieve both short and long-term acceptance of the devices

b) Some promotion of a general conservation ethic, including recommendations for home practice

Media Utilized

Media coverage was fairly evenly distributed among television, radio and newspapers. The kickoff of the public information effort occurred in June 1982 along with the beginning installation phase of the pilot program. The kickoff event featured the Mayor of Orlando installing water saving plumbing fixtures in the dwellings of several senior residents.

Highlights of the media coverage are

* Radio - Coverage consisted of news stories, Public Service Announcements (PSA's) and interview (both taped and live). Interviews occasionally used a talk show format. Radio coverage was significant and errors in reporting were held to a minimum.

* Television - Coverage was characterized by basically the same format as for radio and consisted of news stories, PSA's and interviews.

* Newspapers - Coverage was sporadic and a high rate of errors in reporting was encountered. Notwithstanding these considerations, news articles covering the various aspects of the Program and editorials were helpful in generating awareness and support.

* Other Media - Public awareness flyers were distributed by Program staff to neighborhoods immediately prior to contact by the staff to maximize acceptance of that contact and ultimately the water saving plumbing fixtures. (See Exhibit IV).

* Program Staff - Telephone calls to and personal contact with Orlando residents.

The budget for the Public Information/Awareness effort was relatively modest compared to the scope of this component. Its success is indicated by an overall 66% acceptance rate of the water saving devices by Orlando residents of existing housing.

EXHIBIT I
SUMMARY HISTORY OF ORLANDO'S
CONSERVATION PROGRAM

1981

Note: Citywide sewer connection moratorium placed in effect prior to 1981.

Oct. City Council approval and budget authorization for pilot program. Sewer System Evaluation Survey (SSES) authorized.

Nov.

Dec. Sewer Moratorium Lifted. (Some restrictions remained. Connections would be approved only for individual homeowners and very small developers and only as capacity became available.)

1982

Jan.

Feb. Program Management staff hired. (1 Manager & 2 Assist. Managers)

March Planning of pilot program for 3,500 residential units.

April Invitation to bid mailed to 80 manufacturers/distributors.

May Water saving plumbing fixtures selected. Pilot program installers and appointment clerk hired.

June Pilot program implementation began.
Public Information/Awareness Campaign Kickoff.

Aug. Initial evaluation of program inputs and preliminary planning for citywide program.

Sept. Pilot program installation phase completed.
Short-term evaluation of pilot program results undertaken.

Oct. City Council approval of citywide effort and budget authorization. Additional installers and appointment clerk hired for citywide effort. (Total of 9 full time installers and 2 full time appointment clerks for citywide program.)

Nov. Citywide Installation Program began.

Dec.

1983

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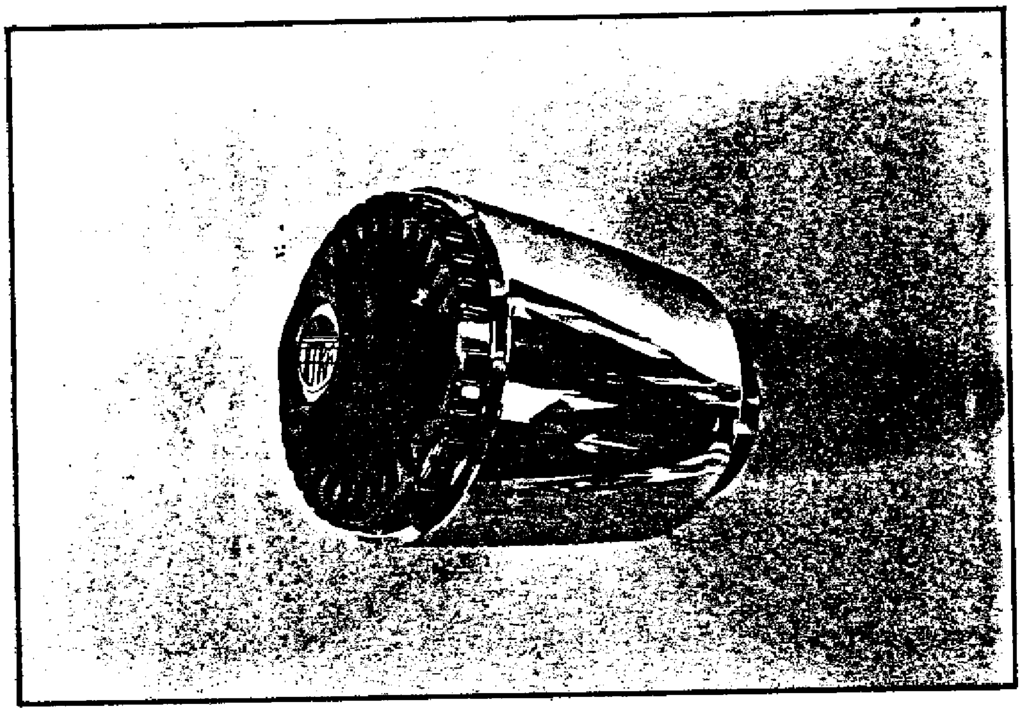
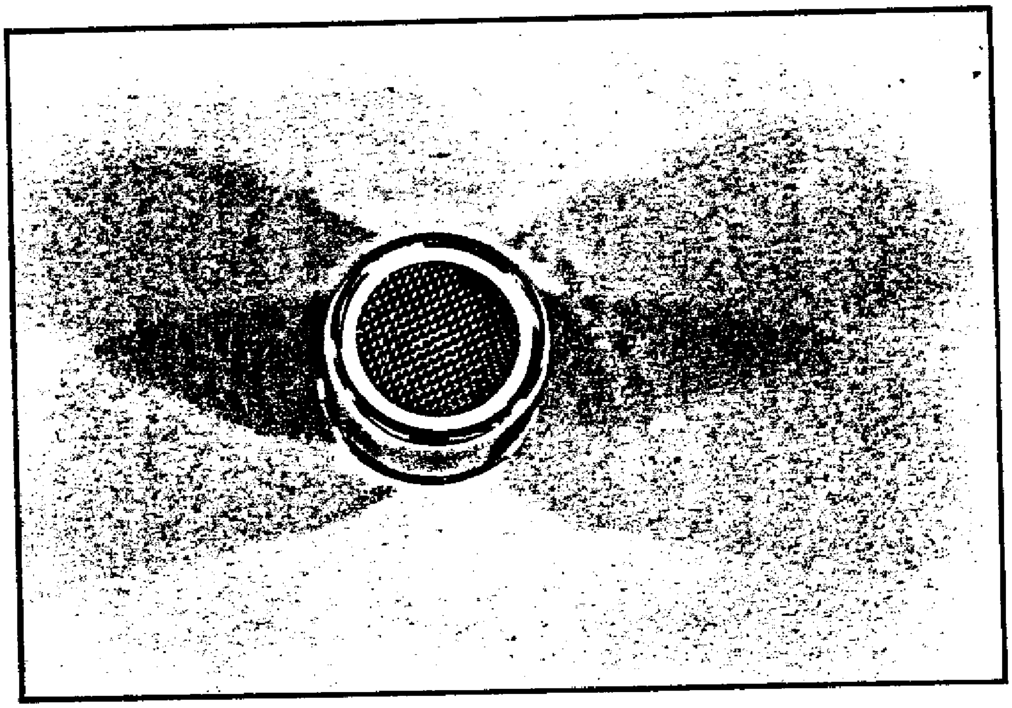
Sept. Citywide Installation Program completed. Administrative Review.



PLASTIC SHOWERHEAD

While maintaining a conventional appearance, this showerhead restricted the flow of water to 3 GPM. The Shay Corp. showerhead came with an adjustable spray and had swivel capabilities. It also fit any 1/2" standard showerarm. The Shay showerhead was highly accepted by the public. Orlando purchased 15,000 of these showerheads at $2.91 each.



FAUCET AERATORS

The aerators purchased were constructed of chrome plated brass and were equipped with universal threads (male/female). On its first bid, Orlando purchased 17,250 aerators at $0.34 each from Resources Conservation Inc. On the second bid, we purchased 35,000 aerators at $0.24 each from Wrightway Mfg. Company.

EXHIBIT III

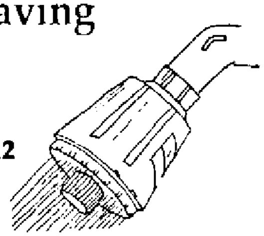
TOTAL PARTS PURCHASED

DEVICE	TIME OF PURCHASE	QUANTITY ORDERED
Resources Conservation Toilet Tank Dams	1st Bid	10,000 PR X 1.59 = 15,950
	2nd Bid	15,000 PR X 1.55 = 23,250
		$39,200
Resources Conservation Brass Showerhead	1st Bid	10,000 EA x 3.27 = $32,700
Shay Corp. Plastic Showerhead	1st Bid	10,000 EA X 2.70 = 27,000
	2nd Bid	5,000 EA X 2.91 = 14,550
		$41,550
E. C. Systems Save/N/Energy	1st Bid	1,000 EA X 3.84 = 3,840
	2nd Bid	2,000 EA X 1.59 = 2,980
		$6,820
Resources Conservation	1st Bid	11,500 EA X .34 = 3,910
	50% Reorder	5,750 EA X .34 = 1,955
Wrightway Mfg. Co. Faucet Aerators	2nd Bid	35,000 EA X .24 = 8,225
		$14,090
Total costs for all parts (including pilot program)		$134,360

Source: City of Orlando, Retrofit Program Report (Unpublished).

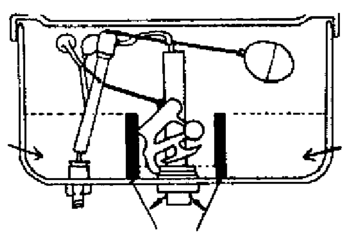
STEP 1

Install Water Saving Fixtures

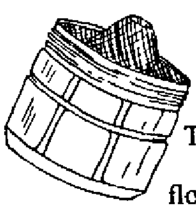


CONVENTIONAL SHOWERS USE 6 TO 12 GALLONS OF WATER PER MINUTE.
Water conserving shower heads use only 2-3 gallons of water per minute. Low flow shower heads look similar to conventional heads, although their internal designs are different. The newly designed shower heads provide invigorating showers with variety in spray.

TOILETS CONSUME UP TO 45% OF YOUR INDOOR WATER



The typical toilet uses approximately 5 to 7 gallons of water for a single flush. The devices provided by the City of Orlando will save up to 1.5 gallons per use; while still providing sufficient water for an adequate flush. Dams will be installed to physically hold back water in toilets. It will work similar to reservoirs.



AERATORS LIMIT FLOW FROM INDOOR FAUCETS
The aerator installed by the City will restrict the water flow to a greater degree than conventional aerators; while maintaining the pressure and appearance of previous flow levels.

STEP 4

Leaks Not Only Create Water Loss But Dollar Loss

Leaks in your toilet, faucets and showers waste thousands of gallons of water a month, costing you hundreds of dollars a year. A leaky toilet, for instance, can waste approximately 3,000 gallons a month and 36,000 gallons a year of precious water, not to mention the significant money.

On a smaller scale, a drippy kitchen faucet may waste up to 1,000 gallons of water a month, which converts to 12,000 gallons of wasted water per year.

Leaks inside and outside of your home are costing you hundreds of dollars, so it's in your best interest to stop them. The first step in fixing leaks is locating them. Below, you can find a list of clues which can alert you to existing and future leaks. Take a few minutes of time and check for leaks. In the long run, it will save you dollars.

- Leaks from most faucets consist of obvious drips or water that runs after the faucet has been firmly turned off. Kitchen, bathroom and outdoor faucets can be visually checked with no problems.
- Water dripping or running from the showerhead when the shower is turned firmly off, is usually caused by bad washers or seats which need replacing. Also, check for leaks from the tub faucet when a tub shower is on. This leak will defeat the purpose of a lowflow showerhead because the water you save with the lowflow shower is lost from the tub faucet.
- Leaks in toilets are harder to find and are normally caused either by a bad flapper valve, flapper valves seat, or a bad ballcock valve. Both cause a constant flow of water into the overflow tube.
  Toilet leaks can be located by listening – looking – testing.

  Listening – a faint hissing or running water noise from your toilet when it is not in use; alerts you to a possible leak.

  Looking – take the tank top off and look inside. Located in the center of the tank is either a hard plastic or copper tube. If water is running over it and will not stop, you possibly have a bad ballcock valve, you should consult your plumber.

  Testing – after taking the tank top off, if everything appears proper, drop food coloring or a dye tablet in the tank. *DO NOT FLUSH.* Leave for 15-20 minutes, if color appears in the toilet bowl you do have a leak.

NOTE: Problems with plumbing fixtures may be due to old age, corrosion, etc. Replacement or repair parts can be purchased at a local hardware store, or consult your plumber.

Save Water Orlando

CITY OF ORLANDO
PUBLIC WORKS DEPARTMENT

Orlando's Water Saving Plan...

The City of Orlando has launched a major campaign to conserve water and reduce the flow of waste water. This campaign has drawn the enthusiastic endorsement of many city officials.

Mayor Bill Frederick Had These Words To Say:

"The success of our 'Save Water, Orlando' program depends on the cooperation of you, your family and your neighbors. The conservation of Florida's precious natural resources is essential to preserving the quality of life for future generations. The City of Orlando is convinced that our water-saver program will protect the environment while it saves its citizens money. And the best part: It's FREE."

Bill

Bill Frederick
Orlando Mayor

A Word From The Public Works Director

"We feel our Water Conservation Program, with your cooperation and assistance, can be of great value in addressing the water resources problems of Central Florida, as well as reducing your utility bills. We look forward to working with you."

Bob

Bob Haven
Director of Public Works

How The Program Started

The City of Orlando is officially starting its *Citywide Water Conservation Program*. This follows the highly publicized Water Conservation Program Test Phase conducted between June and September of 1982. During the test program, 8 target neighborhoods and 7 highrise complexes in Downtown Orlando were retrofitted with water saving fixtures; low-flow showerheads, toilet dams, and faucet aerators. The results were a *SUCCESS*. Homeowners realized *savings* in their water and sewer bills ranging from $1.00 to $7.00 in the first month with an *average savings of $2.00 to $3.00 per month* over a 3-4 month period. Highrise complexes realized a *reduction in water consumption of 15-30%*.

The City has developed **FOUR STEPS** to assist you in conserving water:

STEP 2 How The Program Works For You

Through a Citywide program, officials hope to contact and install water saving fixtures in every home within the City Limits of Orlando. During the coming year City crews will be *working in assigned neighborhoods* and *contacting residents by phone or in person* to set up appointments to have the fixtures installed. The devices will be provided and installed by City crews *FREE OF CHARGE*. This *service* will be provided to those residents who live within the *Corporate City Limits*.

How Will I Save Money?

Conservation of water not only helps preserve our natural resources, it saves you money. Your water bill charge is tied directly to the amount of water you use. Also, the charge for sewage is tied directly to the amount of fresh water you use.

Many cities charge a flat sewer fee. Everyone's bill is the same. The City of Orlando's rate schedule encourages conservation, and rewards those who conserve with lower water and sewer bills.

For More Information:

Contact City of Orlando
Public Works Department
Water Conservation Section
423-0390

If your school, civic group or club would like to hear more about our program please give us a call and we will set up an appointment for a presentation at your convenience.

More Water Saving Suggestions

STEP 3 Every Day Tips For Saving Water

INDOOR WATER USE
75% in the Bathroom
20% in the Kitchen and Laundry
5% for Cooking and Drinking

Bathroom Tips

- Don't flush toilets unnecessarily – utilize trash baskets for tissues and insects.
- Avoid leaving the water running when shaving or brushing teeth. You can SAVE up to 10 gallons each time you wash.
- When using the bathtub – fill it only a ¼ to ½ full instead of all the way.
- Keep the length of showers to 5 minutes – A 5 minute shower could use up to 35 gallons.

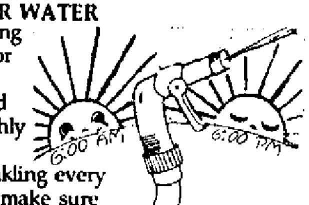
Kitchen Tips

- When using a dishwasher, wash with a full load as opposed to a partial load. Dishwashers use 15-25 gallons of water per cycle. Avoid pre-rinsing when possible.
- Use moderate amounts of detergent; extra detergent means extra rinsing.
- When washing dishes, don't let the tap water run freely. Fill the sink for washing *and* rinsing.
- Store water in the refrigerator for drinking; this eliminates the running of tap to obtain drinking water.
- Put a stopper in the sink to rinse vegetables. Do not use running tap water.

Laundry Tips

- When washing clothes, remember to wash full loads and eliminate pre-soak and extra rinse cycles when you can.
  - You can save up to 19 gallons of water per load by avoiding extra rinse cycles.
  - Remember washing machines use up to 50 gallons per cycle. Washing one full load as opposed to two half loads can save you up to 50 gallons of water.

CONSERVE OUTDOOR WATER



- Water your lawn during early morning hours or at sunset to reduce evaporation. You need only to water thoroughly twice a week as opposed to light sprinkling every day. When watering, make sure you are sprinkling your lawn and not your driveway or sidewalk. Don't apply excess fertilizer; it requires more water. Mulch around trees and bushes; it keeps moisture around the root systems longer.
  - Avoid using fine mist sprinklers that hasten evaporation. Use sprinklers with firm coarse sprays.
  - When cutting your grass raise the mower blade to 1½ inches above ground level. This provides shade for roots and helps reduce water loss.
  - When washing your car – avoid leaving the hose running; use a bucket or "gun" type hose attachment. A 20 minute car wash can use up to 600 gallons of water.

EVALUATION OF PROGRAM GOALS

The primary goal of the Orlando Water Conservation Program was an immediate increase in the number of units which could be serviced by existing sewage treatment capacity. As explained earlier in the Section on Program Inputs, the measurement of wastewater flows (and, therefore, sewage treatment capacity) was not feasible. It was discovered during the pilot phase of the program that many of the sewage pump station service areas were experiencing inflow and infiltration into the sewage collection system which significantly increased sewage flows during periods of heavy rainfall. Therefore, reductions in residential wastewater levels were not identifiable during these periods of rainfall and high groundwater.

The best alternative measure of program effects was the actual water use data of Orlando residents supplied by the Orlando Utilities Commission. (A reduction in residential water use translates into a reduction in wastewater generation, and, in turn, an increase in sewage treatment capacity.) The focus of this evaluation, then, centered on the change in residential water use as a result of the retrofit program.

It should be reiterated that the South Florida Water Management District evaluation has been conducted independently of the City of Orlando and its short-term evaluation of the pilot program. The methodology and results of that evaluation are contained in Appendix A. It should also be noted that, in addition to being independent, the SFWMD evaluation is retrospective in nature and must rely on accurate historical data which can be obtained.

The effort incorporates evaluation of the primary program goal, defined as reduction in residential water use, and the secondary goal of a high degree of public acceptance--both short- and long-term. Since public acceptance of the water saving plumbing fixtures is essential to the success of a voluntary retrofit installation program, it warrants separate consideration within this report.

Design and Methodology

The Program as originally planned and implemented did not incorporate a formal evaluation component. It was not intended as an experiment but rather as an interim solution to a longer term problem. The pilot phase of the program could at most be be interpreted as a quasi-experiment with a nonrandomized one group pre-test - post-test design.

The inherent weakness of such a design, however, needs to be made clear. The program participants were not randomly selected from the Orlando population. Rather, devices were installed only in households that were contacted and receptive to the program. This nonrandomized one group pre-test-post-test design provides no control for events which occurred within the participants' environment that may affect water use (such as rate structure changes) or within the participants (defined as households) themselves, such as a change in household size, that may provide a rival explanation for water use patterns observed after the installation of the devices.

Additionally, timing of the measured intervals is important in this analysis since no control group was established for comparison of water use in the pre-program and post-program periods as defined by the City of Orlando. In this particular case, rainfall would provide an equally or more plausible explanation of the water use pattern in the two time periods measured (see Appendix A). The limited number of billing periods, combined with the lack of a control group, serves to bring into question the validity of any conclusion that observed change in water use from the pre to the post-program period was caused by the retrofit devices.

It is with these concerns in mind that SFWMD approached and designed the methodology for its retrospective evaluation of the Orlando Water Conservation Program. Since internal validity of the design is essential, the decision was made for the single-family residential analysis to select a treatment group sample from the population that was retrofitted during the citywide phase of the program and a corresponding control group sample. The methodology used in the selection process is as follows.

Selection of Test and Control Groups

Single-family Residences

The selection of the single-family test and control samples was conducted by the staff of the South Florida Water Management District. The procedure followed was a stratified, systematic random selection for the Test Group. It was stratified to ensure that neighborhoods were proportionately represented in the sample based on their respective acceptance rate of the water saving fixtures.

Actual worksheets from the Program were used. The worksheets reflected the breakout of households that 1) were contacted and accepted the fixtures, 2) that were contacted and did not accept the fixtures and 3) households the Program staff were unable to contact at all. A systematic random sample procedure was employed in selecting the Test Group from households that accepted the fixtures while the Control Group was selected from the nearest street address corresponding to the Test Group.

The selection was based on a 4 percent sample size of those households that actually accepted the fixtures. (This sample size was determined due to the high rate of account changeovers with the Orlando Utilities Commission.) For each single-family residence selected for the Test Group, a corresponding household was selected for the Control Group. (It should be noted that due to account changeovers during this period, that the final test sample equalled 396 while the control sample equalled 370.) The primary criterion for Control Group selection was the street address with closest proximity to its paired Test Group residence. Whenever the closest address provided the opportunity for selection of a household that had been contacted but did not accept the fixtures, it was selected.

There were, however, a significant number of instances in which satisfaction of that selection criterion posed a trade-off of geographic proximity, the primary selection criterion. Whenever that situation occurred, geographic proximity prevailed and households that the Program staff had been unable to contact were chosen for the Control Group.

The selection process for the Control group was followed to ensure homogeneity between the Test and Control Groups in the pre-program period. In effect, the methodology was intended to control for confounding independent variables -- characteristics such as household size, income, etc. -- that may account for a change in the dependent variable. Since no pretest survey had been conducted to collect such cross sectional data, this selection approach which allowed for testing the two groups in the pre-program period for differences in mean water use provided the desired control in a retrospective evaluation. The groups, however, could not be tested for differences in pre-program means of other characteristics, such as income, since the data were not available.

Another essential criterion for both the Test and Control Groups was that the same responsible parties for the respective water accounts were in place throughout the entire measurement period. It was possible through the Orlando Utilities Commission to identify account changeovers to new residents during this period. Any account changeover so identified was eliminated from the Test and Control samples.

Again, the result was a Test Group sample of 396 single-family residences and a Control Group sample of 370. This result indicates a mortality rate in excess of 33 percent from September 1980 through August 1985.

For the 24 month billing period prior to the program, the mean water use for the test group was 10,950 gallons per month. The test sample of 396 yielded a confidence interval for the mean of 8,880 - 13,020 gallons at a 95 percent confidence level. The confidence level relates to the population of single family households within the city limits of Orlando that accepted the retrofit devices. Mean water use for the Control group during the pre-program period was 10,680. The sample of 370 households yields a confidence interval of of 7,910 - 13,450 gallons at a 95 percent confidence level.

Limitations of Methodology

Since the program did not randomly assign the residences to receive and install the retrofit devices and did not establish a control group matched on cross sectional characteristics, the question of equivalency of the control group in a retrospective evaluation is of major concern to internal validity. Equivalency in mean water use between the Test and Control Groups was established by a pre-program measurement of the variable. Equivalency of the groups on other characteristics which may have an effect on water use could not be tested. The underlying assumption of the methodology employed was that geographic proximity of the Test and Control samples ensured that there were no significant differences between the groups on these characteristics. In turn, this would provide a control for the effects of history, maturation and mortality. Notwithstanding the high mortality rate (account changeovers) during this period of time, the geographic proximity of the final Test sample unit to its paired Control unit remained basically constant from the initial sample selection.

The issue, however, is that the assumption of homogeneity of the groups based on characteristics that are significant determinants of water use could not be tested. This raises concern in relation to the interaction of selection with other factors. For example, selection maturation interaction could create a significant error in interpretation of effects if the Test Group were to experience a change in characteristics, such as household size, that was not experienced by the Control Group. Additionally, the Control Group is comprised of two sub-groups -- those that were contacted and refused the devices and those that the staff were unable to contact at all during the citywide phase of the Program. The question of equivalency of these two subgroups may hold implications for the overall equivalency of the Test and Control Groups.

These issues are raised since they may offer an alternative explanation of any significant difference in water use by the Test and Control Groups during the post-program period. Given these considerations, a statistical model for program evaluation was formulated as follows.

Statistical Model

A data set which combined pooled time series data for 48 billing periods with cross sectional data on program participation or nonparticipation was generated. A total of 36,768 monthly water use observations were analysed. The 48 monthly billing periods were for fiscal years 1981, 1982, 1984, and 1985. (The Orlando Utilities Commission fiscal year runs from September through August.) Fiscal year 1983 was eliminated from the analysis since the citywide program was conducted over the entire year and nearly 30,000 units were retrofitted--approximately 2,500 units per month. Given that the Program records were unclear on the timing of installation of any specific unit, the entire year was removed from the period of analysis.

A multiple regression analysis was performed using the Statistical Package for the Social Sciences (SPSS). A statistical model of the form

$$WUij = A + B_1D1ij + B_2D2ij + B_3D3ij + B_4Prij + B_5Ir_j + e_{ij}$$

was estimated where ...

Wu_{ij} is observed water use, in thousands of gallons, by the ith single-family household in the jth month

A is the intercept term (which is equal to the predicted water use by a nonparticpating single-family household in the pre-program period)

$D1_{ij}$ is a dummy variable which is set equal to 1 if the household participated in the retrofit program and the time period was pre-program (fiscal 81 and fiscal 82); 0 otherwise

$D2_{ij}$ is a dummy variable which is equal to 1 if the household participated in the program and the time period was after installation of the water saving fixtures (fiscal 84 and fiscal 85); 0 otherwise

$D3_{ij}$ is a dummy variable which is equal to 1 if the household did not participate in the program and the time period was after the installation of the devices; 0 otherwise

Pr is the marginal price of water using the block rate structure and the varying rate levels applicable throughout the pre and post periods. The marginal price was adjusted (relative to other consumer prices estimated) for inflation using the Consumer Price Index, 1967 = 100, U.S. City average for all items.

Ir is an estimate of lawn irrigation requirements. Research publications from IFAS were utilized to determine evapotranspiration for turfgrass. Historic rainfall data for the period under analysis were used as input. The SFWMD's modified Blaney-Criddle program was run using historic rainfall and evapotranspiration from the IFAS publication. Output from this program was utilized to determine the ratio of average effective rainfall to average, measured rainfall (using the average of three rainfall stations in the Orlando area) for each month. This factor was then applied to estimate actual effective rainfall for each month. Evapotranspiration minus effective rainfall was used as a measure of irrigation water requirements to be utilized as an explanatory variable.

Due to the block rate structure and the declining rate which was altered dramatically over the period of analysis, the magnitude of the partial regression coefficient was in question. Specific measurement of the effect of this variable was eliminated and incorporated into the error term. Since there was no significant interaction between price and the dummy variables, there was no impact on the measurement for program effects by this adjustment.

This model was selected because it could provide information on the amount of change in water use as well as incorproate other explanatory variables. It is statistically equivalent to analysis of variance measures.

Regression Results

The estimated equation is given below

$$WU = 8.7957 + .12689D1 - .63091D2 - .70238D3 + .84635Ir$$

s.e.	(.1471)	(.1466)	(.1471)	(.1499)	(.4649E-01)
t	(59.80)	(.866)	(-4.28)	(-4.68)	(18.20)

$R2 = .011$

$F = 101.43$

The coefficient of determination (R^2) for the equation is .011 which indicates a significant unexplained variation in the water use observations. Additionally, the low value of R^2 is due in part to the fact that pooled time series-cross sectional data was utilized. According to Intrilligator in his text on Econometric Models, Techniques, & Applications,1978, "It might also be noted that R^2 values tend to be high when using time-series data, where both dependent and explanatory variables may reflect certain underlying time trends. When using cross-section data, by contrast, R^2 values tend to be low because of both the great variability that is possible across the individual entities and the lack of a common underlying trend". (Intrilligator, p. 126.) The problem is compounded in the model under consideration because of the lack of data on factors other than program participation. Additionally, identification of a clear longer-term time trend is difficult given a 48 month period of analysis.

The hypotheses being tested by the model, however, relate to the change in water use over time that are attributable to the effects of the independent dummy variables as defined. The model does not attempt to explain all of the variation in water use over this period.

Specific null hypotheses to be tested are described below and the test results are presented.

(1) There is no significant difference between the water use of participants and non-participants in the pre-test period. The hypotheses may be expressed as: $A = A + B_1$, or equivalently that $B_1 = 0$. The test statistic for testing this hypothesis is given by the t-ratio for B_1 (.866 shown above) which is insignificant at greater than the .25 level. Therefore, the null hypothesis that there is no significant difference between water use by participants and non-participants in the pre-program period cannot be rejected.

(2) Water use by program participants and by non-participants declined following the program. This hypothesis involves testing that $A = A + B_3$, which is equivalent to the hypothesis that $B_3 = 0$, and that $A + B_1 = A + B_2$, which is equivalent to the hypothesis that $B_1 = B_2$, or that $B_2 - B_1 = 0$.

The test statistic for the hypothesis that $B_3 = 0$ can be taken directly from the computer output. The t-statistic for this test is -4.68, which is significant at .001. From this result, the hypothesis that there was no decline in water use among program non-participants can be rejected at the .001 level. The estimated magnitude of the decline in water use by non-participants is 702 gallons per month.

The appropriate test statistic for the hypothesis that there was no significant decline in water use among program participants depends upon whether B_1 and B_2 are independently distributed. The regression model run is based on the assumption the D1 and D2 are independently distributed. An analysis of the variance-covariance matrix for the regression coefficients indicates that there is relatively little co-variance between the B's. The appropriate test statistic is $(B_1 - B_2)$/standard error of $(B_1 - B_2)$, which, assuming that B_1 and B_2 are independently distributed, may be written as:

$(B_1 - B_2)$/SQRT $(V(B_1 - B_2)) = (B_1 - B_2)$ (SQRT$(V(B_1) + V(B_2))$. If B_1 and B_2 are not independently distributed, then it is necessary to account for the covariance between B_1 and B_2 in calculating the standard error of the difference between B_1 and B_2. The appropriate test statistic when B_1 and B_2 are not independently distributed becomes $(B_1 - B_2)$/SQRT $(V(B_1) + V(B_2)$ - twice the covariance between B_1 and B_2).

The estimated difference between B_1 and B_2, that is the estimated decline in water use among program participants, is .758, indicating that water use among program participants declined by approximately 758 gallons per month per single-family household. To test the significance of this decline, assuming that B_1 and B_2 are independently distributed, the following test statistic is calculated".

t=.758/SQRT(.02148+.02164)=.758/.1682=4.507. This is statistically significant at the .001 level of significance. When the covariance term is added, this test statistic becomes:

t=.758/SQRT(.02148+.02164-(2*.01118))=.758/.1449=5.231

This is statistically significant at the .001 level of significance. This indicates that there was a statistically significant decline in water use by participating households following implementation of the program.

(3) The final tests to be conducted relate to the hypothesis that the decline in water use for the test group, those receiving the water conservation devices, was equal to the decline in water use among the control group, those not receiving the devices. Two variants of this test will be conducted. Since the previous test established that there was no significant difference in water use between the test and control groups in the pre-test period, one test is simply that $B_2=B_3$, the difference between the post-test water use for the test group and the pre-test water use for the control group is equal to the difference between the post-test water use for the control group and the pre-test water use for the control group.

Since the value of B_1 was not zero, the above test may be biased. A more direct test is that the difference in water use among participants before and after the test, represented by B_2-B_1, is equal to the difference in water use among non-participants, represented by B_3.

To test that $B_2=B_3$, it is again necessary to specify whether or not the test is considering the covariance between B_2 and B_3. In the case where the covariance between B_2 and B_3 is assumed to be 0, the appropriate test statistic becomes:

t=(B_2-B_3)/SQRT(V(B_2)+V(B_3)) = -.63090945-.70238042/SQRT (.0214+.02248) =.0715/.1696=.4212-- which is insignificant.

Including the covariance between B_2 and B_3, the test becomes $t=(B_2 - B_3)/SQRT(V(B_2)+V(B_3)-2*cov(B_2B_3))=.0715/SQRT(.02164+.02248-.0225)=.4861$. This t-value is also not significant. These tests indicate that although water use declined for both the control and test groups in the post-program period, the decline for the test group from the control group's pre-test level was not significantly different from the decline for the control group.

The final test to be conducted tests whether the decline in water use for the test group was greater than the decline in water use for the control group. Specifically the null hypothesis to be tested is that $B_2-B_3 = B_1$. The test statistic for the null hypothesis that $B_1 = B_2-B_3$ is given by:

$$t=((B_2-B_3)-B_1)/s.e.((B_2-B_3)-B_1)$$

The standard error of the quantity $((B_2-B_3)-B_1)$, assuming that B_2,B_3, and B_1 are independently distributed is given by the $SQRT((V(B_2)+V(B_3)+V(B_1))$. The t-statistic then becomes $t=-.0554/.1911=-.29$. On this basis, the null hypothesis that the decline in water use among program participants was equal to the decline in water use among non-participants cannot be rejected.

On the basis of the foregoing analysis, the following conclusions are reached:

(1) There was no statistically significant difference in water use between the test group and the control group in the pre-test period.

(2) Water use for both the test group and the control group declined significantly between the pre-test and the post-test periods.

(3) The decline in water use by the test group, although slightly greater in absolute magnitude, is not significantly different from the decline in water use by the control group. This result implies that the analysis failed to reveal a significant independent effect attributable to program participation for single-family households.

A comparison of the average monthly water use between the test group sample and all single-family residences within the Orlando City limits is provided in Table 2 on page 45. A similar pattern for all single-family residences compared to that of the test group prevailed over the time period in question. There appears to be a high correlation between the rainfall pattern during this time, (irrigation requirements), and water use. To control for outdoor water use, an analysis of a time period in which irrigation requirements were relatively low was conducted. The three month time period July, August, and September was selected on the basis of rainfall and turfgrass irrigation requirements for Orlando. The hypotheses to be tested are the same as those for the analysis conducted for water use for all months in the pre-program and post-program periods.

Test statistics are calculated on the same basis as in the analysis of overall water use and results are presented below.

The estimated equation is

WU=	13.119	- .1052D1	- 1.462D2	- 1.085D3	- 1.330Ir
s.e.	(.378)	(.376)	(.378)	(.385)	(.119)
t	(12.378)	(-.279)	(-3.87)	(-2.81)	(-11.14)

$R^2 = .00381$

$F = 34.64$

This three month period provided a limited control for water use for irrigation purposes and allowed a more direct analysis of the change in indoor water use for the sample groups. Mean water use for both groups during these months was 9,656 gallons of water per month per single-family household compared to an overall mean water use of 10,277 gallons. Again, the accompanying tables on rainfall and irrigation requirements for the four-year period show a relatively erratic pattern for the Orlando area.

Hypotheses to be tested and test results are as follows:

(1) There is no significant difference between the water use of participants and non-participants in the pre-test period for the three-month period measured. The test statistic is given by the t-ratio for B_1 which is taken directly from the computer printout (-.843) which is insigificant at greater than the .25 level. On this basis, the null hypothesis cannot be rejected.

(2) Water use by program participants and non-participants declined following the program.

The test statistic for the Control group is the t-ratio for B_3 which equals -1.84 and is significant at the .05 level of significance.

The test statistic for the Test Group is B_2-B_1 which equals -1.356/.446=-3.04. This t-ratio is significant at the .001 level. The t-ratio is calculated on the basis that D1 and D2 are not independently distributed.

The decline in water use for the Test Group following the program was approximately 1,356 gallons of water per month which is relatively higher than the estimated 1,085 gallons for the Control Group.

The hypotheses that water use declined for both groups following the program can be accepted.

(3) The final test relates to the hypothesis that the decline in water use for the Test Group was equal to the decline in water use for the Control Group. Again, two variants of this test are conducted as in the analysis of overall water use for these groups.

(a) $B_2 = B_3$ In the case where the covariance between B_2 and B_3 is assumed to be zero, the t-ratio is calculated as -.3764/.5261 = -.7154 which is insignificant.

In the case where the covariance between B_2 and B_3 is included, the t-ratio is calculated as -.3764/.4518 = -.8331 which is also insignificant. It may be concluded on the basis of this analysis that the decline in water use for the Test Group following the program from the pre-test water use by the Control Group was not significantly different than the decline for the Control Group from its pre-test water use.

(b) Since B_1 was not equal to zero, the final test is that the decline in water use for the Test Group from its pre-test level was not significantly different than the decline in use for the Control Group from its respective pre-program level. This is expressed as $B_1 = B_2 - B_3$.

Assuming that B_1, B_2, and B_3 are independently distributed, the t-ratio is calculated as -.271/.6674 = -.406 which is insignificant.

The above analysis indicates that the estimated decline in water use for the Test Group was of slightly greater magnitude than the estimated decline for the Control Group, taking into account outdoor water use for irrigation. The null hypothesis that the decline in water use for the two groups were not significantly different, however, cannot be rejected.

The similar pattern of water use for both the Test and Control Groups in the pre-program and post-program periods warrants concern for the implementation of retrofit programs without a planned evaluation component as an integral part of the program. Certainly water use for these single-family households declined significantly from the pre- to the post-program period and a significant portion, but not all, of that decline may be attributed to the rainfall pattern and to some degree to the frequent increase in the rate structure by the Orlando Utilities Commission.

That there was no significant difference in the decline for these two groups and no measured program effects which may be attributed to the Water Conservation Program indicates the need for large-scale retrofit programs to incorporate a well-designed evaluation component from the outset.

The limitations of the methodology used in this retrospective evaluation (specifically the inability to obtain necessary cross-sectional data in order to test for Treatment and Control Group equivalency on any characteristic other than pre-program water use) have been clearly outlined. To conclude that there were no program effects given these methodological limitations would be erroneous. The results of the analysis, however, do give rise to some questions and concerns in this area. These concerns are reinforced by the similar overall water use pattern displayed by all single-family residences within the Orlando city limits during the time period of analysis. (See Figure 1 on page 45 and Table 2 on page 46.)

One final test for program effects is made analysing the water use data for multi-family dwellings that were retrofitted during the citywide phase of the Water Conservation Program.

Multifamily Water Use

A total of 120 multifamily complexes representing nearly 20,000 dwelling units that received and installed the water saving plumbing fixtures during the citywide program were included in the analysis of the pre- and post-program water use. Given the variation in multifamily units in terms of age of plumbing fixtures, number of units per complex, turnover in residents, etc., the control group methodology was precluded. Identifying true control complexes that did not install the devices simply was not possible.

The analysis, therefore, took the form of a direct comparison of pre-program and post-program water use for the multi-family buildings that installed the devices.

Again, a concern for the turnover in residents and limited control for the size of household for any given unit must be considered in the interpretation of statistical results. A comparison is made between the water use for all multifamily buildings that were retrofitted during the citywide program (Figure 2 on page 47) to three Senior Citizen Buildings that installed the devices during the pilot phase of the program. These buildings were selected for comparison since they do provide a limited control for the number of persons per dwelling unit in their occupancy requirements.

Statistical Model

The model that was formulated for the multifamily sector differed from that of the single-family. There was no control group and the price variable is eliminated for the reasons identified on page 32.

Since outdoor irrigation requirements for each building and/ or complex are unknown, rainfall data using the average of three rainfall stations in the Orlando area are incorporated as a measurement for the change in outdoor water use. Water use for irrigation requirements in the multi-family sector, however, are expected to be relatively insignificant. A statistical model in the form of

$$Wu_{ij} = A + B_1 D1_{ij} + + B_2 Ra_{ij} e_{ij}$$

WU_{ij} - is water use for the ith apartment building (complex) in the jth month

A - is the intercept term

$D1_{ij}$ is a dummy variable which is equal to 1 if the time period is after the program, 0 if before the program

Ra_j is the average rainfall in the jth month based on recorded rainfall data for District stations MRF 3, MRF 4, and MRF 6100 for the Orlando area.

Regression Results

The estimated equation is:

$WU_{ij} = 271.81 + 26.40D1 - .00085Ra$

s.e.	(28.24)	(39.94)	*
(t)	(9.62)	(.661)	*

$R^2 = .0387$

$F = 19.14$

* The tolerance level for rainfall was less than .001, the SPSS default level for stepwise regression and was insignificant.

The coefficient of determination (R^2) equals .0387. Again, it is not unusual in an analysis utilizing pooled time series data with cross sectional data to derive a low R^2. The null hypothesis that water use in the pre-program period for the retrofitted buildings did not differ significantly from water use in the post-program period is the issue under analysis.

The test for that hypothesis may be taken directly from the computer output as shown above. The t-ratio for B_1 is .661 which insignificant. The partial regression coefficient is positive which indicates that there was an actual increase in water use from the pre-program to the post-program period. The null hypothesis cannot be rejected and it is concluded that water use for this group, (although slightly higher after installation of the devices) in the pre- and post-program period was not significantly different.

As in the case with single-family dwellings, there appear to be no effects on water use which are attributable to the Water Conservation Program. The limitations of the methodology used in the multi-family analysis need to be reiterated, particularly since no control group was used for comparison.

The three senior citizen buildings referred to that were retrofitted during the pilot phase of the Program and which provide limited control for size of household per dwelling unit are the Orlando Central Towers, Magnolia Towers and the Kinneret II. Water use data for these individual accounts show the same pattern as for the total multi-family sector analysed above. Water use for Orlando Central Towers and Magnolia Towers include both indoor and outdoor water use. Water use for the Kinneret II is for indoor water use only. (Combined accounts only were available from the Orlando Utilities Commission for Orlando Central Towers and Magnolia Towers while the irrigation account was separated out from indoor water use for Kinneret II.) The water use pattern is presented in the table below and compared to the average water use for the 120 multi-family complexes used in the foregoing analysis.

TABLE 1

FISCAL YEAR	ORLANDO CENTRAL TOWERS		MAGNOLIA TOWERS		KINNERET II		120 MULTIFAMILY COMPLEXES RETRO-FITTED DURING CITYWIDE PROGRAM	
	WU	%CH	WU	%CH	WU	%CH	AVG WU	%CH
81	612	--	534	--	286	--	300	--
82	555	-9.3	480	-10.1	289	+1.0	300	0.0
84	436	-21.4	440	-8.3	325	+12.5	309	+2.8
85	458	+5.0	477	+8.4	303	-6.8	312	+1.0

Source: Orlando Utilities Commission

Note: The three buildings listed in the above table had retrofit devices delivered at the end of June 1982. The devices were actually installed between the end of June and beginning of September by the maintenance staff of the respective buildings. The pre-program period for these three buildings may contain one month to two months of data after the installation of the devices. (The lack of a consistent pattern in water use after the installation of the devices, however, underscores the conclusion that there are no apparent, longer-term program effects. This is reinforced in particular by the indoor water use data for the Kinneret II.)

Water use in the post-program period versus the pre-program period for these three apartment complexes shows no distinct pattern of decline which could be attributed to program effects. In fact, indoor water use for the Kinneret II actually increased in the post-program period.

The limitations of the methodology due to the retrospective nature of the evaluation are clear. Notwithstanding those limitations, there is no clear pattern of reduced water use in the post-program period either for multi-family or single-family residences that were retrofitted during the Orlando Water Conservation Program.

The results of the analyses strongly indicate the need for a well designed evaluation as an integral component of a retrofit program. The limitations of a retrospective evaluation as outlined within this report may serve as a partial basis from which to establish guidelines for systematic evaluation of future retrofit efforts.

FIGURE 1

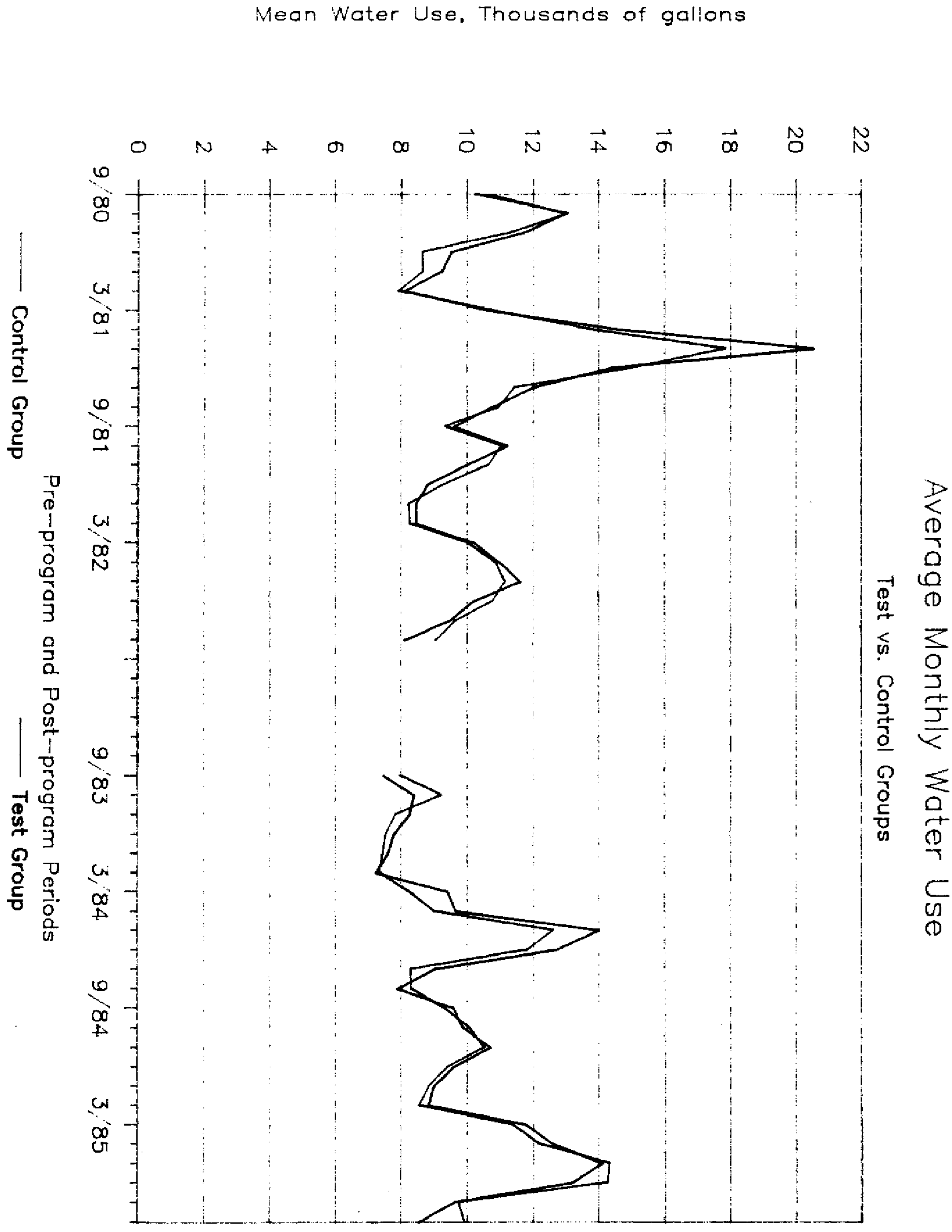

Average Monthly Water Use
Test vs. Control Groups
Mean Water Use, Thousands of gallons
0
2
4
6
8
10
12
14
16
18
20
22
9/80
3/81
9/81
3/82
9/83
3/84
9/84
3/85
Pre-program and Post-program Periods
Control Group
Test Group

TABLE 2

CITY OF ORLANDO

Average Monthly Water Use
Single-Family Residential

Fiscal Year	All Single-Family Dwellings with Billing Code 050 (gallons)	Sample of 396 Retrofitted Single-Family Dwellings with Billing Code 050 (gallons)	Sample of 370 Control Single-Family Dwellings with Billing Code 050 (gallons)
1981	11,916	12,090	11,550
1982	9,916	9,800	9,810
1984	9,333	9,270	8,880
1985	9,916	10,500	10,670

Source: Orlando Utilities Commission

FIGURE 2

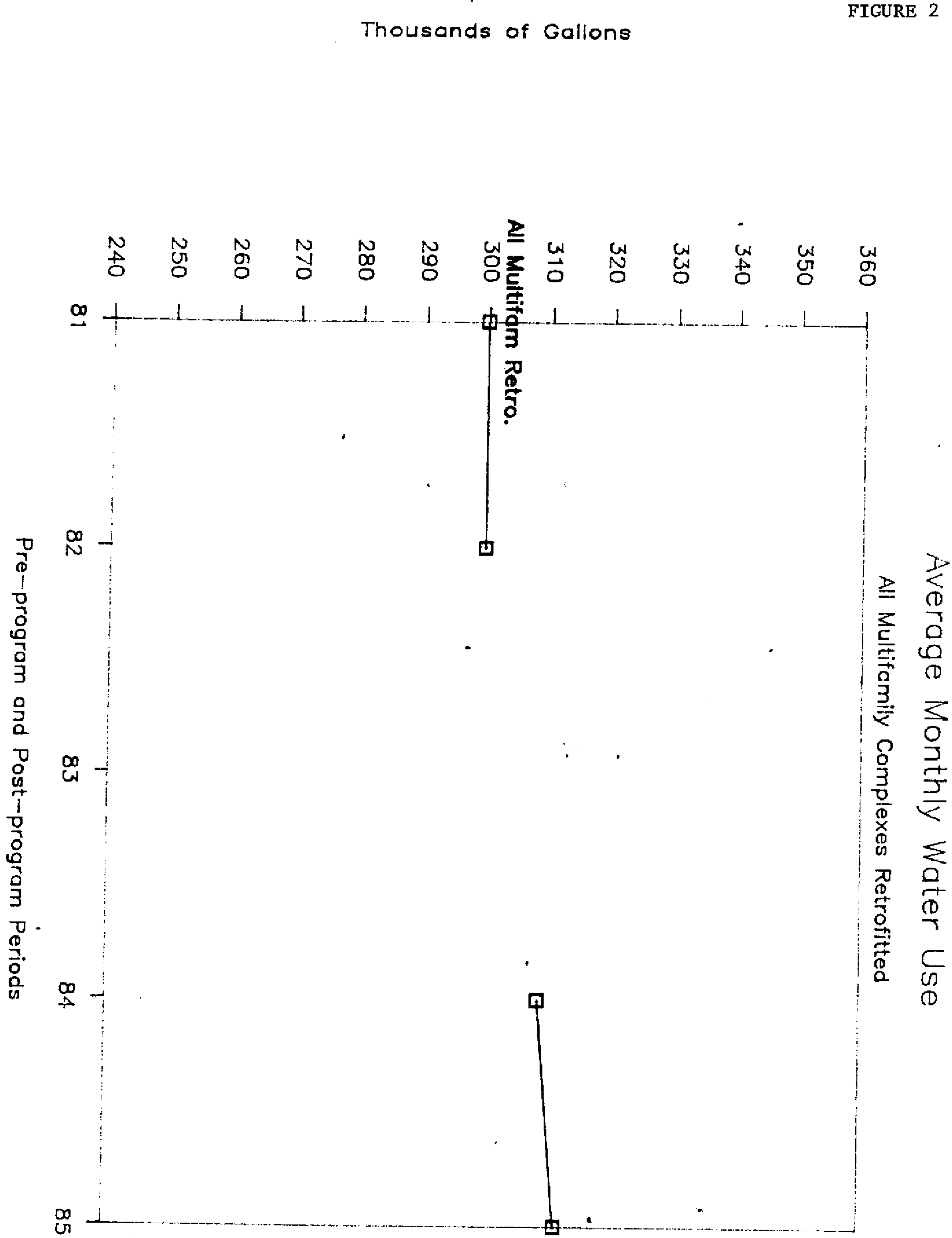

Average Monthly Water Use
All Multifamily Complexes Retrofitted
Thousands of Gallons
360
350
340
330
320
310
300
290
280
270
260
250
240
All Multifam Retro.
81
82
83
84
85
Pre-program and Post-program Periods

TABLE 3

ORLANDO AREA

TURFGRASS IRRIGATION REQUIREMENTS
(inches of water)

Yr	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
80	--	--	--	--	--	--	--	--	2.25	2.84	0	1.69
81	1.95	.98	2.46	4.16	4.52	0	2.01	3.39	2.66	2.72	1.85	1.42
82	1.71	2.25	1.10	2.52	4.50	2.31	2.47	2.90	--	--	--	--
83	--	--	--	--	--	--	--	--	2.24	2.55	2.24	0
84	1.32	1.29	3.00	2.46	3.49	2.74	.19	3.22	.29	3.22	2.39	1.88
85	1.81	2.11	1.69	3.61	3.81	1.96	1.76	2.23	--	--	--	--

Note: Dashed lines indicate months that were not used in analysis.

Data represents an estimate of lawn irrigation requirements. Research publications from IFAS were utilized to determine evapotranspiration for turfgrass. Historic rainfall data for the period under analysis were used as input. The SFWMD's modified Blaney-Criddle program was run using historic rainfall and evapotranspiration from the IFAS publication. Output from this program was utilized to determine the ratio of average effective rainfall to average, measured rainfall (using the average of three rainfall stations in the Orlando area) for each month. This factor was then applied to estimate actual effective rainfall for each month. Evapotranspiration minus effective rainfall was used as a measure of irrigation water requirements.

TABLE 4

ORLANDO RAINFALL

Average of 3 Rainfall Stations
MRF 3,4, 6079
(inches)

Yr	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1980	--	--	--	--	--	--	--	--	3.65	1.28	5.67	.53
1981	.13	3.29	1.84	.10	1.34	9.52	6.11	3.03	2.72	1.55	1.31	1.12
1982	.66	.58	2.60	3.34	1.31	4.27	5.09	4.10	3.73	.82	.50	.87
1983	1.46	8.44	5.18	3.72	.90	5.23	2.75	5.65	3.68	1.92	.49	7.00
1984	1.50	2.62	.72	3.47	3.34	3.32	10.10	3.39	8.11	2.28	2.21	.10
1985	.43	.87	3.42	1.18	2.73	5.03	6.66	5.53	--	--	--	--

Note: Dashed line represent months not used in analysis.

EVALUATION OF PUBLIC ACCEPTANCE OF WATER SAVING PLUMBING FIXTURES

A secondary goal of the program was a high degree of public acceptance of the water saving plumbing fixtures both in the short and long-term. The short-term is measured simply by the percentage of existing residences that agreed to have the devices installed. The overall level of acceptance was 66% of the total number of existing single- and multi-family dwellings within the Program boundaries. (See breakout of installation data in Introduction.)

The long-term acceptance of water saving plumbing fixtures may be measured by the percentage of those fixtures still in place after a significant period of time had passed since the completion of the citywide program in the late summer of 1982.

The Water Use Planning and Management Division of the South Florida Water Management District designed and conducted a post-program telephone survey in early 1986 of the recipients of the devices. The survey was conducted nearly two and one-half years after their installation. The survey methodology and instrument were designed in February and testing of the instrument occured in late February. After some revision, some 162 surveys were conducted in March 1986.

The survey was designed to measure the ongoing acceptance of the devices by program participants (by determining the percentage of each type of device which was still in place) as well as gain information on the participants' perception of the effectiveness of the program and the water saving fixtures.

Since the thrust of the Orlando Water Conservation Program was on the installation of hardware which would achieve water conservation without necessitating a conscious behavioral change on the part of consumers, the orientation of the survey was basically to determine their attitudes toward the devices themselves. It also incorporated an effort to collect limited information on general water use practices and changes in practices as a result of the program.

Additionally, data were collected on household size in 1980 and 1985 for those residing at their respective address since September 1980.

Survey Design

A systematic random sample was selected from the 17,000 program participants who resided in single-family dwellings. One hundred and sixty-two households were actually interviewed--a final sample size of nearly one percent. Multi-family residents were not included since the installation of the devices was actually performed by the staff of the building itself with the Water Conservation staff providing follow up to ensure that the devices had been installed. In effect, the multi-family residents may not have been as well informed since they had no direct contact with the Program staff and may have in many instances not been fully aware of the program or even the actual installation of the devices.

The survey instrument contained 14 questions which were closed ended and interview time per resident averaged 15 minutes. Only two possible responses could be given to many of the questions. A sample size of 1% of a population of 17,000 yields a confidence interval of + or - 3.5% at a confidence level of 95% based on $p = .5$.

The questionnaire on pages 58-59 contained several questions designed to measure the number of devices still in place and the reason for removing those devices which were no longer in place. The remaining questions sought to assess attitudes and perceptions towards the Program, namely the retrofit devices themselves. Three questions related to household size and length of residency.

The staff of the South Florida Water Management District actually conducted the interviews. It should be noted that the staff identified themselves accordingly which may have biased some of the answers provided by the respondents. The consensus of the staff that conducted the interviews, however, was that the respondents for the most part were not guarded in their answers and that any bias that may have resulted was not significant enough to warrant dismissal of the results as invalid.

Survey Results

It was determined that not all of the households participating in the Orlando Water Conservation Program received all of the fixtures as identified in the Section on Program Inputs. Additionally, a number of households either did not know or remember exactly which fixtures were installed. This was particularly true for the faucet aerators since they were less obtrusive than the other fixtures used in the Program.

A specific measure of public acceptance of the fixtures was the number of fixture removed in relation to the total number installed.

TABLE 5

Percentage of Devices Still In Place
March 1986

Device	#Installed	#Still in Place	% Still in Place
Showerhead	109	98	89.9%
Toilet Dam	151	121	80.1
Aerator	109	103	94.5

The foregoing table shows that a very high percentage of all the devices were still in place some two and one half years after installation. These percentages are a clear indication of the high degree of long-term public acceptance of the devices. (These percentages, however, are not an indication of the actual effectiveness of the devices.)

Notwithstanding the low percentage of devices removed by participants, the reasons for removal indicate that performance was the primary consideration. The survey measures only the perception of performance problems by participants and does not determine if performance problems were actual malfunctions of the devices or a dissatisfaction with the designed performance characteristics of the fixtures.

TABLE 6

Reasons Given For Removal of Devices

Device	Num. Removed	Percent Removed Due to Performance Problems	Percent Removed Due to Appearance Problems
Showerhead	11	82%	18%
Toilet Dam	30	87%	13
Aerator	6	50	50

Toilet dams were the device that resulted in the highest perception of performance difficulties. Aerators, on the other hand, posed problems with both appearance and perception of performance.

Since the Program did use plumbing fixtures that are subject to failure, the number of perceived performance problems reported did not appear to be excessive. The responses to this question, however, do reinforce the importance of quality assurance in the design of retrofit conservation programs.

When the devices installed during the Program needed to be replaced, few survey participants reported replacing them with other conservation devices. Eleven households reported removing the showerhead which had been installed during the Program. Of these eleven, only one participant reported installing another water saving showerhead. Similarly, out of 27 households that reported removal and replacement of the toilet dam, only one household replaced it with another water saving fixture. None of the households that removed the aerators reported replacing them with an alternative conservation device.

The responses to the question of whether the participants noticed a reduction in their water and sewer bill need to be interpreted within the context of the numerous water rate increases which were implemented over this period of time. Three increases were implemented from May 1983 through February 1985. Only 21% of the surveyed participants perceived a reduction in their water and sewer bill after the installation of the devices. Again, the high percentage that experienced no reduction may be attributable to rate increases or little to no change in water use. Rate increases alone may have offset any decline in water use that did occur in the post-program period.

While the implications of the responses to the question of lower water and sewer bills are unclear and caution needs to be exercised, the interesting point to be made is that 86% of respondents expressed satisfaction with the Program. Expression of satisfaction in many cases, however, represented the absence of any problems with the conservation program and, more specifically, the water saving fixtures.

As importantly, nearly 80 percent of the respondents indicated that they would recommend the Program to friends in other Florida cities. (It should be reemphasized that some bias may have resulted from the survey being conducted by the staff of the SFWMD.)

Relatively few of the participants reported changing their water use practices as a result of the water conservation program. This result is particularly important in light of the results of the water use analysis for single-family residents.

Approximately 30 percent of the participants reported change in their water use habits. Of that 30 percent:

76 percent reported that family members were taking shorter showers

85 percent reported turning off the water while brushing their teeth

52 percent reported no longer using the toilet for as a receptacle for paper trash

69 percent reported running the dishwasher/washing machine only when full

The results of this question are significant since the Orlando Water Conservation Program did not aggressively attempt to change conscious water use practices and relied on a passive approach to reduction in water use through water saving fixtures.

Summary

Several useful observations may be drawn from the survey, notwithstanding its limitations (i.e., limited sample size, potential bias of responses to the staff of the SFWMD, length of time elapsed from installation of the devices to the telephone survey and resultant memory lapses).

1. Most of the devices that were installed were still in place which indicates a high degree of acceptance of the water saving fixtures.
2. Few of the participants felt that the Program had reduced their water bills yet expressed support for the Water Conservation Program. This finding tends to support the notion of a relatively important water conservation ethic among program participants.
3. There was a significant relationship between dissatisfaction of the Program and perceived performance problems with the retrofit devices.
4. The change in water use habits may be interpreted in two contexts. Since only 30 percent of the households surveyed indicated any change in habits, any savings in water use attributable to the Program would for the most part result from the physical devices themselves. However, since the Orlando Program did not allocate many resources to attempt to change conscious water use habit, the 30 percent reporting a change in habits after the Program is significant. Again, the potential for biased answers needs to be considered.

The overall thrust of the survey and this evaluation component was to evaluate public acceptance of the Program and, specifically, the water saving fixtures selected and installed. It may be concluded from these survey results that public acceptance was high in the long-term and that selection of devices based on appropriate performance and appearance criteria will minimize the removal of these fixtures once installed--a condition which is necessary for program success.

EXHIBIT V

ORLANDO CONSERVATION SURVEY
SURVEY INSTRUMENT - February 1986

Introduction (Be prepared to describe SFWMD and conservation program)

Verification of Name and Address

(1) Which of the following conservation fixtures are still in place?

	Still in Place	Not Installed	Don't Know
Showerhead(s)	______	______	______
Toilet dam(s)	______	______	______
Faucet aerators	______	______	______

(* If none checked, ask questions 2 and 3)

(2) Why were the fixtures removed?

	Performance	Appearance
Showerhead(s)	______	______
Toilet dam(s)	______	______
Faucet aerator(s)	______	______

(3) What were the fixtures replaced with?

	Original	Other Conservation	Other	Nothing
Showerhead(s)	______	______	______	______
Toilet dam(s)	______	______	______	______
Faucet aerator(s)	______	______	______	______

(4) Did you notice a reduction in your water and sewer bill? Y____N____

(5) Were you satisfied with the program? Y_____N____

(6) Would you recommend to friends who live in other cities in Florida that they support and participate in this type of program? Y_____N ____

(7) How long have you lived at your present address? ___________
(*If greater than 5 1/2 years, ask questions 8 and 9)

(8) How many people lived in your home in 1980? ___________

(9) How many people presently live in your home?________

(10) Did the Orlando Conservation Program change your indoor water use practices? Y______N ______

If yes, which of the following apply:

	Yes	No	Already Did
(a) Take shorter showers	________	________	________
(b) Turn water off while brushing teeth, etc.	________	________	________
(c) Not use toilet for paper trash	________	________	________
(d) Run dishwasher and washing machine only when full	________	________	________

"The Water Management District is also concerned with outdoor water use and I would like to ask you just a couple of questions about your outdoor water use"

(11) Do you use city water or well water? C _____ W _____

(12) Do you use a hose with an attached sprinkler, or do you have a sprinkler system? Hose _______ System ______

If #12 is "system", ask #13

(13) Is your system on a timer or is it manual? Timer______Manual______

(14) Which of the following statements best characterizes your outdoor water use:

"I water my lawn only when it's been dry and my lawn needs watering." ________

"I water my lawn on a regular basis" _______

CONCLUSIONS

The lack of measured statistically significant differences in water use during the post-retrofit period for both the single-family and multi-family evaluations must be interpreted conservatively due to limitations of methodology employed. The findings, however, do raise a concern regarding real effects and reinforce the need for further research and evaluation of retrofit with a focus on smaller demonstration projects to determine device effectiveness once installed in its final setting and subject to consumer behavioral patterns. It is this setting, rather than a laboratory environment, that will provide the final test for effectiveness of this approach to water conservation.

While the lack of cross sectional data employed in the Orlando evaluation will certainly raise questions regarding interpretation of the results, the basic soundness of the methodology employed combined with the trend in citywide water use as presented on page 45, provides a basis of concern to the South Florida Water Management District. This basis of concern is neither a final declaration of retrofit device ineffectiveness nor a recommendation of abandonment of such programs or projects.

It is rather a carefully studied observation suggesting the need to proceed systematically with smaller scale projects that are evaluated by designs based on experimental principles wherever and whenever possible. The recognition of this need based on observations of the Orlando experience is consistent with the trend towards more intense program evaluation that has been evolving during the 1980's throughout the country.

This recognition has resulted in the undertaking of a retrofit demonstration/evaluation project by the South Florida Water Management District which has targeted a minimum of 1,400 individually metered residences for device installation. While a report on the methodology to be employed for that project is beyond the scope of this publication, principles of experimental design will be emphasized to the greatest degree possible in a social, quasi-experimental setting.

It is on the basis of the evolving pool of knowledge about retrofit as well as the results of the demonstration project that the South Florida Water Management District will base its conclusions and recommendations regarding this approach to water conservation.

APPENDIX A

City of Orlando Evaluation of Retrofit Program

The following evaluation was taken from a Draft Report prepared by the Orlando Retrofit program staff in October 1983. Since a formal, final program report has not been published to date by Orlando, the draft (which represents the latest version available) is used to reflect the evaluation performed by the City itself of the retrofit program. Since the methodology employed by Orlando has already been critiqued in the body of this report, no further observations are made here. The appended pages represent only the evaluation section of the draft report dated October 1983.

EVALUATION BY ORLANDO RETROFIT PROGRAM STAFF

According to Orlando Utilities Commission, there are approximately 50,000 residential units in Orlando, 27,000 single-family units (homes) and 23,000 multi-family units (apartments). The water conservation program has installed 15,098 single-family units, and delivered fixtures to apartment complexes representing 17,504 units. A comparative illustration along with percentages is listed below.

	Number installed and/or delivered	Number of units	Percentage
Single-family	15,098	27,000	56%
Multi-family	17,812	23,000	77%
Total Residential	32,910	50,000	66%

Although Orlando's water conservation program was conceived during a dry year, additional sewage treatment capacity was the main objective of the program. This made total acceptance from the public difficult when water supplies are not seriously threatened with shortages. It also became apparent that the general public is apprehensive of "free" programs, although since the City of Orlando conducted the program credibility was not a problem. Extensive media coverage, word of mouth, and the potential for savings provided the community interest necessary for the success of the program. A public acceptance of approximately seventy percent (70%) (based on a comparative of installations and not interested responses) was consistent throughout the pilot and city wide phases of the water conservation program. It must also be noted that the purchase of quality water conservation plumbing fixtures substantially aided in the acceptance of the program.

The water conservation plumbing fixtures chosen for the program received wide acceptance from the residents of Orlando. Since the showerheads are the most noticeable they received the most attention and scrutiny. The plastic conventional appearing showerheads were preferred by most residents over the smaller brass showerheads. The reasons most commonly given by residents for this preference, were the appearance and the spray pattern. Residents were often curious of the toilet tank dam, but since they are placed out of sight inside the toilet tank they are easily forgotten. After installing the toilet tank dam, the installer would check the flush to insure it was adequate. The inline restrictors were occasionally installed for owners of massage type or hand held shower units, and the aerators installed received modest attention. In conclusion, it is important to note that quality fixtures were not only important for public acceptance, but to insure the fixtures would remain in place.

To determine the effectiveness of the water conservation plumbing fixtures, studies were conducted on multi-family units (apartments) and single-family units (residential homes). The reductions in water usage observed were statistically significant in that average water consumption declined in a predictable pattern. All findings were predicated on consumption data from the Orlando Utilities Commission computer. The findings of the multi-family water usage determinations were examined first, followed by the single-family water usage study.

TABLE A-1

Complex #1

Magnolia Towers
100 E. Anderson St.

Date	Consumption	Note
2/82	548,000	
3/82	606,000	Average of 6 months without water saving fixtures 466,000
4/82	442,000	
5/83	439,000	
6/82	417,000	
7/82 Fixtures installed	346,000	Average of 6 months with water saving fixtures 378,000
8/82	361,000	
9/82	342,000	
10/82	382,000	
11/82	393,000	Savings as a function of a 12 month average - 19%
12/82	390,000	
1/83	396,000	
2/83	367,000	

TABLE A-2

Complex #2

Kinneret II
530 Margaret Court

Date	Consumption	Note
2/82	300,000	
3/82	311,000	Average of 6 months without water saving fixtures 300,000
4/82	309,000	
5/82	303,000	
6/82	305,000	
7/82 Fixtures installed	270,000	Average of 6 months with water saving fixtures 263,000
8/82	252,000	
9/82	257,000	
10/82	253,000	
11/82	262,000	Savings as a function of a 12 month average - 12%
12/82	262,000	
1/83	274,000	
2/83	268,000	

TABLE A-3

Complex #3

Orlando Central Towers
330 E. Jackson St.

Date	Consumption	Note
2/82	675,000	
3/82	636,000	Average of 6 months without water saving fixtures 533,000
4/82	570,000	
5/82	474,000	
6/82	423,000	
7/82 Fixtures Installed	420,000	Average of 6 months with water saving fixtures 421,000
8/82	423,000	
9/82	428,000	
10/82	416,000	
11/82	403,000	Savings as a function of a 12 month average - 21%
12/82	416,000	
1/83	419,000	
2/83	444,000	

The following is the statistical savings from 411 retrofitted single family homes. 500 retrofitted homes were chosen for the single-family water usage reduction study, but only 411 were retrievable from Orlando Utilities Commission computer memory. The process for selecting test homes were as follows: homes installed before November 1982, homes that had all fixtures installed, and those that represented the best demographic breakdown of Orlando. Each home was monitored for 6 months of data, alike months were compared (November-April). Totals for all homes are presented as follows:

TABLE A-4

Nov 81	4,693	
Nov 82	3,472	26% savings
Dec 81	4,333	
Dec 82	3,673	15% savings
Jan 82	3,979	
Jan 83	3,781	5% savings
Feb 82	3,664	
Feb 83	3,638	.7% savings
Mar 82	4,237	
Mar 83	3,182	25% savings
Apr 82	5,110	
Apr 83	3,338	35% savings

Average

6 months without devices 4,336

6 months with devices 3,514

19% savings

(Note from the SFWMD: Rainfall in the Orlando Area average 1.60 inches/month in the Nov. 81-April 82 period. It averaged 3.36 inches/month, nearly 3 times as high, in the Nov. 82-April 83 period).

Note that the January and February savings results are not consistent with the other periods. Examining individual units of data, it was found that one home unfavorably skewed the figures within the February period, removing this home from consideration and recalculating an average for the remaining four months reveals the following:

4 months without devices 4,593

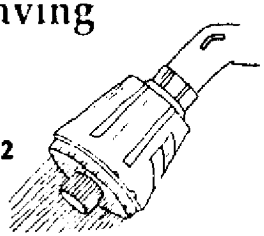
4 months with devices 3,416

26% savings

It was known that water saving fixtures used less water, however it was not known that these fixtures would prove statistically significant when installed in a multitude of homes. It can be concluded that the water conservation plumbing fixtures have statistically proven to reduce water usage in both multi and single family homes.

Although a comprehensive determination of the water usage and the wastewater generation reductions created by the program was desired, there are two problems in making this determination. Since Orlando is in a constant state of growth, new water and sewer hookups are constantly being added, and therefore increases in usage and discharges occur. Groundwater infiltration that is dependent on rainfall levels affects the volume of wastewater a treatment plant receives. With the variables considered, calculating an accurate overall water usage or wastewater generation reduction percentage is virtually impossible.

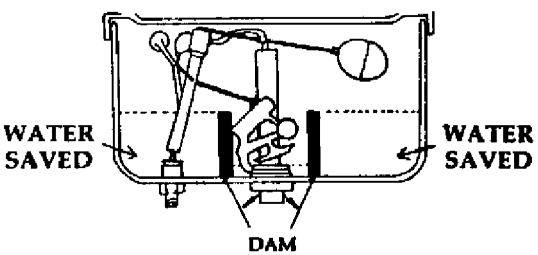
STEP 1 Install Water Saving Fixtures



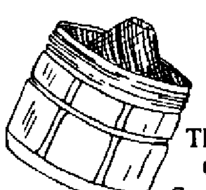
CONVENTIONAL SHOWERS USE 6 TO 12 GALLONS OF WATER PER MINUTE.

Water conserving shower heads use only 2-3 gallons of water per minute. Low flow shower heads look similar to conventional heads, although their internal designs are different. The newly designed shower heads provide invigorating showers with variety in spray.

TOILETS CONSUME UP TO 45% OF YOUR INDOOR WATER



The typical toilet uses approximately 5 to 7 gallons of water for a single flush. The devices provided by the City of Orlando will save up to 1.5 gallons per use; while still providing sufficient water for an adequate flush. Dams will be installed to physically hold back water in toilets. It will work similar to reservoirs.



AERATORS LIMIT FLOW FROM INDOOR FAUCETS

The aerator installed by the City will restrict the water flow to a greater degree than conventional aerators; while maintaining the pressure and appearance of previous flow levels.

STEP 4 Leaks Not Only Create Water Loss But Dollar Loss

Leaks in your toilet, faucets and showers waste thousands of gallons of water a month, costing you hundreds of dollars a year. A leaky toilet, for instance, can waste approximately 3,000 gallons a month and 36,000 gallons a year of precious water, not to mention the significant money.

On a smaller scale, a drippy kitchen faucet may waste up to 1,000 gallons of water a month, which converts to 12,000 gallons of wasted water per year.

Leaks inside and outside of your home are costing you hundreds of dollars, so it's in your best interest to stop them. The first step in fixing leaks is locating them. Below, you can find a list of clues which can alert you to existing and future leaks. Take a few minutes of time and check for leaks. In the long run, it will save you dollars.

- Leaks from most faucets consist of obvious drips or water that runs after the faucet has been firmly turned off. Kitchen, bathroom and outdoor faucets can be visually checked with no problems.
- Water dripping or running from the showerhead when the shower is turned firmly off, is usually caused by bad washers or seats which need replacing. Also, check for leaks from the tub faucet when a tub shower is on. This leak will defeat the purpose of a lowflow showerhead because the water you save with the lowflow shower is lost from the tub faucet.
- Leaks in toilets are harder to find and are normally caused either by a bad flapper valve, flapper valves seat, or a bad ballcock valve. Both cause a constant flow of water into the overflow tube.
  Toilet leaks can be located by listening – looking – testing.

  Listening – a faint hissing or running water noise from your toilet when it is not in use; alerts you to a possible leak.

  Looking – take the tank top off and look inside. Located in the center of the tank is either a hard plastic or copper tube. If water is running over it and will not stop, you possibly have a bad ballcock valve, you should consult your plumber.

  Testing – after taking the tank top off, if everything appears proper, drop food coloring or a dye tablet in the tank. *DO NOT FLUSH.* Leave for 15-20 minutes, if color appears in the toilet bowl you do have a leak.

NOTE: Problems with plumbing fixtures may be due to old age, corrosion, etc. Replacement or repair parts can be purchased at a local hardware store, or consult your plumber.

Save Water Orlando

CITY OF ORLANDO
PUBLIC WORKS DEPARTMENT