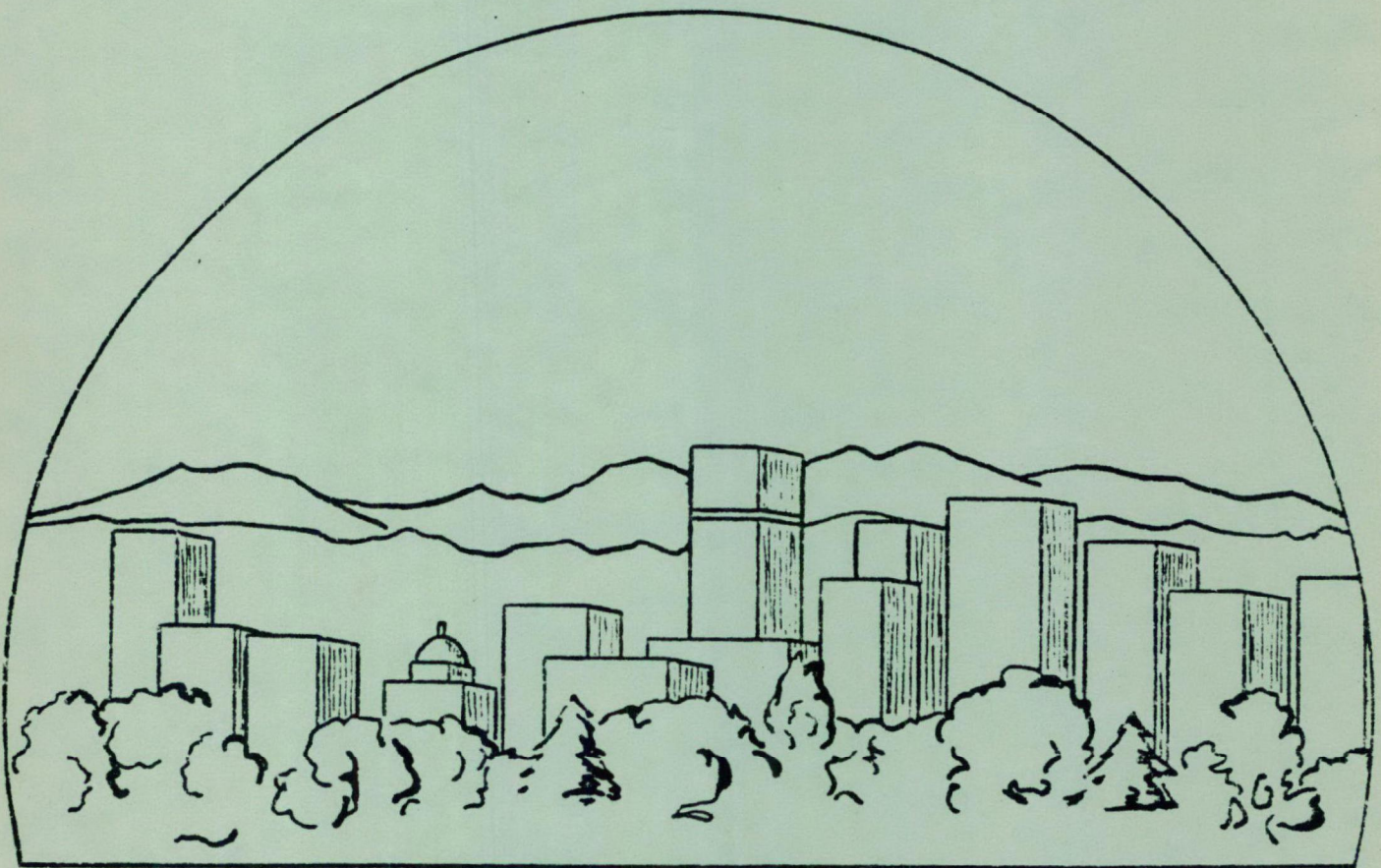


Evaluation of Denver's Water Conservation Program



EVALUATION OF DENVER'S
WATER CONSERVATION PROGRAM

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December 1982

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As shown by Table ES-1, actual water use for Denver's service area in 1981, based on the correct data, was 226 GCD. This indicates that the Denver Water Board failed to meet the goals established in the Decree. However, these figures fail to take into account dominant factors that directly influence water use - precipitation and temperature. The use of a fixed GCD goal is misleading in that it may give the appearance of conservation during wet years and of lack of conservation during dry years. What should be measured is conservation, not rainfall.

A realistic analysis of water use and the setting of future goals should take into account the effects of temperature and precipitation. Therefore, the Regional Administrator recommends that the concept of a normalized demand, i.e., demand calculated through analysis of historical weather and water use data be used in the future to measure the progress of the Denver Water Board in meeting its water conservation goals. Based on 20 years of historical weather data and using regression analysis, the calculated (normalized) demand vs. the actual usage is shown in Table ES-2:

Table ES-2
Actual Usage Vs. Calculated Water Use
(GCD)

<u>Year</u>	<u>Actual Usage</u>	<u>Calculated Demand</u>	<u>% Change</u>
1978	248	251	-1%
1979	222	225	-1%
1980	243	253	-4%
1981	226	245	-8%
1983	Recommended Goal		-11%
1988	Recommended Goal		-17%

The calculated usage is the water use that might have occurred given only the actual population, temperature, and precipitation. In other words, factors such as conservation efforts are not considered. Thus, while the goal stated in the Decree (even using the more accurately calculated goal of 211 GCD) was not met, the percentage reduction, based on the difference between actual usage and normally anticipated usage (-8%), at least realized the goals of the Decree.

Water usage in 1981 was 8% below what would have been expected given actual weather conditions. Therefore, the Regional Administrator recommends that the January 1, 1984 goal be an 11% reduction from the calculated demand (using the normalized demand analysis) given the weather factors during calendar year 1983. This reflects an additional 3% savings over the 8% reduction achieved in 1981.

The Regional Administrator further recommends that the goal for January 1, 1989 be a reduction in actual usage of 17% from the calculated demand for calendar year 1988.

The Regional Administrator further finds and determines that there is no evidence of bad faith on the part of the Denver Water Board in attempting to meet the water conservation goals established in the "Foothills Consent Decree."

EXECUTIVE SUMMARY

The controversy surrounding the construction of the Foothills Water Project was settled by the 1979 "Foothills Consent Decree." That Decree mandated the following responsibilities to the Regional Administrator of the Environmental Protection Agency, Region VIII:

- 1) Monitor the water conservation program of the Denver Water Board;
- 2) Evaluate Denver's progress and good faith efforts to attain the water conservation goals set forth in the decree; and
- 3) Recommend conservation goals for 1984 and 1989.

Water conservation goals established by the Decree were based on the best information available at the time, but subsequent findings show that the base average used to calculate the goals was inaccurate. The average water use for the base period (1968-1977) was computed to be 209 gallons per capita per day (GCD). Goals of a 3% reduction by 1982, and a 5% reduction by 1984 were then established. The Denver Water Board was thus expected to meet a 203 GCD limit by January 1, 1982, and a 199 GCD limit by January 1, 1984.

The original base (209 GCD) was found to be inaccurate because the results of 1980 census showed that the population served had been over-estimated. Additionally, it was discovered that not all water sales had been accounted for in the water consumption data. Table ES-1 indicates the original figures and the revised figures using the correct data. Based on this information, the actual water usage for the base period is 218 GCD and the goals become 211 GCD for January 1, 1982 and 207 GCD for January 1, 1984, (3% and 5% reductions as specified in the Consent Decree).

Table ES-1
Denver Water Use
(GCD)

<u>Years(s)</u>	<u>Original Consent Decree</u>	<u>Corrected Using 1980 Population</u>	<u>Corrected for Water Sold to Aurora & Others</u>	<u>Adjusted Consent Decree Figures</u>
<u>1968-77</u> (ave.)	209	219	218	218
1978		249	248	
1979		224	222	
1980		244	243	
1981 (1/1/82)	203	227	226	211 (3% reduction)
1983 (1/1/84)	199			207 (5% reduction)

CHAPTER I

INTRODUCTION

This report was prepared by EPA in partial fulfillment of its responsibilities as specified in the 1979 "Foothills Consent Decree." This Decree was an out-of-court settlement agreement among numerous litigants involved in the Denver Water Board's Foothills Project.

Background

The Foothills Project consists of Strontia Springs Dam in Waterton Canyon, a 3.4 mile diversion tunnel, and a water treatment plant. In reviewing the DWB's application for a right-of-way permit across federally managed land, the Department of the Interior determined that an Environmental Impact Statement was required by Section 102(2)(c) of the National Environmental Policy Act (NEPA). In addition to the NEPA requirements, right-of-way permits were required from both the Bureau of Land Management (BLM) and the Forest Service, and a "404" Dredge and Fill Permit was required from the Corps of Engineers.

The Foothills Project generated considerable controversy over the environmental impacts, the adequacy of consideration of alternatives, efficiency of water use in Denver, potential impacts on development patterns and subsequently, on ambient air quality in Denver. The original draft Environmental Impact Statement (EIS) was released in January 1976 but was determined to be of insufficient scope to comply with NEPA requirements.

A second draft EIS was issued in August, 1977 but still did not resolve many of the concerns raised earlier. The final EIS was released in February, 1978 but was still considered inadequate by EPA and consequently, was referred to the Council on Environmental Quality (CEQ). CEQ basically concurred with EPA and recommended that the special use permits not be issued and that the EIS be withdrawn as inadequate.

In response to concerns about the issuance of the required permits, the City and County of Denver, through the Denver Water Board, and the Homebuilders Association of Metropolitan Denver filed suit against the Secretary of the Interior and several agencies (including EPA), organizations and individuals in order to require issuance of the permits. (City and County of Denver, et. al. vs. Cecil D. Andrus, et. al.) A counter suit was filed by opponents of the Foothills Project in Federal District Court in Washington (National Wildlife Federation, et. al., Plaintiffs, vs. Secretary of the Department of the Interior, et. al., Defendants).

These two suits were settled out of court in February 1979 through the signing of the Foothills "Consent Decree", also referred to as the Foothills "Settlement Agreement". In signing the Consent Decree document, the litigants basically agreed to permit the Foothills project to proceed and that, among other requirements, a water conservation program would be implemented by the Denver Water Board.

Foothills Consent Decree

The Foothills Consent Decree and accompanying stipulations cover a broad array of issues which were raised during the course of the debate over the Foothills Project. Of specific interest to this report are the settlement conditions relative to water conservation.

Denver's responsibilities for water conservation as stated in the Consent Decree are:

5. a. ...Denver will further institutionalize conservation measures into its activities. Denver has agreed to develop and intends to implement a conservation program and, no later than the 56th day after the dismissal of the claims herein, will present to its water users the conservation program, which program may be revised by Denver from time to time, and which is designed to reduce present average annual consumption within Denver and its treated water contract service area from 209 gallons per capita per day (gcd) to a goal of 203 gcd by January 1, 1982 and to a goal of 199 gcd by January 1, 1984.
- b. In 1984 after the evaluation called for in subparagraph 5.c., a further reduction goal in the range of 3 to 5% (from the goal of 199 gcd) to be sought in the five years subsequent to January 1, 1984 will be finally determined according to the procedures set forth in subparagraph 5.c. In 1989, again following the subparagraph 5.c. evaluation of progress and, in view of the then existing situation, a further reduction to be sought in the ensuing 10 years will be finally determined according to the procedures set forth in subparagraph 5.c. The parties presently estimate this figure to fall in the range of 5 to 10%.

The Environmental Protection Agency's requirements are to monitor and evaluate Denver's Water Conservation program and to recommend conservation goals:

5. c. The Regional Administrator of Region VIII of the EPA shall assume primary responsibility for monitoring the above conservation program. At the end of each of these periods (January 1, 1982, January 1, 1984, January 1, 1989), the Regional Administrator of the EPA shall evaluate Denver's progress and good faith efforts to attain the goals set forth in subparagraphs 5.a. and b., and recommend the 1984 and 1989 goals. In the event of disputes between EPA and Denver, the Army Corps of Engineers (Omaha District Engineer) shall be the final administrative arbitrator, with its findings being subject to judicial review.

EPA Evaluation Process

To comply with requirements in the Consent Decree that EPA evaluate Denver's "progress and good faith efforts" to attain the water conservation goals and also to recommend goals for 1984 and 1989, an Evaluation Team was

formed with representatives from the Environmental Assessment Branch, Drinking Water Branch, and the State Programs Management Branch. The Office of Regional Counsel was also involved on an ad hoc basis.

Litigants in the Foothills Consent Decree were notified by telephone and also by letter from the Regional Administrator that EPA was commencing the required evaluation. Key local and State political leaders were similarly notified. Participation in the evaluation was solicited; however, responses were generally limited to a request to be "kept informed" on the results of the evaluation.

The principal thrusts of the evaluation centered on a review of status of the individual elements in Denver's Institutionalized Water Conservation Plan (discussed in Chapter II) and an examination of water use information (discussed in Chapter III). Information was obtained through numerous meetings with appropriate staff from the Denver Water Department.

To obtain broader background knowledge on municipal water conservation programs and opportunities, a literature review was made. In addition, a number of communities along the Front Range and selected metropolitan areas in the West were contacted regarding their water conservation activities (summarized in Appendix A).

There are several current, ongoing activities which are relevant to EPA's evaluation responsibilities. In the interest of sharing information and avoiding unnecessary duplication of efforts, the Evaluation Team contacted the Denver Water Board Citizen's Advisory Committee (CAC), the Governor's Metropolitan Water Roundtable, and the U.S. Corps of Engineers. The CAC was established as a condition of the Consent Decree to provide citizen input to Water Board Activities. A "Water Conservation-Landscaping Task Force" was formed by the CAC, and the development of the "E-T" program (see Chapter II) came primarily from that group. The Roundtable effort is an attempt to formulate a "consensus" plan for meeting water needs in the Metropolitan area. A "Water Use Efficiency and Recycling Task Group" prepared a report to the Roundtable on water conservation opportunities.

Lastly, the Corps of Engineers has accepted the lead in preparing a "Systemwide Environmental Impact Statement" on the cumulative effects of future water development proposals of the Denver Water Board. Preparing this assessment is also a stipulation in the Settlement Agreement. Although this effort is just beginning, it is anticipated that water conservation will be an integral element of the Systemwide EIS.

Acknowledgments

As noted previously, the major portion of the evaluation effort centered around information and data obtained from the Denver Water Department (DWD). Numerous meetings were held with DWD staff and the Evaluation Team very much appreciates the professionalism, openness, and patience of the DWD staff in assisting EPA in carrying out its responsibilities. In particular, the Evaluation Team acknowledges the assistance of John Wilder, Conservation Officer; and R. D. Wiley, Manager of General Planning; and Mary Martin, Planner. The information provided by the DWD staff was critical to this report, however, EPA alone bears responsibility for contents.

CHAPTER II

Denver's Institutionalized Water Conservation Program

The information in this chapter was provided by Denver Water Department (DWD) staff members through a series of information-gathering meetings with the EPA Evaluation Team. These meetings were held between May and August, 1982. The Evaluation Team obtained information on the status of each element in the program in terms of content, implementation, timing, and effectiveness. The conservation plan elements are addressed in the order in which they appear in the Institutionalized Water Conservation Program as written in 1979.

Program Development

Immediately after the Settlement Agreement, a task force was formed, consisting of representatives from the Denver Water Department (DWD), the Office of Water Resources and Technology (OWRT), the Denver Regional Council of Governments (DRCOG), the Denver Planning Office, and the Colorado Department of Natural Resources. This task force was charged with developing the conservation program for the DWD. The DWD staff briefed EPA in June 1979, on the Water Conservation Plan. EPA indicated in a letter dated June 20, 1979 that it had briefly reviewed the executive summary of the Draft Water Conservation Plan and supported the concepts presented therein. The Plan was presented to and adopted by the Water Board on June 20, 1979. The complete Plan was then submitted to EPA. Executive Summaries were distributed to several entities (e.g., DWD suburban contract customers, state legislators, planning offices, building department, and numerous city agencies). The major elements of DWD's Water Conservation Plan are listed in Table II-1.

Table II-1

Denver Water Department's Institutionalized Water Conservation Program:

- I. Education and Public Information
 - A) Ongoing TV and Printed News Media Program
 - B) Daily Watering Graph (E-T Program)
 - C) RTD Mobile Program
 - D) Silent Salesman for Building Owners and Managers
 - E) Real Estate Package for Home Buyers
 - F) Demonstration House
 - G) Plumbing Fixture and Appliance Rating System
 - H) School Poster Contest
 - I) Denver Parks Department Notice and Sign Program
 - J) Water Bill Consumption Program
 - K) DWD In-School Teacher Program
 - L) Reassignment of Water Use by Class
- II. Retrofit Program
- III. Code Regulations and Provisions
- IV. Leak Detection Program
- V. Pressure Reduction Program Analysis
- VI. Universal Metering
- VII. Filter Plant Water Measurement
- VIII. Denver Water Department Successive Use Program
- IX. Conservation through Rate Modification

Program Elements

I. Education and Public Information

The Denver Water Department's stated purpose with respect to public education has been to develop a conservation "ethos" rather than impose "quick-fix solutions". The primary approach for accomplishing this has been an emphasis on the economic benefits of water conservation.

A. On-Going TV and Printed News Media Program

The Water Board has chosen not to buy TV time, and therefore, has had to rely on Public Service Announcements (PSAs) to convey their message. The primary reason for not buying advertising time has been the Water Board's concern over customer reaction about the propriety of such expenditures. The Water Department does not have a schedule for TV, radio, or newspaper ads for the coming year. They "play it by ear" and "take what they can get" due to lack of funds allocated to purchase advertising time.

"Water Follies", an animated "short" film depicting instances of common water wastage and conservation practices is one of the primary audio-visual materials distributed by the DWD. The DWD has developed several public service "spots" from the film. The film has been purchased by some stations (and HBO) and EPA. It was not possible to accurately determine how often the film has been shown or the extent of exposure the PSAs have had. DWD has produced other films including the "ECH₂ONERGY House" (1979) which was essentially a tour of the house and grounds and a discussion of the relevant water and energy conservation features.

DWD has developed radio "spots" or "drop-ins" (PSA's) and distributed them to all Denver-area radio stations for use at their discretion. DWD has distributed the Fred Arthur song on water conservation to the top 15 radio stations in Denver. These messages were aired by some stations, but the frequency of air time is unknown.

DWD staff have appeared on KHOW this year for a talk and phone-in program which was subsequently divided into several short segments for future use. They also appeared on the Peter Boyle Talk Show (KOA radio). Additional TV and radio programs promoting water conservation include the use of horticultural experts Herb Gundell and Gerry Niederkorn. The Evapo-Transpiration program (see Section I(B): Daily Watering Graph) went into effect last year and, in general, the news media have been very cooperative in advertising the program.

DWD distributes conservation messages including information on E-T with customers' water bills six times per year. The DWD distributes brochures on Xeriscape and the E-T program to all nurseries and stores selling plants, lawn and garden equipment, and landscaping materials. Articles have been published on Xeriscape (see Section XI) and the Water Department's role in the Home and Garden Show, in "Colorado Green", the Associated Landscape Contractors of Colorado (ALCC) publication (Spring, 1982). These brochures were also distributed at the Home and Garden Show, the ECH₂ONERGY II demonstration home and the Associated Landscape Contractors of Colorado trade show.

The low cost-no cost program was a state-wide effort sponsored by the Department of Energy with support from DWD and the Public Service Company of Colorado. It consisted of mailing information and water flow restrictors state-wide, following a three-week TV and printed news media promotion. This mailing was preceded by an advertising campaign where additional flow restrictors were placed in some grocery stores the weekend before Thanksgiving 1980. PSC did much of the mailing and DWD did participate in financing (amount unspecified). Many units (e.g., multifamily and condominiums) apparently did not receive the restrictors and there was no follow-up on the program. Therefore, there is no measure of its effectiveness.

The Water Department provides flow restrictors free to the public, at trade shows, home and garden shows, upon the purchase of watering permits and when conducting educational meetings. They are also distributed in cooperation with the PSC energy audit and are available at the Water Department upon request.

B. Daily Watering Graph (The E-T Program)

The initial concept for developing the daily watering graph was to divide the service area into several reporting areas and have water department employees (volunteers) report moisture data every day so that rainfall calculations could be made and passed on to citizens through the news media. The process was found to be too complex and cumbersome and was abandoned as impractical.

In the meantime, the Citizens' Advisory Committee Water Conservation/Landscaping task force chairman, Nick Schmidt, in consultation with CSU horticulturalists, helped develop an agricultural Evapo-Transpiration (E-T) model for blue grass lawns. The program was first implemented in the Denver area in 1981. The calculated E-T rate is made available to all media via "Newswire Denver". Channel 9 also agreed to distribute copies of the DWD bulletin, "The Water Wise Way to a Healthier Lawn," which explains the E-T system. In 1981, the Water Department printed 50,000 copies of this brochure and reordered 50,000 for 1982. This year nurseries, contract water distributors, landscape companies, homebuilders, show homes, and realtors will all get the E-T and Xeriscape brochures. They were also distributed this year at the Home and Garden Show, the ECH₂ONERGY II demonstration home and the Associated Landscape Contractors of Colorado trade show. Eventually these brochures will also be distributed to local government agencies responsible for approving subdivisions.

E-T program information is available on CSU sponsored "teletips" which is a service providing free horticultural information. An explanation of the E-T program was also included in the water bills of all 230,000 DWD service customers this year. The E-T program was designed for blue grass and is not directly applicable to other types of vegetation. As a result of some misapplications of E-T, the DWD modified the "Water wise" brochure to indicate that trees and bushes need a deep root irrigation.

The E-T system has been credited with contributing to the twelve percent reduction in summer water use in 1981. It should be noted that the water savings were noticed in the flat rate customer class. (Report to the Roundtable - Water Use Efficiency and Recycling Task Group.)

C. RTD Mobile Program

The Regional Transportation District (RTD) was contacted in 1979 relative to carrying water conservation messages on the outside of their buses. RTD told DWD they could not give special consideration to any group for advertising and that the back advertising panel on the buses was reserved for transportation issues. The matter was dropped until this year when RTD indicated that a waiver of their rules might be possible. RTD apparently told DWD they could advertise for water conservation provided: (1) the advertisement was generic enough to apply in the entire RTD service area, and (2) there was adequate regional interest by water utilities. DWD developed a proposed poster after soliciting and obtaining the support of the other 43 metro water suppliers. RTD apparently took DWD's water conservation idea and transformed it into a general statement about conserving natural resources. This was unacceptable to DWD, and the project was dropped. Advertising inside the bus was considered too expensive for the number of people reached. The Water Board feels that it would be difficult to justify such costs when they feel the conservation message can be delivered to their customers more economically through other methods.

D. Silent Salesman

The Silent Salesman Program (i.e., the provision of stickers or tags promoting water conservation) for building owners and operators has not yet gone into effect. DWD has developed the art work for a set of stickers (which would be placed on walls and mirrors) and plans to approach building managers beginning this year. DWD will begin with government buildings, motels/hotels, public buildings, (e.g., Stapleton Airport) and apartment houses.

DWD has approached some nurseries with the idea of tagging stocks of low water consuming plants. The nurseries are not opposed to the concept, but would like some idea as to the acceptability by the consumer, of this type of vegetation in the Denver area. As a result, no tags have yet been placed on nursery stock.

E. Real Estate Package for Homebuyers

In 1980, over 90% of the metro home builders, in cooperation with DWD and PSC, sponsored a conservation program for new home buyers. This program rates a home and gives conservation credits based on the homes construction and plumbing equipment. Mortgage lenders then allow the home buyer financial credit toward loan qualification, based on the estimated cost savings from conservation. There are no statistics on the number of homes sold under this program. The Denver Board of Realtors has been approached by DWD about extending the program to resales and they are apparently receptive to the idea but feel this is not the appropriate time to implement the program since the industry is currently rather depressed.

F. Demonstration House

The first ECH₂ONERGY home was shown in late summer to fall of 1979 to approximately 30,000 people. The house was a joint venture among PSC, DWD and the Denver Metro Homebuilders Association. The home included minimum grass

landscaping, low flush toilets, low-flow shower heads, low water use dish and clothes washers, and all the latest state-of-the-art conservation devices. As a result of this and other initiatives, PSC now includes a water use survey as part of their home energy audit. They also distributed shower flow restrictors and the brochure, "Forty-four Ways". ECH₂ENERGY II, open to the public in the Spring of 1982, incorporated all internal water-saving devices and appliances and had a zoned and metered (for demonstration only) irrigation system. Three different grass types and low use sprinkler systems were used. (ECH₂ENERGY II closed at the end of June 1982 and was visited by approximately 40,000 people). The water use monitoring results for the different types of vegetation will be provided early in 1983.

G. Plumbing Fixture and Appliance Rating System

The DWD worked with plumbing suppliers in the area and promoted the concept of supplying only water saving plumbing fixtures to builders and plumbers. DWD maintains that only water saving fixtures are now available in the Denver metro area. Therefore, it has been considered unnecessary to establish a program to rate plumbing fixtures for their conservation potential.

An attempt was made to rate the water conservation potential of washing machines and dishwashers. However, most of this equipment is coded and the code number changes yearly. Consequently, the DWD abandoned the appliance rating system as unworkable. The DWD encourages buyers to ask for water saving appliances through talks and literature.

H. School Poster Contest

Begun in the Summer of 1978, the school poster contest is conducted every other year as a means of fostering conservation awareness. This contest covers grade levels six through twelve. The posters are displayed at the DWD offices and at shopping centers.

Another special award program to encourage water conservation is the "Great Gildersleeve" award. In 1982, this award was presented to Nick Schmidt for his work on the E-T program. These awards are only given when the DWD feels that a citizen deserves recognition for an especially noteworthy contribution to water conservation.

I. Denver Parks Department - Signs and Non-Potable Water Use

This program element consists of identifying, for the public, the source of park irrigation water and reducing water waste. DWD indicated that the Denver Parks Department has been very cooperative with their sign program (begun in 1980) as well as efforts to reduce water waste. (All parks were metered as of last year).

The Parks Department has problems with watering the median strips on a number of city streets. DWD found that high volumes of vehicular traffic, vandalism, curb contour and other conditions often develop water waste problems between the time the staff turns on the sprinkler and when they return to

shut it off. They would like to eliminate vegetation on some of the narrower median sections and are interested in changing the irrigation systems to underground and/or drip irrigation where possible. DWD is testing these systems at Xeriscape. Switching to new irrigation systems may be hampered by budget constraints.

J. Water Bill Consumption Program

This program element consists of an inclusion in the bimonthly water bill comparing the water consumption of the current billing period with that of the same period for the previous year. It was implemented as of the Spring of 1982 and is available to metered customers only. The expectation by DWD is that this information will be used by the customer to modify habits and reduce consumption. This information could also be helpful to owners and managers of multi-family type dwelling units by alerting them to the presence of system leakage.

K. DWD In-School Teacher Program

The DWD employs a fully certified teacher in its community affairs office to teach school children the "why" of water conservation, and discuss all the issues surrounding water in Colorado (e.g., the water cycle, East slope/West slope controversy, water treatment). School visits are made by invitation only and many schools have been visited numerous times. From 1976 to June 1, 1982, 35,092 students, representing 225 schools in 14 districts, have received water conservation education. Most requests for talks come from schools outside of Denver. DWD also makes contacts through the Teacher Newsletter and through "Water News", the DWD bill insert.

The Water Department also conducts summer bus tours of the elements of their system located near the Denver Metro area. One of the tours is for teachers only. DWD staff will talk to any group about water conservation. The staff often volunteer to meet with neighborhood groups, community college classes, or appear at special interest group functions for presentations.

L. Reassignment of Water Use by Class

This element of the water conservation program is intended to identify water use by sector or class (e.g., residential, commercial, industrial) in order to design a specific program analysis for each specific class of customer. Water suppliers initially followed the rate classification system established nine years ago by the Denver Metro Sewer System. This classification is based upon sewage BOD and has led to some misclassifications of water users. The customer classification system began in February 1981. Developing the necessary data base will take 2-3 years.

II. Retrofit Program

The retrofit of city buildings with water-saving devices began two years ago and has been completed wherever possible. All city buildings, hospitals, city shops and 7200 units of public housing have been retrofitted with shower flow restrictors and, in some cases, sink faucet aerators. The DWD has no data yet on water savings from the Retrofit Program.

The federal government buildings have not been retrofitted. The DWD hopes to approach the federal agencies through the Federal Regional Council beginning in the Fall of 1982. The State has been contacted. The Retrofit Program is expected to be complete within two years.

DWD checked on sending out water conservation kits (separate from the no-cost/low-cost program) and found some communities were dissatisfied with the kits available. Therefore, the DWD decided against buying conservation packages. It does advertise flow restrictors at public talks and DWD "44 Ways" advises customers on retrofit. Approximately 250,000 restrictors have been distributed. The program for assisting the elderly and handicapped with retrofitting their homes has not materialized. DWD has worked with a few building managers (e.g., University of Denver, Condominium Associations) and plant engineers on leak detection and retrofitting programs.

III. Code Regulations and Provisions

The revision of code regulations and provisions has not been pursued because of the multitude of governmental jurisdictions in the service area and the legal and political difficulty in addressing the retrofitting of existing residences. Additionally, DWD assumes that since newer buildings will be fitted with water-saving devices, there would be no need for ordinances. The Denver Building Department has been approached concerning planning and zoning changes to regulate lot sizes and landscaping. However, DWD feels there is little possibility for lot size or landscaping size requirements in the future due to the political atmosphere and the great number of areas over which the DWD has no control.

IV. Leak Detection Program

In their leak detection program, the DWD uses a computer and other equipment which is capable of locating the point of a leak within inches. This operation has been functioning since June 1980. Because of its accuracy, this process is also cost-saving by reducing unnecessary labor time and efforts. DWD does issue notices of leak detection and does a follow-up inspection. It is studying ways to detect/correct leaks in the raw water side of its system.

The DWD's objective is to survey the entire 2,000 miles of its water lines. From June of 1980 to June of 1982, they have completed about 400 miles. The estimates in Table II-2 were provided by the DWD.

Table II-2

Leak Detection Program

	<u>Miles Surveyed</u>	<u>Water Saved (Gallons)</u>	<u>Leaks Located Non-visual</u>	<u>Leaks Pin-point</u>
1980	90			
1981	392	82,130,000	36	93
1982	97	8,625,000	5	48

The amount of water saved is a "guesstimate", arrived at by measuring the size of the leak and, through computer program based on a standard 10-day projected flow, determining an estimate of water lost. The 10-day variable is a standard projection but will not be used if actual time information is available.

V. Pressure Reduction Program Analysis

In 1930 and 1981, the DWD contracted with Brown and Caldwell to look at the effect of water pressure reduction on water use. The results of this study should be available in 1983.

VI. Universal Metering

The Denver Water System encompasses approximately 88,000 unmetered residential services. A recent comparative study (DWD 3" Meter Study) of water use in selected areas of the city indicates that 12,500 acre-feet of water could be saved per year by metering Denver's flat-rate customers.

One of the major obstacles to the implementation of metering has been the development of a financing arrangement. There are many options for paying for meters, ranging from the customer making the total payment to the DWD assuming the estimated \$ 40 million cost. DWD feels that unmetered customers should be reimbursed both for the meter installation and for the water they "free-up" as a result of decreased consumption.

The DWD currently has an internal study underway on methods to pay for metering. Meter installation is estimated to cost \$400-1,500/home. The study looks at how and from whom the money could be collected. DWD's preferred option at this time seems to be required meter installation upon resale of the home. It is estimated that this would probably complete total metering in 8-11 years.

Any building conversions (from single family residences) or extensive remodeling are noted by the Denver Building Department and passed on to DWD. Meter installation is then required. The Conservation Program calls for metering historic buildings within 90 days of application for historic status. No data is available on the status of this program.

DWD refused money which the State Legislature had appropriated as a low interest loan for meter installation because the contract required that DWD give up ownership and control of the meters (apparently in violation of their city charter) and because the \$5 million offered was only a small part of the \$40 million needed and was not available at one time.

VII. Filter Plant Water Measurement

This element of the Conservation Plan was designed to detect suspected water loss in the Marston Plant. There are currently three meters measuring inflow to the plan and eight meters measuring outflow. DWD discovered discrepancies (plus and minus) in water use measurements and suspected they were not properly accounting for all water use in the plant (e.g., leaks, storage, backwashings).

A plant survey was undertaken and large errors in two meter recorders were discovered. Low flows in the winter were primarily responsible for the mistakes. DWD is currently trying to calibrate the meters at Marston so the problem will be eliminated. They are also investigating the margin of error in the flumes and meters. If greater accuracy is attainable, DWD will study the cost effectiveness of replacing or modifying the meters.

The Moffat Plant had sonic meters installed last year and does not appear to have a problem.

VIII. Successive Use Program

Under conditions of the Blue River Decree (1955) and Senate Document 80 (Construction Settlement on Dillon Reservoir), Denver was required to look at successive use of water in its system. In 1969, the University of Colorado received a grant from the Federal Water Pollution Control Administration to look at the possibility of starting a pilot reuse plant. In 1970, the pilot was started and was funded for 10 years by the Denver Water Department.

In 1974, the need for a demonstration plant became evident and CH₂M Hill was retained to develop the design. In 1979, EPA awarded a \$7 million grant for design and construction (DWD is contributing \$21 million) of the successive use plant and health effects testing of the treated water. In 1978, construction of the Denver Water Reuse Demonstration Plant was begun. Completion is expected by late 1983.

The earliest a full scale (50-60,000 AF/yr) reuse plant selling potable water for consumption could be on-line would be in about 20 years. The DWD has conducted four surveys of public reaction and over 50% of the persons surveyed accept the idea of potable reuse. The guarantee of water quality the same as the present quality was very important to those surveyed. A major public education effort will be needed to guarantee the acceptance of the treated water.

IX. Conservation Through Rate Modification

It should be noted that in the absence of full metering, the use of rate structure modifications to promote water conservation is limited. This element of the conservation program was designed to examine the importance of rate structure modifications on water use. The "philosophy" of the DWD is to encourage conservation without adversely affecting lifestyles. DWD is concerned that an immediate inverse rate structure would not accomplish the goal of increased conservation unless a conservation ethic has already been established. DWD staff claims that a rate increase of 2-3 times would be necessary to see any real conservation because the water bill is such a small part of the total monthly bill paid by most people. DWD believes that an increase of such magnitude would be politically unacceptable. DWD uses this same reasoning to reject time-of-year rate structures (increased summer rates) as a water conservation measure or as a means of reducing peaks when the water restrictions are lifted next year.

The present water rate schedules are divided into blocks. The width of the blocks is set so as to (in effect) establish a flat rate for each customer class. Industry has been given a declining block rate because its smoother load characteristics help the functioning of the water system. The DWD is continuing to look at a variety of rate structures including a flat volume rate for metered residential customers. DWD did a survey to ascertain the effect of not charging for the first 4,000 gallons and then imposing inverse or double rates for additional water, in response to the Morris Study (Water for Denver, An Analysis of Alternatives, 1980). The findings indicated that in 80% of the cases apartment users would get free water and this "benefit" would accrue to the wealthy as well as the poor. (It would not target poorer families to receive this benefit as the Morris Study had suggested). The DWD has not evaluated other combinations of providing "free" water and modifying rate structures in order to ascertain the viability of such a system.

One change that was implemented in 1979 was a switch from a minimum bill to a service charge bill. The minimum charge bill had charged a minimum monthly fee to cover service and standby costs. The service charge bill lowers the minimum monthly charge (it covers only service) and changes the flat fee base gallonage from 11,000 to 1,000 gallons. The standby costs are picked up as the customer pays for each 1,000 gallons used. This rate change allows the customer to see some economic return for his/her conservation efforts. This change was based upon a recommendation from the 1979 Black and Veatch Study. In addition, the DWD instituted a new (higher) customer system development charge (hook-up fee) which is a front-end fee covering new supplies, treatment and storage.

X. Water Violation Enforcement

The criteria for determining water waste are somewhat subjective, but in theory, the Water Board will tolerate no waste. The "water police" employed by the Water Department consist of students (summer help), servicemen, and occasionally, night dispatchers and load control personnel. There are three shifts which patrol from 4:30 AM to 9:00 PM. The cases they investigate arise almost exclusively from complaints received at DWD by phone. Unless the first offense is grossly flagrant, the DWD water police will issue a warning. This warning carries no penalties, it simply warns that a continued violation will result in special charges being included in the next water bill. DWD has a hotline number to call to report water wastage.

XI. Xeriscape (The Conservation of Water Through Creative Landscaping)

The Xeriscape landscaping concept has been developed to encourage the use of low water-using vegetation as an alternative to conventional lawns. The DWD, after consulting with professional horticulturalists, established a Xeriscape garden at its main office building and promotes public tours. The Water Board has decided to use the Xeriscape concept in landscaping their Water Reuse Plant.

XII. Expenditures

Expenditures for the conservation program as reported by DWD are as follows:

1979 - \$	880,587
1980 - \$	1,894,249
1981 - \$	<u>1,322,844</u>

Total	\$4,097,730
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Over three-fourths of this expenditure went for the successive use plant and the repair of system leaks. A complete listing of these expenditures appears in Appendix B.

CHAPTER III

Water Conservation Goals

The Foothills Consent Decree specifies a reduction in the Denver water use in gallons per capita per day as a measure of the effectiveness of the Denver water conservation program. This appears, on the surface, to be a very easy way to measure that impact. However, this "seemingly simple" method has many complicating factors and all must be taken into account before comparing the water use figures before and after the elements of the conservation program have been implemented.

Water Use Measurement

Gallons-per-capita-per-day (usually designated as GCD or gpcd) has been used for a number of years to generally describe a community's water use.

GCD is defined as the total amount of water produced for the community and placed into the distribution system, divided by the total number of persons being served by the water system. Before comparing the GCD's of several water systems or the GCD's for several years on the same water system, the following factors must be recognized:

- Population - Accuracy is critical
- Weather - Affects outdoor water use on lawns and other landscaping
- Commuters - Use water but are not counted in the "Population"
- Water Use Restrictions - Limits the amount used
- Leakage - Some treated water may never reach the consumer but is still included in the "water used" when calculating GCD.
- Public Use (parks, fire fighting, street washing etc.)- may not be accounted for.

Denver Water Use Trends

Water from the Denver system is used in many ways. The following listing by class provides an estimate of the percentage used in each category:

Single Family Residence	58%
Multi-Family Residence	10%
Commercial & Business	7%
Public Agencies	8%
Parks	6%
Industries & Construction	5%
Water Loss & Fire Protection	6%

The Foothills Consent Decree utilized GCD figures which averaged Denver's past water use. Based on these figures, projections were calculated for a reduction in future water use. At the time of the Consent Decree, the Denver water use over the previous ten years (1968 to 1977) was computed to be an average of 209 GCD. Goals for water use were then established to be 203 GCD by January 1, 1982 and 199 GCD by January 1, 1984. These figures represent a 3% and a 5% reduction, respectively.

Since 1978, when the Denver GCD was computed for the Consent Decree, additional information has become available which indicates the original data were inaccurate. The dominant factor affecting the original computation of the GCD figures was the estimated population. Population figures were being drawn from the 1974 report by the Denver Regional Council of Governments (DRCOG) which used the 1970 census data and over-estimated the population growth of the Denver service area. A comparison of the projected population used and the adjusted population based upon the 1980 census, are shown in Table III-1.

Table III-1
Population Projections
(Persons Served By Denver Water System)

Year	Based on <u>1970 Census</u>	Based on <u>1980 Census</u>
1968		710,000
1969		756,000
1970		768,000
1971	792,000	782,000
1972	812,000	795,000
1973	833,000	803,000
1974	879,000	808,000
1975	891,000	818,000
1976	904,000	818,000
1977	919,000	825,000
1978	935,000	830,000
1979	952,000	838,000
1980	971,000	846,000
1981	990,000	857,000

The Denver Water Board has recently made an attempt to more accurately determine the population of the Denver Water System Service area. Using 1980 Census Block Data, the total population for the years between 1970 and 1980 were then estimated (See Table III-1). These estimates for Denver were not projected on a straight line basis, but were based upon knowledge of Denver growth patterns. The population estimates for suburban water districts served by Denver were projected on a straight line basis.

Another factor not considered in the computation of the original consent Decree GCD was the sale of water to other water systems which are not part of the Denver Service Area. Sales of water to the Cottonwood Water District and the Cities of Aurora and Thornton during the years 1968 through 1977 were not originally included. The corrected GCD values shown in Table III-2 factor out these water sales and utilize the 1980 census data.

Table III-2
Denver Water Use
(GCD)

<u>Year(s)</u>	<u>Consent Decree Figures</u>	<u>Corrected Using 1980 Population</u>	<u>Corrected for Water Sold to Aurora & others</u>	<u>Recommended Adjusted Consent Decree Figures</u>
1968-77 (ave.)	209	219	218	213
1978		249	248	
1979		224	222	
1980		244	243	
1981	203	227	226	211**
1984	199			207**

*Based on erroneous 1974 population projections and included water sold to Aurora & others. The 1981 figure is an estimated goal based on a 3% reduction from the 1968-77 average value.

**Estimated values based on 3% & 5% reductions respectively from adjusted 1968-77 value.

The weather is one of the major factors affecting water use during the irrigation months. The amount of precipitation received and the maximum temperature reached each day obviously affects the amount of water customers use to maintain green lawns and other outdoor vegetation.

In an attempt to account for this important factor in the GCD figures calculated, the DWD has calculated the monthly water demands by multiple linear regression analysis. The equations include service area population, temperature and precipitation as controlling variables and are based on twenty years of historical data. The calculated GCD's then better reflect the impact of other factors, such as water restrictions, on the water use of the community. GCD's calculated using this method are listed in Table III-3.

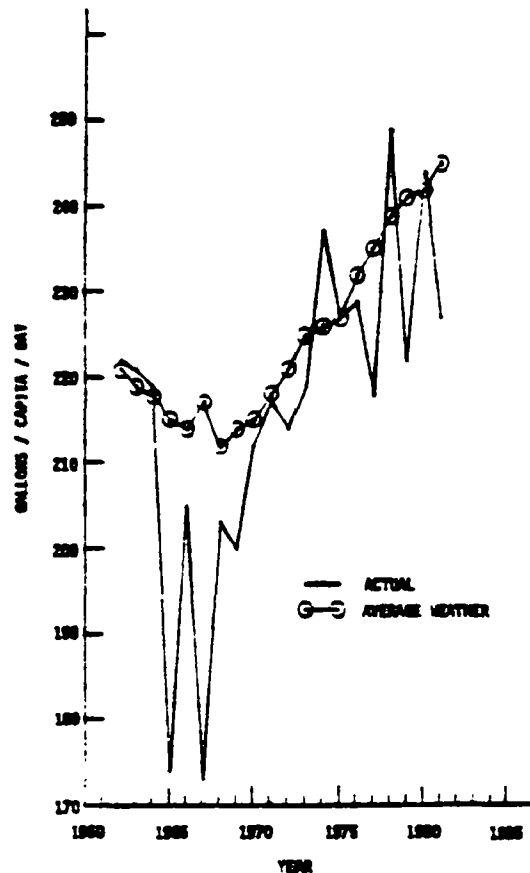
Table III-3
Denver Water Use
(GCD)

<u>Year</u>	<u>Actual Demand</u>	<u>Calculated Demand*</u>
1978	248	251
1979	222	225
1980	243	253
1981	226	245

* Indicates the calculated water use for the actual weather experienced during that year. Based on 20 years of historical weather data using regression analysis.

When calculations are made using an average weather factor, the resulting figures indicate a very definite increase in per capita use. (See Figure III-1).

FIGURE III-1
WATER USE IN THE DENVER SERVICE AREA



Water use restriction may or may not reduce the total amount of water used by consumers. For instance, in 1977 when Denver restricted both the days and number of hours outdoor watering could take place, calculations suggest a 14% decrease in total water used during the year. However, in the following years when only daily restrictions (watering every third day) have been imposed, the calculations show that very little water was saved. (See Table III-4). It should be noted that the 3 day (circle, square, diamond) watering restrictions were imposed to reduce daily peak water demand and were not intended to be a water saving/conservation program.

Table III-4
Effects of Outdoor Water Use
Restrictions on Water Demands*

Annual Water Demand	1977**	1978	1979	1980	1981
Calculated (mg)	72,900	75,900	68,700	78,000	76,540
Actual (mg)	62,599	75,451	69,363	76,525	71,052
Water Saved (mg)	10,301	449	337	1,475	5,458
Percent Saved	14%	0%	0%	2%	7.7%

*Taken from the Denver Water Department unpublished report "Outdoor Water Use Restrictions" by the Planning & Water Resources Division (1982)

**Customers were restricted to only 3 hours of outdoor watering every third day.

Water use, measured on a GCD basis, is substantially higher within the City of Denver than it is in surrounding suburban areas served by the Denver Water Department. (See Table III-5.) This may be due to a number of factors:

1. Heavier industrial water use in Denver,
2. Commuter impact in Denver (Commuters use water during the day but are not counted as part of the "population" when calculating GCD),
3. Greater percentage of parks in Denver,
4. Full metering in suburbs,
5. Higher cost of water in suburbs.

Table III-5
Denver & Suburban Service Area Water Use
(GCD)

<u>Year</u>	<u>Denver</u>	<u>Suburban Service Area*</u>
1968	230	149
1969	224	150
1970	237	163
1971	245	161
1972	246	172
1973	243	176
1974	273	197
1975	259	178
1976	258	183
1977	230	176
1978	273	216
1979	247	191
1980	268	212
1981	247	201
1968-77: Average	245	171

*Suburban Water Districts served under contract by Denver.

Future Water Use

In a 1981 report for the Denver Water Department, titled "Treated Water Planning Study", Black and Veatch projected future per capita water use. Assuming that the Denver Water Conservation Plan would be somewhat successful in achieving a reduction in the GCD increase, they extended the projection of water use to 1985 (201 GCD), 1990 (208 GCD) and 2000 (197 GCD). Black and Veatch and the Denver Water Department both recognized that the estimated population figures (based on 1970 census) were a bit high, but they were the best estimates available at the time.

Additional Water Use Factors

The three-inch Meter Study provided an excellent opportunity to measure actual residential GCD consumption within the city. Although the use rates varied widely, the study showed overall that metered customers in similar housing situations were generally more conservative in their water use. For example, in 1981 the use in metered areas was about 15% less than in similar flat rate neighborhoods. In another trend analysis conducted by the DWD on the use per account from 1960-1981, flat rate users were consistently higher than metered users.

Consent Decree Goals

The problems of accuracy with the original Consent Decree Baseline GCD have already been discussed in this chapter. Instead of the original 1968-1977 average of 209 GCD, the corrected figure would be 218 GCD (See Table III-2). Therefore, using the Consent Decree suggested reductions of 3% and 5% for January 1, 1982 and January 1, 1984, the projected values should have been 211 and 207 GCD, respectively. The summarized 1981 data shows an actual water use GCD of 226. Therefore, the Denver Water Department fell short of the calculated goal of 211 GCD. However, the difference between the actual use of 226 GCD and the calculated demand of 245 GCD is a reduction of 19 GCD which may be attributed to the combined impacts of the DWD's water conservation programs (See Tables III-3 & III-4).

CHAPTER IV

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

The DWD's Water Conservation Program reflects an effort to foster water conservation. The program contains innovative concepts to develop a conservation ethic which is essential to the goal of more efficient water use. In particular, the DWD is to be complimented on its E-T and Xeriscape programs as they both provide practical, cost-effective approaches to promoting water conservation. However, the over all program, as implemented thus far, is still developing and continued emphasis is necessary for the goals of the program to be fully realized. There is room for program expansion and improvement, particularly in the areas of public education and awareness.

The DWD has not linked the elements in the Institutionalized Water Conservation Plan to specific water conservation goals. The absence of this correlation could make scheduling implementation of needed conservation measures more difficult.

The DWD still has not published a schedule to progress toward the Board's commitment to achieve 100% metering. Metering affords water management benefits far beyond water conservation, but could save 12,000 to 19,000 AF/year. The absence of total metering also limits DWD's ability to consider potential rate structure modifications which other communities have found useful for managing water supplies.

The baseline 209 gallons per-capita per-day (GCD) ten-year average water consumption stated in the Consent Decree was based on inaccurate population estimates and water use which resulted in a goal in 1981 of 203 GCD. When corrected, the actual 1981 goal should have been 211 GCD. The actual water use in the Denver system in 1981 was 226 GCD. Measured against this recalculated goal it is obvious that overall water consumption was not reduced, in spite of the water conservation effort. However, if weather history and water use are considered, the expected consumption would have been 245 GCD. This suggests that the water conservation program may have resulted in a 19 GCD, or about an 8% reduction.

Recommendations

The following recommendations are presented in the interest of making DWD's water conservation efforts more effective.

Conservation Goals

- o The goals in the Decree should take into account the effects of temperature and precipitation. Therefore, it is recommended that the calculated usage (using the normalized demand analysis) be used as a basis for the 1984 and 1989 goals. It is further recommended that the actual water use in 1983 (1984 goal) be 11% less than the calculated demand and that the actual water use in 1988 (1989 goal) be 17% less than the calculated demand.

- o In recognition of the limitations inherent in GCD figures, an ad hoc group (with representatives from DWD, EPA, COE and the contractor working on the Systemwide EIS) should evaluate alternative indices for measuring water use and water savings. Such an effort would be consistent with the Metropolitan Systemwide EIS currently being prepared for DWD under the direction of the COE.

Evaluation

- o The DWD should pursue a market survey approach to registering public opinion of existing conservation activities, i.e., the E-T Program, Xeriscape, and proposals for future conservation program elements. Surveys can be utilized to determine the acceptance of the programs and also solicit new ideas for water conservation.
- o The DWD should evaluate (to the extent feasible) the impact that each element of their conservation program has on water use in their service area. For example, an element of this evaluation could consist of installing water conservation devices in a selected area and measuring before and after water consumption.
- o The DWD should evaluate the linkage between elements in the Conservation Plan and the water conservation goals. This evaluation should describe how the specific elements will contribute toward achieving water conservation goals and should permit a more systematic approach for program implementation.

Public Awareness

- o Since water conservation is an issue which extends beyond Denver, the DWD should consider a regional, cooperative effort to further the conservation ethic. Other communities also have recognized the importance of water conservation and are making efforts to educate the public. Regional or metro-wide activities could be jointly sponsored to foster the conservation message (e.g., a regional water awareness day, or bumper stickers fostering the conservation message) through such organizations as the Urban Water Management Group, DRCOG or the Metropolitan Water Development Group. Such a regional effort would also have an impact on metropolitan commuters.
- o The future direction of the DWD's Water Conservation Program should be to cultivate an on-going public awareness which will result in a recognition of water conservation benefits. The benefits should extend beyond financial considerations to include social and environmental aspects. Consumers should be presented the "why's" as well as the "how's" of water conservation so as to understand the rationale.
- o As a means of improving its public awareness/public education effort, the DWD should consider expanding its current program to include greater utilization of Public Television, employment of government

access channels on cable TV, more creative employment of commercial TV public service opportunities, acquiring time and/or space in the media, and utilization of consulting services to help develop and/or implement public awareness/education programs.

Metering

- o The DWD, working through the CAC, should actively develop a program to implement their commitment to achieve full metering in the Denver Service Area. This process could include a wide range of public education/involvement activities to solicit input on alternative approaches to financing the program.

Xeriscape

- o The Xeriscape program could be made even more effective by a more aggressive campaign to encourage the use of dry landscaping (Xeriscape) in all residential areas. Promotion of Xeriscape would be aided by the development of several Xeriscape projects in locations convenient to DWD customers, e.g., public facilities such as parks, schools, fire stations, museums, and DWD facilities. The establishment of a "Xeriscape of the Month" award should also be considered.
- o The DWD should enlist the aid of nurseries in promoting the use of native landscaping. One method of accomplishing this could be to coordinate the formation of a nursery co-op. A cooperative arrangement would require limited financial investment from individual companies while allowing for an adequate supply of low, water-use vegetation and the use of combined resources to generate a new market for the product.

Retrofit

- o The DWD should consider undertaking a comprehensive retrofit program. Appropriate advertisement should precede the distribution of conservation kits and a follow-up survey should be used to assess the success of the program. It is highly advisable to try this program in a limited area (e.g., one service district) and to evaluate its impact before expanding to the entire service area.

Program Review

- o The DWD should revise and update its Institutionalized Water Conservation Program and provide for a periodic program review (through the Citizen's Advisory Committee and/or EPA) so that new, useful program elements can be added and ineffective elements deleted in a timely manner.
- o To comply with the Consent Decree requirement that EPA "monitor" DWD's conservation efforts, periodic meetings between DWD and EPA should be scheduled.

APPENDIX A

WATER CONSERVATION IN OTHER COMMUNITIES

The criteria, "good faith effort", as stated in the Consent Decree, is nebulous and subjective. In an effort to compensate for this condition by providing a more objective frame of reference, a survey of water conservation literature was conducted. In addition, several water suppliers, both in-state and out-of-state were contacted to discuss their approaches to water conservation. These efforts provided the Evaluation Team with a broader perspective on municipal water conservation programs.

Overview of Conservation Programs

The key elements of water conservation programs include public education, leak detection, metering, rate structure modifications, distribution of water-saving devices, and restrictions to meet peak load demands.

Of the 18 water suppliers contacted, 15 provided varying degrees of public education, 9 have either ongoing or periodic leak detection efforts, and 15 have implemented some form of rate modification. These modifications span a range from fees based on lot size, to inverted rates, penalty rates, and summer rates. Fifteen of the 18 have metered 100% of their system while one system is partially metered. Eleven suppliers have at some time distributed water saving devices. Most suppliers have these devices available upon request, on an on-going basis. The devices generally consisted of shower and faucet restrictors, toilet dams, toilet bags, and dye tablets to detect leaks. Seven of the in-state suppliers have implemented use restrictions on a temporary basis, often as a one-time event. Several of the in-state suppliers are familiar to some degree with the DWD's conservation program, particularly the public education element. (See Table A-1).

Public education seems to be a basic component of many water conservation programs. These educational programs range from newsletters to feature news stories, publicity, and advertising. Most agencies draw heavily on existing resources in the community. They utilize the full spectrum of media (i.e., radio, TV and print, public libraries) and local community events such as county fairs and home & garden shows, to disseminate brochures and pamphlets, as well as water saving devices. Conservation exhibits are displayed in various public locations.

Several communities also have some type of water awareness program at all levels in the schools. Most communities contacted felt that metering was an essential management tool for any public water system as it allowed flexibility for controlling water use. Most communities felt that the greatest water savings could be obtained by concentrating on the reduction of outdoor use; specifically lawn and garden watering. Several communities felt that public surveys (both before and after conservation program implementation) were necessary to effectively implement and properly readjust conservation programs. Obviously, all communities have somewhat unique characteristics and a program that may be appropriate for one community may not be suitable for another community.

San Diego County Water Authority (SDCWA)

The San Diego scoreboard (professional sports stadium scoreboard) has been made available for Water Authority conservation messages. Two major theatre chains have expressed interest in providing screen time for water conservation Public Service Announcements. The business community is being encouraged to develop in-house water awareness programs applicable to their individual organizations.

A new concept to provide low water use plants for the area is being proposed to local nurseries. They will form a co-op nursery by investing funds or plant material. The objective is to limit investment in a newly developing market and yet have sufficient low water-use plant material available. The Water Authority's role will be coordinator and developer of marketing programs.

A weekly water report has been added to the weather report of one of the local newspapers. Regular visibility for water conservation issues and activities is provided through a brief message or slogan which is direct, easily understood and remembered. These messages reach some 722,000 consumers.

East Bay Municipal Utilities District (EBMUD)

The East Bay Municipal Utilities District of Oakland, California (EBMUD) recognizes the importance of generating a voluntary public commitment to a water conservation ethic. The incentive is based on an awareness of benefits broader than personal, financial savings, including common benefits such as the potential reduction or delay in future water supply projects, energy savings for both the water system and customers, the efficient use of public resources, and better preparation for any future water shortage emergency. The District assumes a two-fold responsibility through communicating the benefits of water conservation and providing specific information on methods to reduce water use.

An initial survey was conducted to establish a data base of customer attitudes, behavior, and preferences for water conservation. From this information, a specific conservation program will be developed.

The Captain Hydro water conservation materials were originated to teach water awareness in the schools at all grade levels. The State and other water agencies nationwide use these materials. The District retained a consultant to revise and update these educational materials.

The District also has an in-house conservation program. Efforts to conserve water include backwash reclamation at filter plants and wastewater reclamation at the wastewater treatment plant. Low-use water landscaping has been installed on District grounds and use of these landscape alternatives are being encouraged for new city and county developments. Another water conservation innovation by EBMUD is a handbook guide, ("Puddle Stopper's Handbook") to basic home plumbing.

Seattle Water Department

The Seattle Water Department has been involved in extensive follow-up to their water conservation activities. They are surveying consumers to get feedback on the public's level of awareness and cooperation with the water conservation effort. These surveys have been designed both by the staff and consultants.

In addition to the savings estimates, actual metered water consumption data was analyzed for residents in the parts of Seattle where water conservation kits were mailed during 1981. Households receiving the kits consumed 20% less water than the control group.

The Water Department will supply up to 100 kits to multi-family unit managers or apartment owners if they will commit to 100% installation. Subsequent to installation, a 6-month and 12-month follow-up consumption report will be provided for comparison purposes. Preliminary results indicate up to 20% water savings.

An extension of these programs is a retrofit study involving several sample areas. Household meters will be read to monitor monthly consumption before and after retrofit. Phone follow-up will be done concerning the use of the conservation kits. Computer correlations will be done to calculate the amount of savings achieved through the retrofit program.

Los Angeles Department of Power & Water

The Los Angeles Department of Water & Power has a five-year Conservation Plan. They too refer to instilling in the public a "conservation ethic". They have mailed retrofit kits to all of their consumers. They have forecasted a total savings of 76,000 AF/year for the year 2000.

In addition to the commonly used approaches to water conservation, the Department provides awards and related publicity to members of the business and industry community whose conservation efforts have resulted in substantial energy and water savings. Community and metropolitan newspapers, as well as in-house publications are utilized for recognition of these firms.

A HUD sponsored water conservation study by Brown & Caldwell is underway. The objective of the demonstration project is to measure the effectiveness of conservation devices. Additional studies have been conducted by the Department to determine water usage goals for commercial, high-rise, multi-family dwellings and other consumers.

Evaluations are made of the effectiveness of on-going programs. In the first part of 1980, the city was continuing to use about 5% less water than in the pre 1976-77 drought period. The current total consumption is less than that of 10 years ago despite population increases.

A penalty economics system has been implemented for both excessive and prohibited uses, e.g., restaurants are prohibited from serving water unless it is requested. Outside watering is prohibited between 10 AM to 4 PM. Violations of excessive use are responded to by letters and personal visits, both of which include information on conservation and retrofit devices. An escalating fine, the installation of a flow restrictor (at the consumer's expense), and suspension of service are the penalties for repeated violations.

1979 - 1981

WORK ORDER NUMBER	DESCRIPTION	ISSUED TO	DATE ISSUED	STATUS	EXPENSES RECORDED		1981	TOTAL
					1979	1980		
1060	Water Conservation, to accumulate costs associated with the overall Water Conservation Program	Admin./Public Affairs	6/13/79	Open	3,464	6,775	48,092	58,331
7925	Costs for committee or meeting at time of real estate transfer	"	8/25/81	Open	-	-	1,980	1,980
8811	Costs for committee or meeting at time of real estate transfer	"	1/5/82	Active	-	-	201	201
4386	Costs for builder tie-in program to Schyberg's home	"	1/18/80	Open	-	2,648	180	2,788
4385	Costs for Jan Annual Water Conservation Poster Contest	"	1/18/80	Open	-	2,163	-	2,163
2976	Costs for joint venture with BBA & P&C to construct H ₂ O Saver [®] conserving house	"	5/29/79	Open	51,692	279	183	52,074
3059	Costs for successive Joe Community Education Program	"	6/13/79	Open	-	123	100	423
9351	Costs for Film Restrictor Program	"	1/3/82	Active	-	-	-	-
9374	Costs for (a) Landscape Community Involvement & Education Program Brochures & Materials	"	1/5/82	Active	-	-	-	-
3193	Costs for 1981 Water Conservation Poster Contest	"	1/9/82	Active	-	-	-	-
9616	Costs for 1982 Schools Conservation Education Program (Capt. Hydro Materials, Equipment)	"	1/12/82	Active	-	-	-	-
5674	Purchase 50,000 Flow Restrictors for Dist. 10 Dept. Service Area.	"	10/6/81	Closed 12/31/81	-	6,211	19	6,230
4078	Costs for Research and Implementation of Water Use Measurement at DWD Treatment Plants to determine per capita consumption figures	Plant	12/18/79	Open	-	103	-	103
4165	Costs for 1-acre Metering for Flat Rate vs. Metering Research	"	12/28/79	Open	-	32,321	49,952	77,643
7237	For Costs of Design & Construction of Low Maintenance Drought Tolerant Landscaping for Department Facilities (Koradape Garden)	"	5/21/81	Active	-	-	32,490	32,490
4144	Costs for Pressure Equalization Study Conservation and Offsets	"	12/28/79	Open	-	537	731	1,288
1495	Successive Joe - Investigations, Design Survey, Plans & Specs	Engr.	2/79	Closed 4/81	218,554	984,435	184,107	2,197,096
3112	Successive Joe - EPA Grant Administration Expense	Engineer-plant & QC	6/79	Closed 12/80	10,731	23,069	1,938	35,738
3113	Successive Joe - Project Advisory Committee Expense	"	6/79	Closed 12/80	2,495	2,693	293	5,481
3114	Successive Joe - User Design Consulting Services Expense	"	6/79	Closed 12/80	121	51,783	2,976	54,880
3115	Successive User - Design Advisory Committee Expenses & Fees	"	6/79	Closed 12/80	2,572	616	268	3,456
5723	Costs of Universal Metering Program, Planning, Monitoring, Administration	Cost. Svcs.	10/15/80	Active	-	6,378	2,139	8,517
2619	Water Restriction Program, Enforcement, Guidelines, Materials	"	3/79	Closed 12/79	128,036	-	-	128,036
4378	"	"	1/80	Closed 2/81	-	123,245	108	123,353
6635	"	"	2/12/81	Closed 2/28/82	-	-	137,387	137,387
9199	"	"	2/12/82	Active	-	-	-	-
4711	Cost for 1980 Leak Detection Program	Plant	3/20/80	Closed 12/31/80	-	41,795	67	41,862
4242	Cost for 1981 Leak Detection Program	"	1/2/81	Closed 12/31/81	-	10	60,493	60,503
8842	Cost for 1982 Leak Detection Program	"	1/6/82	Active	-	-	-	-
7197	Make 40 signs for City Parks Dept. to promote H ₂ O Conservation	"	5/13/81	Closed 5/31/81	-	-	1,840	1,840
5210	Accumulate all costs for Project Group reviewing J. R. Morris Report "Water for Denver - An Analysis of the Alternatives"	Manager	4/27/80	Open	-	9,437	139	10,076
OTHER WORK ORDERS POSSIBLY RELATING TO WATER CONSERVATION								
9611	To accumulate costs of (a) maintenance) landscape garden at Admin. Building	Plant	4/8/82	Active	-	-	-	-
7088	Landscaping for Wynetha Residence	"	1/27/82	Open	-	-	-	-
7359	Reseed native areas at Westwood	"	1/27/82	Open	-	-	-	-
9290	Regrade & reseed between Reservoir & Josephine St. (Capital Hill Reservoir)	"	1/27/82	Open	-	-	-	-
9091	Remove berm, regrade, reseed with native grass & landscape at Ashland Reservoir	"	1/27/82	Open	-	-	-	-
TOTAL EXPENDITURES 1979 - 1981 INCL.					417,487	1,592,923	492,213	2,102,543
**	For all work and materials needed to repair leaks to mains & services	Plant	Continuously open & close as needed		463,000	601,626	931,641	1,996,267
***Notes of all work orders to extensive to last here								
GRAND TOTAL WATER CONSERVATION PROGRAM EXPENDITURES 1979 - 1981					880,487	2,194,549	1,423,854	4,508,890

Table A-1
CONSERVATION OVERVIEW

<u>Community (in-state)</u>	<u>Restrictions</u>	<u>Metering</u>	<u>Public Education</u>	<u>Rate Structure Modification</u>	<u>Leak Detection</u>	<u>Water Saving Devices</u>
Arvada	Yes	100%	No	Inverted Rate	Yes	*N/A
Aurora	Yes	100%	Yes	Penalty Rate	Yes	Available Upon Request
Boulder	No	100%	No	Flat Rate	No	No
Colorado Springs	Yes	100%	Yes	10% Annual Increase	No	Distributed
Englewood	No	Partial	No	No	No	Low Cost/ No Cost
Fort Collins	Yes	No	Yes	Fee: Size of lot	No	By Request
Greeley	Yes	Partial	Yes	Yes	Yes	No
Loveland	No	100%	Yes	Yes	Yes	No
Thornton	Yes	100%	Yes	Summer Rates	No	By Request
Westminster	No	100%	Yes	Yes	Yes	Distribution by Request

* Not Available

<u>Community (Out-of-state)</u>	<u>Restrictions</u>	<u>Metering</u>	<u>Public Education</u>	<u>Rate Structure Modification</u>	<u>Leak Detection</u>	<u>Water Saving Devices</u>
Albuquerque	No	100%	Yes	Yes	Yes	No
East Bay	Yes	100%	Yes	Considered	Every 3 years	Distribution
Los Angeles	Yes	100%	Yes	Yes	Yes	Yes
Phoenix	Yes	100%	Yes	Flat Rate	Yes	Not Yet
San Diego	No	100%	Yes	No	Yes	Distribution
Salt Lake City	No	100%	Yes	Declining Block to Straight Line	Yes	No
Seattle	No	100%	Yes	Yes	Contracted	Distribution
Tucson	No	100%	Yes	Yes	Yes	By Request

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