IMPLEMENTING MUNICIPAL WATER CONSERVATION POLICY:

GOALS, PRACTICES AND THE CASE OF TEXAS

Kariann Elizabeth Sokulsky, B.S.

APPROVED:

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Major Professor

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Committee Member

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Committee Member

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Dean of the Robert B. Toulouse School of Graduate Studies

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Kariann Elizabeth Sokulsky, B.S.

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This study examines whether water conservation is actually being incorporated into municipal water management practices. The development of a conservation policy from a general goal declaration to specific programmatic practices is reviewed for a Texas state water agency, the Texas Water Development Board (Board).

From January 1986 through September 1989, 102 political units in Texas applied to the Board for water-related loan funds and thus were required to implement municipal water conservation plans. Two aspects of this conservation policy are assessed: one, the Board's procedural arrangements for the development and review of water conservation plans, and two, the conservation plans of each political unit. It is concluded that Texas state water managers, and local managers also, have yet to incorporate conservation as a significant planning tool for the achievement of water management goals.

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CHAPTER 1

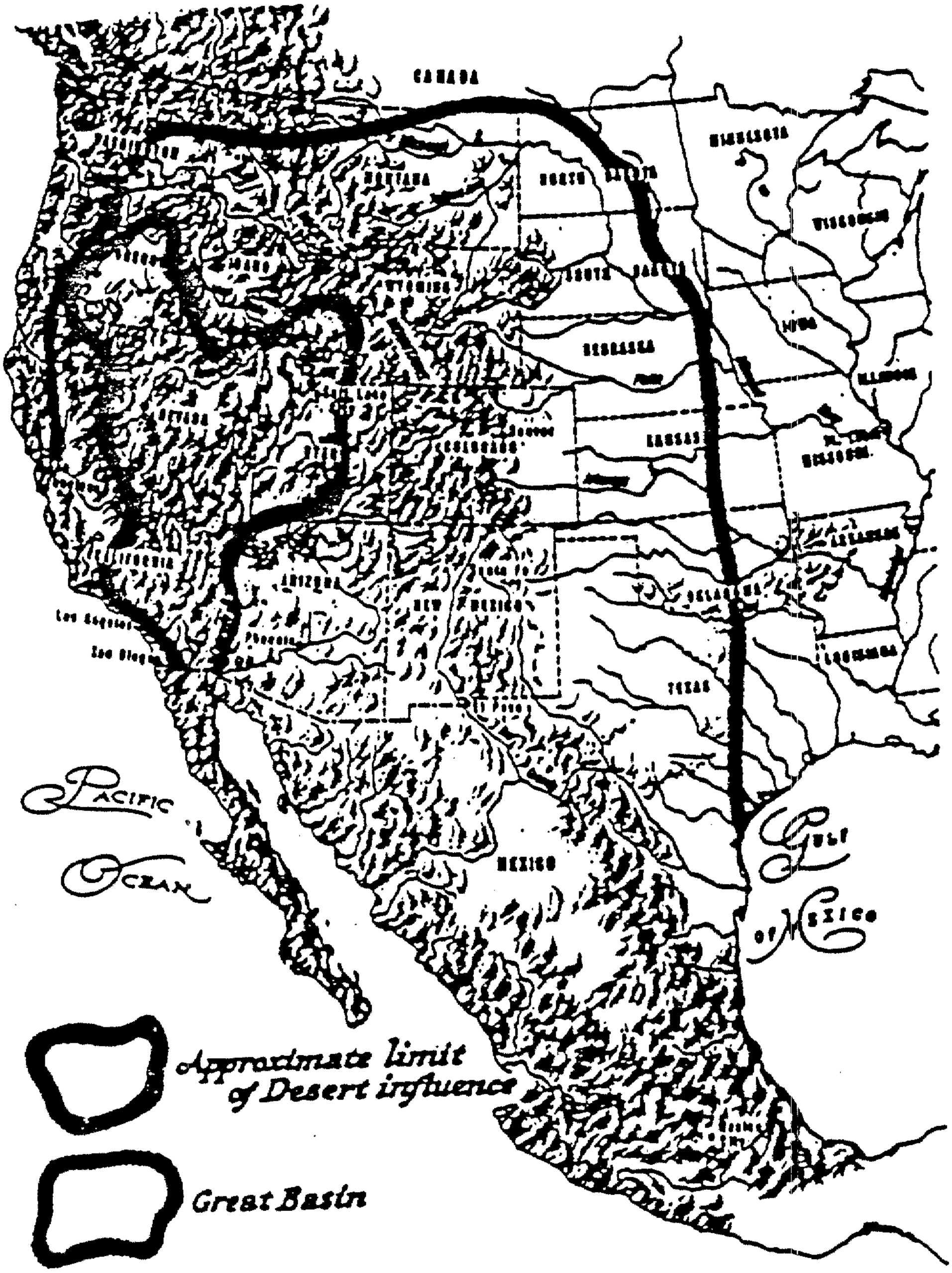
INTRODUCTION

In the western United States settlement has been tied to perceptions of water availability. Until the 1870s the Mississippi River represented the limit to further settlement because most of the land west of the Mississippi lacks the availability of water typical in the east states (Stegner, 1987; Reisner, 1986). Much of the western states is classified as either arid or semiarid; that is, it receives less than twenty inches of rain annually. In fact, the land between the Mississippi and the Rocky Mountains, the Great Plains region, was originally denoted as "the Great American Desert". A map marking the Great Plains as the Great American Desert appeared in an 1824 geography textbook, and later "the Great American Desert" also referred to the territories all the way to the California Coast, as illustrated in Figure 1. This image remained fixed on maps and in the American mind for the next five decades (Hollon, 1966). Time, however, reveals that perceptions change and that perceptions influence the formation of social institutions.

In the 1870s redesign and settlement of the West began to occur as new images of the West formed. The American nation was avid for imperial expansion, the majority of its

FIGURE 1

The Great American Desert



Source: Hollon, 1966.

citizens and immigrants wanted to get rich, and the underpopulated West was where a great many "hoped to find their fortunes" (Reisner, 1986, p. 50). A burning desire to believe in the chance for economic improvement created a mythical West, a West synonymous as a place of unlimited opportunities (Athearn, 1986; McCool, 1987). People would deny that the West was dry, and so, as thousands migrated west, the desert would move. It was always out "there", somewhere. By the late 1870s the Great American Desert referred only to the Great Basin region.

In the 1890s the reality reemerged that the mid-west and western regions were arid. A multi-year drought which began in 1888 and affected the mid-West and West resulted in the abandonment of hundreds of homesteads. As a result of this reality, the reality of aridity, coupled with a political creed espousing agrarian populism and a proposition that development is intrinsically good, the new century witnessed the birth of water management which focused on engineering solutions to "reclaim" the arid lands west of the Mississippi. As Stegner states:

> "And what do you do about aridity, if you are a nation inured to plenty and impatient of restrictions and led westward by pillars of fire and cloud? You may deny it for a while. Then you must either adapt to it or try to engineer it out of existence." (Stegner, 1987, p. 27)

"The water problem" was identified and structured in terms of the <u>quantity</u> of water available. The result would be structural solutions aimed at delivering ever-increasing quantities to both agricultural lands and urban areas. Water management focused on the "development" of supplies. Water management meant strategies for augmenting, moving, or holding back absolute quantities of water.

Water Management Practices

The history of water management in the U.S. illustrates that the range of proposed solutions to a problem depends upon how a problem is originally defined. "The water problem" has been traditionally formulated as a stock, i.e., quantity, problem: either because there wasn't enough of it, or there was too much of it. The result was that water management practices focused on technical or engineering solutions to "the supply" problem. In the West, an arid climate coupled with an adherence to a "water-causes growth" hypothesis has encouraged approaches aimed at augmenting stock supplies. Even the East, where flooding is common, water management strategies have been structurally oriented. Flood control reservoirs, for example, are favored over non-structural approaches such as zoning. Both East and West, these structural solutions have been characterized by capital-intensive projects which have required federal subsidization to finance their construction (Gottlieb, 1988; Schoolmaster, 1987).

Since the 1960s water management has begun to reference a broader range of activities. The quality of water and the nature of service delivery are considered as important, perhaps more important, than the quantity of water present.

Additional considerations in water management have occurred, in part, as the "survival image" of water has begun to fade. The survival image derives from the fact that water is necessary for life, results in water lore that treats all water uses as requirements, and thus concludes that water should be provided practically free in whatever quantities a person can use (Kelso, 1967; Martin, et al., 1984). As a result of changing perceptions as to what is "the" water problem, other strategies have been proposed for managing water resources. In the 1980s, one of the most prominent of these new strategies is conservation.

Currently, water conservation usually denotes reductions in water use. This is the definition used in this research. Conservation is presented in the water management literature and by water managers as a tool for addressing various water management issues rather than being an end in itself. Achieving significant reductions in use thus "stretches" water supplies among more users and for more uses (including environmental preservation). Water conservation can be a cost-effective alternative to the procurement of obtaining additional water or to increasing the size of water supply or wastewater facilities (Macy and Maddaus, 1989; Baumann, 1990; Prasifka, 1980). Water conservation is also being promoted as a tool for addressing environmental concerns (Dyballa, 1990; Keith and King, 1989). And, water conservation is being considered as a management tool for aiding the preservation of aquatic ecosystems (Moore, 1991).

Purpose of Study

The purpose of this study is to assess the nature and role of municipal water conservation within the context of water management in general and in Texas in particular. This study will review the development of a conservation policy from a general goal declaration to specific programmatic practices at the administrative level for a Texas state water agency. While water conservation has been proposed as a significant water management tool, a need exists to document the degree to which water conservation is actually being practiced and then integrated with other planning measures; another research need is the need to monitor actual implementation and operations of conservation programs (Grisham and Fleming, 1989; Maddaus, 1990; Martin, 1990). By examining actual program implementation of a water conservation policy by a Texas state agency, this study intends to meet these two research needs.

The need to both document and monitor the implementation of conservation programs is indicated by two factors. First, there is little rational in studying the desired effects of a program (in this case, decreases in water use) if the program was not properly implemented. The implementation of policy is itself part of the policy-making process and so is a causal factor in the effectiveness of a program. Understanding the operations of policy implementation often reveals why, or why not, programs succeed. Second, in a survey regarding state conservation programs, water managers indicated a desire for information on actual programs (Sawyer, 1984). Results of this survey indicated that understanding the potential benefits from conservation is not the same as knowing how to go about designing an effective program in order to realize desired outcomes.

The Case of Texas

Texas provides an interesting case of a region moving from an era where water management traditionally meant development and into an era of more comprehensive and integrated management strategies. The history of water management practices in Texas, like that of the United States, has been oriented towards development of water supplies. Yet, state-wide planning for water resource management was not initiated until the 1960s. The first state-wide plan, The Texas Water Plan, was formally presented to the public in 1968 by the Texas Water Development Board (TWDB), the agency which was delegated the responsibility for State water planning. This first plan was oriented towards the capture and transport of surface water supplies. Conservation as a management tool was missing from the 1968 plan.

Events in the 1980s indicated a new trend in Texas water resource management. In 1984 a new State water plan, Water For Texas, was adopted, and water conservation was included as a significant tool for meeting water demands. In 1985 the Texas Legislature adopted House Bill No. 2 (H.B. 2) which mandated that political subdivisions receiving water development funds from the State be required to implement conservation programs. The same bill directed the TWDB to form and adopt rules for implementation of conservation programs and, if funds are available, to provide technical assistance to political subdivisions adopting conservation programs (H.B. 2, Sections 6.01 and 1.04) For at least four reasons policy-making power regarding water conservation was imparted to the Texas Water Development Board (Kramer, 1986).

First, the TWDB still retains responsibility for maintaining and updating the State water plan. Second, the specifics of the programs are left to the discretion of the TWDB. For example, no specific conservation element such as water rates or plumbing codes are mandated in H.B. 2. Third, TWDB can employ any one of three competing legal definitions of water conservation. While H.B. 2 legally redefined conservation to mean also reductions in use and improved efficiency, the Texas Water Code still retains the concept of supply development as one meaning of conservation. Fourth, H.B. 2 enables TWDB to grant exemptions given any one of three conditions:

(1) an emergency exists as determined by the board;

(2) the amount of financial assistance to be provided is $500,000 or less; or

(3) the applicant demonstrates and the board finds that the submission of such a program is not reasonably necessary to facilitate conservation or conservation measures.

Kramer (1986) has stressed the implementation process of H.B. 2's conservation directives as significant in shaping the role that water conservation will play in Texas water management. How the TWDB has approached water conservation and its willingness to require conservation practices, in turn, depends on how the TWDB itself conceptualizes the role of water management.

Design of Study

The specific objectives of the study are to:

(1) Provide an overview of water resource management and conservation;

(2) Evaluate the degree to which conservation programs have been successfully implemented in Texas;

(3) Determine the existence and meaning of conservation planning in Texas;

(4) Make relative recommendations, if any, for Texas state water management.

The first objective will provide a standard by which to evaluate water management and conservation strategies as implemented in Texas. The second two objectives are intended to indicate the degree to which Texas is moving towards a more comprehensive water management policy. Data to be examined include the characteristics of program development by the TWDB as it responded to the mandates in H.B. 2 and the individual conservation plans approved by the TWDB; these data were supplied by the TWDB.

Chapter 2 addresses the first objective above, discussing water management in general and the role of water conservation in water management. Chapter 3 presents an overview of the history of Texas water management policy. How the second two objectives will be methodologically achieved is discussed in Chapter 4. Chapter 5 presents the data and analysis of the implementation of H.B. 2's conservation mandates by the TWDB. Conclusions and recommendations are presented in Chapter 6.

CHAPTER 2

OVERVIEW OF WATER RESOURCE MANAGEMENT

This chapter highlights the role of water conservation in water management and planning. Yet, in order to discuss this role, it is first necessary to clarify terms and concepts. How a problem is defined dictates the range of proposed solutions to be considered, and as problems are redefined, or "change", new solutions are proposed. The call for conservation--meaning reductions in use--as one, overlooked tool for addressing various water "problems" is a case in point. Where the water problem is defined primarily in terms of the quantity of water available, water conservation has meant the development, or increasing, of supplies. The meaning of water conservation, however, has changed as the perspective on managing water resources has changed. As additional water "problems" have been addressed by water managers, water conservation has assumed the meaning of decreases in water use, or demand.

The ambiguity and shifting definition of the term "conservation" derive from the fact that each academic discipline and water interest group defines and addresses water resource issues from its own perspective. Each water management "issue"--water supply, protection of water quality, preservation of rivers, wetlands and bays and estuaries--is presented as "a problem", too often addressed independently of the others. What is proposed here is that each water management "problem" is merely one aspect reflecting a base, or fundamental, water problem. The underlying intent of this chapter is to provide a single definition of "the" water problem and "water management" for addressing a range of water management issues. The fundamental water problem is defined below as the problem of allocating water resources among competing uses, or demands.

The remaining part of this chapter is organized as follows. Concepts underlying the definition of the basic water problem as one of allocation are discussed first. These concepts are organized into a rather broad definition of water management and four tenets proposed here as necessary for approaching water management comprehensively. Then, the definition of the water problem as an allocation problem is discussed. Finally, the role of water conservation within water management is discussed, followed by a brief overview of policy in general.

The Meaning of Water Management and The Water Problem

The United Nations Education, Scientific and Cultural Organization (UNESCO) has defined water resource management comprehensively as:

> "all actions taken within a given society concerning the interface of that society with the water resource."

This definition allows for the fact that, whenever it utilizes water, a society engages in water management, whatever the purpose. Water management reflects a goal: the utilization of a water resource in order to realize some benefit it imparts. Even a water resource purposefully left in place for aesthetic or environmental preservation, for example, preservation of wetlands, represents utilization in that this use derives from a chosen goal.

Water management includes the traditional activities of quantity and quality management, or supply management. Supply management refers to those activities which aid in the provision or maintenance of a water resource. Quality control activities are included in supply management since this refers to the "production" of water for various uses.

In the 1970s water management began to reference activities which affect the specific uses of water, that is, demand management. Demand management is often used synonymously with conservation, but equating demand management with conservation is too narrow, for any activity which influences the specific use of water qualifies as demand management. For example, water demand management may involve an allocative change from one use to another, but the total quantity used may remain the same.

Planning is also a subset of management and generally refers to the determination of long-range goals and delineation of objectives to achieve those goals (Marlatt, 1990; Peterson, 1984; Kindler and Russell, 1984; Starling, 1979). The emphasis on long-range goals explicitly introduces time into allocative decisions concerning water resources and distinguishes the planning function from other management activities. The day-to-day implementation of specific actions designed to achieve objectives constitute the operational activities of management. Thus, supply and demand management activities might be thought of as operational management: delivering specific quantities at the right quality at the right time. Anticipating and/or regulating those "right" quantities and quality is a planning function.

Figure 2 and Table 1 illustrate this framework for water management and some specific practices of supply, demand, and planning activities. It should be noted that there is overlap between environmental management and water resources management.

Tenet 1: The demand for water reflects relative value.

Many articles about water issues, especially urban supply, often include such phrases as "Because water is a basic necessity of life. . . ." (AWWA, 1990). Water <u>is</u> necessary for life, but such phrases are misleading in that they imply that water management issues, usually supply, are referencing only quantities for drinking and sanitary purposes. In the Unites States the quantity of water being referenced for urban purposes, and often agricultural use also, is well beyond what is required for sustaining life

FIGURE 2
A Water Management Schema

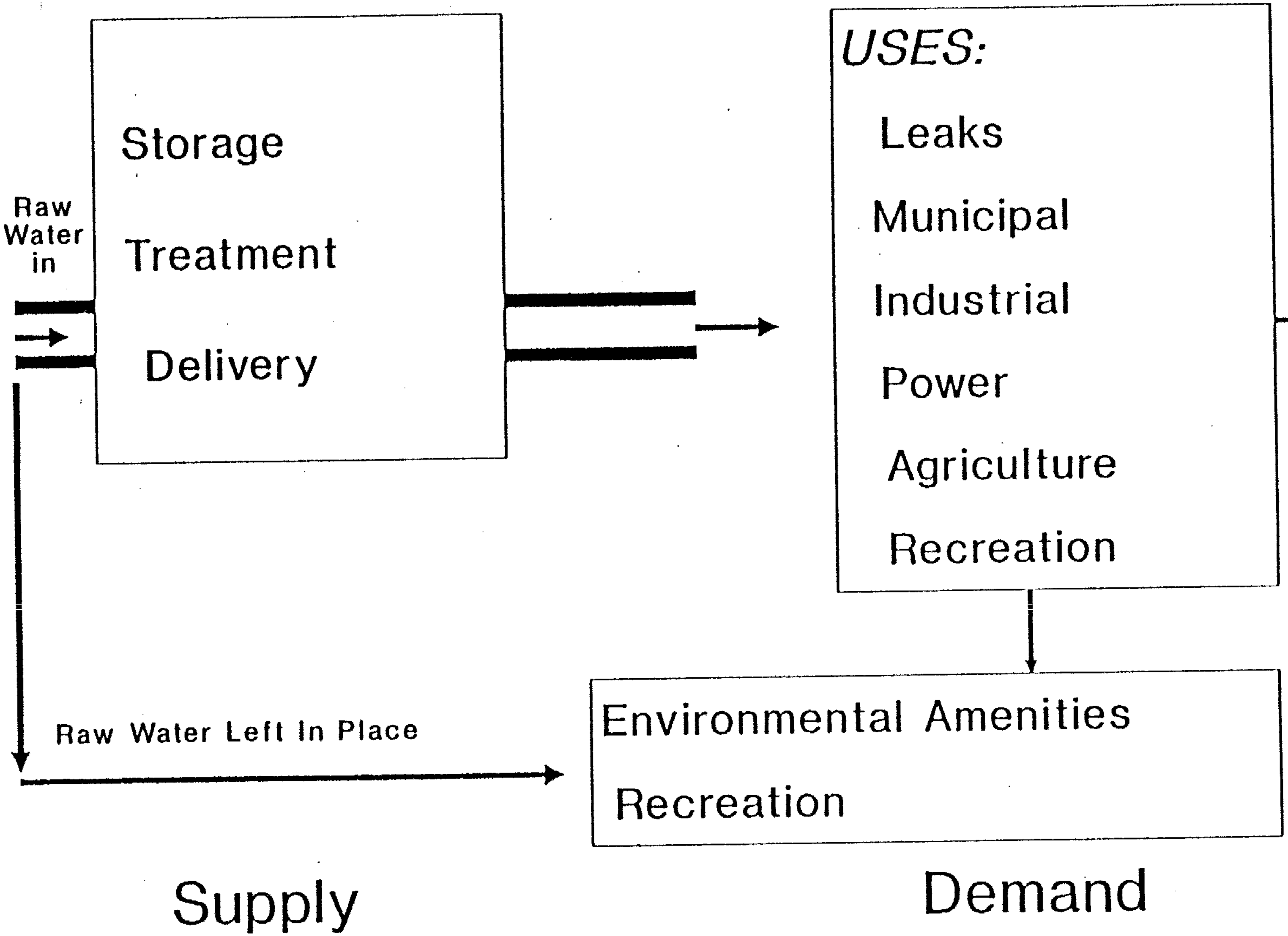


TABLE 1

Water Management Practices

PLANNING	SUPPLY	DEMAND
Goal specification Data collection Forecasting Formulation of strategies to achieve goals Evaluation of programs and planning	Storage Diversion Systems operations Quality control Delivery	Conservation Preservation of the natural environment Adjudication and management of rights

and basic hygiene. Most modern uses for water reflect a preference and not a requirement, or absolute "need" (Kelso, 1969; Kindler and Russell, 1984). For example, in the western states a significant amount of municipal (potable) water is used for landscape irrigation (California DWR, 1988). Moreover, much of this landscape irrigation water ends up as runoff, as people chose to irrigate inefficiently rather than devote time or management resources in order to irrigate more efficiently (Browning, 1986). Such a choice reflects a preference, a lifestyle, for one good--the landscape, its appearance, <u>and</u> the manner of irrigation--over any other good or service which might be consumed for a given income.

To understand the relative value of water resources, a distinction must be drawn between water <u>use</u>, water <u>requirement</u> and economic <u>demand</u> (Kindler and Russell, 1984). Water <u>use</u> is a description of the volume of water directed towards a particular end. Water <u>requirement</u> denotes that some minimum quantity is needed in order to perform a given function. The amount of water used is not necessarily the amount of water required: The human body only needs a few liters per day. Agriculture and industrial activities may also require some minimum quantity of water in order that production be carried on at all, but that minimum requirement can vary as the production technology varies (Gibbons, 1986; Mather, 1984; Grebstein and Field, 1979).

<u>Demand</u>, as used in economics, indicates the relative value of a good beyond some minimum threshhold requirement. Economic demand is a function of the opportunity costs of consumption. An opportunity cost, the real cost of consumption, is incurred whenever a choice is made; it is a sacrificed alternative. The real costs of consumption are other goods which could have been consumed. Alternatively, the real costs of consumption are other goods or services which could have been produced by the economic system. In private and efficient markets, monetary prices serve as a measure of opportunity costs, and all opportunity costs for a given good would be captured in the monetary price of that good. Demand is operationally defined as a function of price (opportunity costs), tastes and preferences, income, availability of other goods, and other variables, depending on the good in question.

The relative need, or demand, for water resources occurs because they are limited in time and space, and, thus, because of competing uses to which water resources may be put.

Tenet 2: Water availability is not a fixed supply.

The value of a resource is a function of people's wants and capabilities, as well as the quantity present, the quality, and the location (Mitchell, 1984; Gibbons, 1986; Ely and Wehrwein, 1964). This perspective ignores the preservationist argument--that natural resources possess value beyond their utility for satisfying human needs and wants. However, even the determination of natural resources left in place for any chosen value may be viewed, from society's viewpoint, as a "use".

Thus, the supply of water has two levels of meaning. On the one hand, supply can be defined in terms of only the stock, that is quantity, of water which is present. This concept of water refers to its occurrence and distribution in the environment. However what is significant for meeting human demands is the availability of water, that is, the economic supply of water. Water is "produced" in order to become available for use. That is, its locational, quality and timing attributes are transformed. This, by definition, is "production". To utilize water for municipal use requires at minimum the employment of other resources to extract, store, treat and deliver specific amounts. Thus, the production, or economic supply, of reflects the opportunity costs of consumption, for the production of water will rule out using related inputs to produce some other good or service.

Tenet 3: Water scarcity is a function of both supply and demand.

Water demand exists because water is valued. Yet, using or producing water costs. Water production involves the utilization of other resources--labor, storage facilities, treatment facilities--in order to make the water available for use. The water problem is not one of supply, nor one of demand. Rather, the economic concepts of supply and demand are useful for defining "the water problem" and for approaching water management issues. Both supply and demand together determine the availability, or scarcity, of water.

Tenet 4: Any "problem" is a function of values.

Before formally defining the water problem, a quick discussion on defining problems may be useful. Problems do not have an objective reality. They are defined rather than discovered and do not exist independently of the human act of valuing what is important. Problem definition is a necessary first step towards clarifying what our goals are and how we can attain them. Dery's (1984) assessment of the nature of problem definition rejects two common definitions of "a problem". First, he rejects the formulation of a problem as a description of causes. To imply that a problem is a cause per se, he argues, often illicits the solution of removing the cause. Yet, neither causes by themselves are necessarily "bad", nor does understanding the cause of a problem necessarily produce feasible solutions. Second, Dery rejects identifying a problem as a discrepancy between "what is" and "what ought to be". Problems as mere discrepancies between what we are experiencing and what we aspire to still leaves unattended "the crucial role of problem definition", the need to identify an array of solutions. Problems, according to Dery

(1984) and others in the public policy field, are approached from an interventionist point of view. A problem is an opportunity for improvement, for doing something. The act of problem definition provides a means for representing a reality which we are seeking to change; a problem is a framework within which certain interventions, or measures, are identified as solutions.

Tenet 5: The fundamental water problem is one of allocating water.

The water problem is a management problem because we seek in some way to do something with it, because we value water for consumptive, recreational, aesthetic and other uses. "The water problem" is a problem of scarcity, with supply and demand being concepts which allow for the structuring of the water resource problem so that the problem is, well, manageable. The fundamental issue for water managers is the problem of how to allocate water among competing uses, or demands. It involves as much the decisions of which uses, when, for whom, as well as determining the technical strategies of how to deliver specific quantities at the right quality and at the right time.

This formulation of "the water problem" as an allocation problem is becoming more common. Viessman and Welty (1985), Mather (1984), and Kindler and Russell (1984) explicitly define the water problem as an allocation problem rather than a supply shortage problem. Mather (1984), for example, writes that water resources management addresses the problem of providing the right amount of water at the right time at the right quality. And Viessman and Welty (1985) state: "The problem of allocating available water so as to satisfy a multiplicity of users is the fundamental water problem" (Viessman and Welty, 1985, p. 16). This definition of the water problem is also congruent with the definition of economics: the study of how societies allocate resources among competing demands.

Structuring the water problem in terms of both supply and demand allows conservation to be more readily considered as a management tool and to become an integral part of the planning procedure. Instead of posing the question, for a given demand how much water "needs" to be supplied, the question might be asked, for a given supply, what demands can be served? However, formulation of the water problem as only a function of the quantity and quality of water present is still prevalent (see, for example, Prasifka, 1985).

The Changing Role of Water Conservation in Water Management

While the basic water problem has not changed, what has changed is the perspective on solutions. The debate over the appropriate role of conservation in water management and planning underscores the premise that the identification of solutions depends upon how a problem is originally defined.

The traditional approach to the water problem

In the western U.S., the traditional focus of water management towards supply augmentation is a logical solution when historical water use, water requirement and water demand are employed synonymously. Thus, increases in demand are viewed as absolute requirements to be met (Boland, 1978; Griffin and Stoll, 1983; Wade Miller Associates, 1987). This approach is in part based upon a survival image of water: that is, water is necessary for life (Kelso, 1967; Griffin and Chang, 1989). However, most often water resource issues are referencing economic demand and not a requirement. In urban water supply, the synonymous use of demand with requirement results in the computation of future water demand by extrapolating historical per capita use. This method of forecasting demand implies that demand is only a function of historical per capita use and service area population and thereby "often carries over into the closely allied process of supply facility planning, where the water use forecast may be taken as an absolute requirement for future supply capacity, to be met regardless of cost" (Boland, 1978, p. 94). As a consequence, water management, using this forecasting method, becomes limited to technical solutions for augmenting, storing and delivering quantities of water. Equating water use, requirement and demand forces a formulation of the water problem as a supply shortage problem rather than one of both demand and supply.

The traditional definition of the water problem as caused by a supply shortage is aided by adherence to a water driven growth hypothesis and use of "supply" which references quantity only. However, Luecke and Fanning (1988), in a review of empirical studies regarding the significance of water to induce growth, conclude that "a careful review of empirical data leads to an acceptance of the null hypothesis, i.e., investments in water supply systems do not have a noticeable impact on a region's growth" (Luecke and Fanning, 1988, p. 25). This hypothesis is further substantiated by studies which have found that water is not a significant location variable for industries (Mather, 1984; Luecke and Fanning, 1988; UNESCO, 1987). However, both the Luecke and Fanning study and the UNESCO report are careful to note that while water does not appear to be a causal factor for growth, water may be significant for development.

The relative unimportance of water for inducing growth is supported by both agricultural and industrial production processes which do not <u>require</u> water but have a <u>demand</u> for it. Both sectors can substitute capital and management practices for quantities of water. In agriculture, timely application of water can decrease the volume of water used without negatively impacting yields. Industrial use of water varies both across and within sectors suggesting that where large volumes of water are used it is "from the fact that inexpensive supplies are available rather than from real need for that much water in the process of manufacture" (Mather, 1984, p. 115).

A common theme in the recent water literature is to attribute the cause of modern water problems to management. The resulting solution is to advocate a return to the market. It may be that the market would result in more efficient use and allocation of water resources, but reliance on the market still involves "management" of resources. That is, we would still be determining towards **which** uses to allocate water resources, **when**, and **how**, only price would become the primary allocative mechanism.

New Approaches in Water Management

In the last 25 years more acute competition for water resources has occurred. Yet, the basic management problem remains in tact: allocation of water resources among competing uses.

Increasing demand for urban water uses has occurred from a number of factors. First, growing populations have increased demand. Also, increases in income also increase water demand, as incomes increase so do the number of "uses" towards which the individual may wish to apply water. Also, the types of uses towards which water may be applied have also increased. Not only does water have value in use as a commodity, it has value for recreation, aesthetic and environmental preservation uses.

Decreases in supply have occurred in both the physical and economic frameworks. Physical depletion occurs when the actual quantity of water is being depleted, such as the mining of an aquifer. A decrease in the economic supply of water occurs when the current stock can no longer be provided without the employment of a greater amount of complementary resources. That is, an increase in opportunity costs decreases supply. Diminishing water quality effectively decreases supply since the poorer quality water may no longer be used by either humans or the environment without more resources being applied to transform the water to a particular use. Negative environmental impacts also contribute to a decrease in supply as these resources represent sacrificed alternatives in the provision of water resources. Finally, increasing financing costs have also contributed to a decrease in supply.

As the public and water managers have recognized a broader range of uses for water, the range of solutions for managing water resources has also increased. Alternatively, as more issues are addressed by water agencies and managers, water "problems" have taken on new meanings, as have solutions. This is the case with water conservation. The meaning of water conservation has changed as the perspective on managing water resources has changed. At least four definitions of conservation can be identified. In the traditional approach to water management, where the water problem is framed in terms of delivering ever increasing quantities to both agricultural and urban users, conservation is necessarily defined as "development". In the West, to waste water is not to consume it, that is, to let it flow unimpeded and undiverted down rivers (Reisner, 1986). This definition reflects the underlying ideology of utilitarianism and the desire to induce regional growth.

Conservation sometimes is used to mean preservation, that is, leaving a resource in place or not using it at all (Martin, et al., 1984). The preservationist definition values environmental resources beyond just their usefulness to man. Preservation itself is a goal and actually reflects competition for an environmental resource for either economic or other uses. Because of the various definitions of conservation, it is suggested here to use "preservation", and not "conservation", to mean preservation.

A third definition of conservation is simply one of better management over time: conservation is that "balance of policies, programs, plans, projects and practices . . . from exploitation to preservation . . . ." (Black, 1987). This definition often takes the form of "wise and efficient use". However, equating conservation to "good management" is too vague in specifying **which** practices should be implemented, how, and for that matter, why.

Baumann, Boland and Sims (1984), in arguing for a more precise and operational definition of conservation, define water conservation as a reduction in use as long as the benefits from using less water outweigh the costs involved in implementing conservation strategies. They argue that "when conservation is thus differentiated from other desirable water management measures, it becomes possible to formulate policies and propose practices that are unambiguously directed to effect conservation, and it becomes possible to evaluate their success" (Baumann, Boland and Sims, 1984, p. 432). Baumann, Boland and Sims (1984) definition of conservation will be used in this research for three reasons.

First, it is operational. Water use can be measured without subjective interpretation. For where variables can be operationalized, results can be more readily repeated or validated by others. Secondly, as Baumann, Boland and Sims point out, defining conservation as a decrease in use allows conservation measures to be distinguished from other management strategies. Then, designing the specifics of a conservation program itself becomes easier.

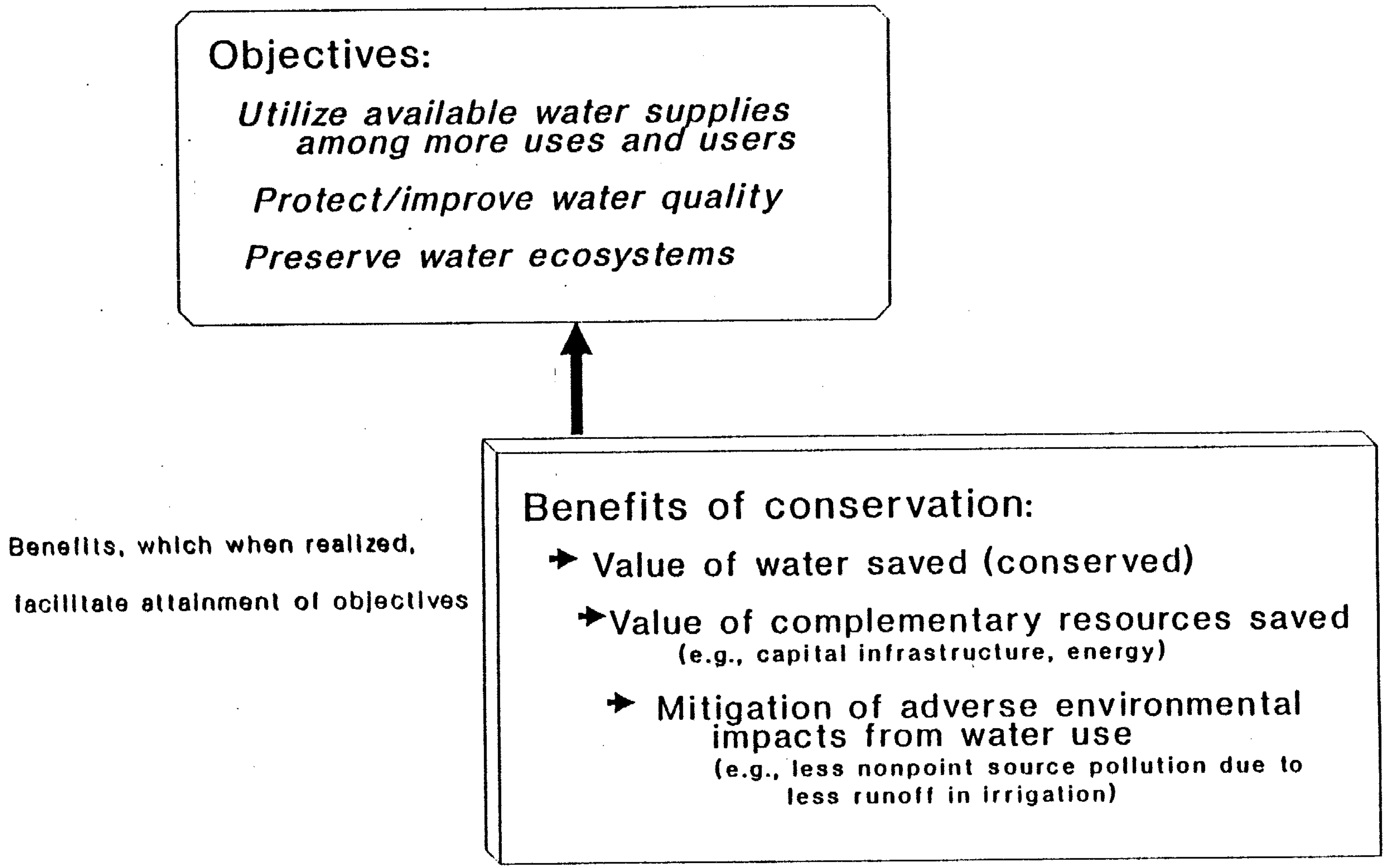
Finally, the last qualification in the definition of conservation, that the benefits should outweigh the costs, is important--for conservation also involves costs.

Conservation programs will necessarily entail the use of resources--personnel, capital equipment, time--which could be utilized in other endeavors. Requiring that the benefits be greater than the costs is congruent with the notion of wise and efficient management.

Figure 3 illustrates three common water management objectives; conservation may be utilized as one of many policy instruments for attaining these water management objectives. The overall goal of water conservation can be summarized as the reduction in the use(s) of water and/or the quantity withdrawn from an aquatic system so as to attain any of the following three objectives: (1) to "stretch" water supplies among more users and uses; (2) to protect or improve water quality; and (3) to preserve water ecosystems. Figure 3 also lists benefits from conservation. Capturing the benefits from conservation facilitates the achievement of water management goals, essentially "stretching" supplies among more users and uses. The value of water conserved is only one benefit from conservation. The deferred costs of complementary resources needed to use, or supply water, also represent a savings. The most significant of these deferred costs are usually capital infrastructure investments and the interest on the capital financing. Mitigation of environmental impacts from

Figure 3

Conservation as a Policy Instrument for Achieving Water Management Objectives



decreased or more efficient water use also represents additional benefits to be realized from conservation.

Conservation measures

Specific conservation measures may be grouped into those which are structural, operational, economic and social (Flack, 1978). However, these last two categories reference activities which would produce a particular behavioral response from the individual user; specifically, the individual user would become more conscious of the amount of water he would chose to use. Structural measures include metering, leak detection, recycling and installation of plumbing fixtures. Operational practices would include restrictions on delivery and elimination of unauthorized users. Behavioral measures include metering, prices, rate structures, penalties, education and horticultural practices.

Public Policy of Water Allocation

Water allocation in the United States has been largely determined in the public policy arena and not in the market. Natural resource policy, in general, is a public-policy process for deciding what we want to do with our resources, how we can manage the resource so as to attain goals, and the impacts of water management decisions. Policy is not just declared by legislative or judiciary branches of government. The policy-making process involves the determination of goals, legitimatation of policy, implementation of plans for achieving goals, and the impacts of policy.

Yet, "policy" is commonly used with two levels of meaning, one narrow and one that is broader in meaning. Narrowly, policy is used to reference a goal or set of goals. A goal reflects a value choice and is often stated in vague or unmeasurable terms, such as "it is the policy to decrease the crime rate", or "our goal is to improve the quality of water within this region" (Starling, 1979, and Carley, 1980). However the broader meaning of policy references not only goals, but the plan and specific measures for achieving goals and the outcomes of putting policy into practice. A plan is a set of <u>measurable</u> objectives to attain a goal and a measure is a specific action to attain an objective. For example, a water conservation plan would state a measurable objective such as decreasing per capita use by 10%. Education, price changes and retrofitting are specific measures for achieving that objective.

This research is concerned with the broader meaning of policy. The policy process involves not just the determination of goals, but also goal legitimatation, implementation of policy, and policy outcomes. Public policy-making is a dynamic process between legislators, administrators and the public, and not a linear process wherein administrators passively receive a message about what to do and whom to affect. Rather, where goals are ambiguously defined, or where tactics for achieving those goals are not specified, agencies responsible for implementing programs to achieve stated goals may have significant influence in defining policy and affecting outcomes. Moreover, outcomes themselves can affect feedback regarding whether a program should be modified or not. The process of implementing policy will be further discussed in Chapter 4, which outlines the method of analysis used in this study.

Summary

This chapter has focused on concepts and premises underlying the analysis and conclusions in subsequent chapters. Four of these concepts in particular are:

> the premise that the implementation process of public policy goals may partially define those policy goals;
>
> the concept that all water issues are but different facets of a basic problem, that of allocation;
>
> the definition of water conservation as a reduction in water uses (demands);
>
> the concept that water conservation is but one tool for achieving the desired objectives of a water management agenda.

The promotion of water conservation as a means to stated objectives has occurred in Texas, particularly as an alternative to additional investment in water facilities. However, the question remains as to whether water conservation has yet to be effectively utilized by water managers in the State. Policy in general may be explicitly and rationally determined, or may be determined in an ad hoc fashion. In Texas, water policy has tended to developed in an ad hoc fashion. Water laws, public water agencies and related programs have been created in a piecemeal fashion to deal with problems as they arose rather than being created to provide long-range planning. The next chapter looks more closely at the development of water resource policy in Texas.

CHAPTER 3

HISTORICAL OVERVIEW OF WATER RESOURCE MANAGEMENT IN TEXAS: 1904 TO PRESENT

Public management of water resources in Texas began in 1904 and until the mid-1980's reflected a policy of water supply development. Whether for the purpose of flood control, irrigation, navigation, or meeting increasing demands, water planning in Texas has emphasized construction of storage and delivery facilities. Considering that Texas has only one natural lake, the degree of construction activity in Texas cannot be overstated. In 1913 there were eight major reservoirs in Texas with total storage capacity of 376,000 acre-feet (Texas Almanac 1988-1989). In 1970 Texas had 149 major reservoirs with total capacity of 51,086,200 acre-feet. This represents a construction rate of approximately 2.5 reservoirs per year. And in 1983 there were 189 major reservoirs with 56,600,000 million acre-feet for a construction rate of approximately 3 new reservoirs per year between 1970 and 1983.

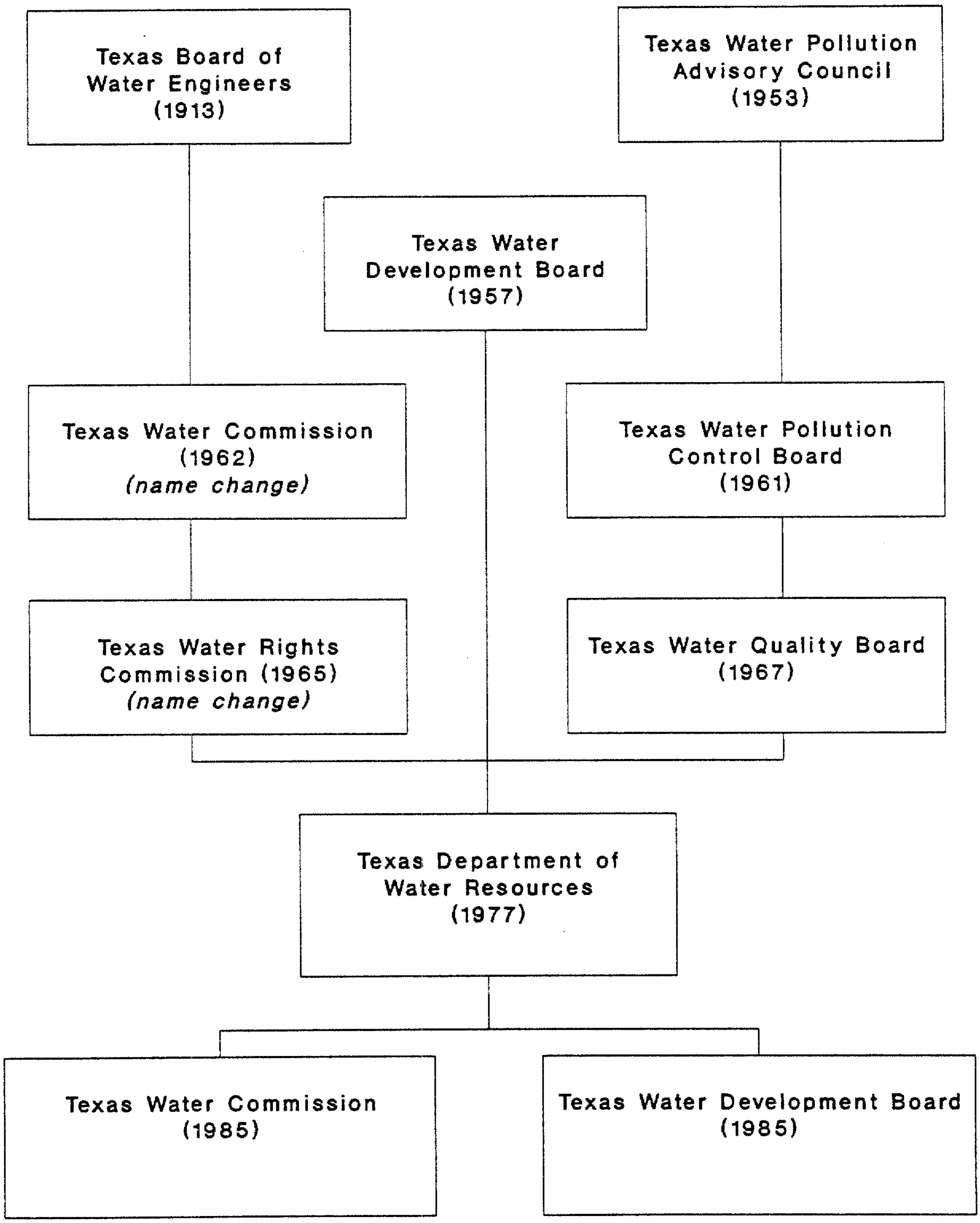
History from 1904 until 1977

The formation of a supply development policy in Texas has been influenced and maintained by an administrative structure of government intended to safeguard local power and authority. Texans have a history of self-reliance on the individual and aversion to central State level planning and control. Negative experiences with the State government during Reconstruction reinforced a mistrust of empowering the State with taxing, spending and planning authority. Thus, the State Constitution, when rewritten in 1874, severely limited the power and administrative functions of both the State and local governments (Texas Almanac 1988-1989). The result for water resource management has been the creation of a multitude of local and regional water agencies in an ad hoc fashion to address flooding and other problems as these problems emerged (Smerdon, Grounouski and Clarkson, 1988). These agencies have remained semi-autonomous political units with the responsibility for developing, financing and operating water facilities. When State water agencies were first created, they were created to aid local water agencies in their water development activities. However, even as these agencies were authorized with planning functions, they have lacked authority to coordinate the actions of the numerous local water agencies. Moreover, State power in general has tended to be diffused across boards and commissions, and this is certainly true in regards to State water resource planning (Smerdon, Grounouski and Hunt, 1987). Currently, Texas has over 1200 water districts and authorities, many with overlapping jurisdictions. At the state government level, Texas has moved from three agencies in 1957, to a single agency in the late 1970s, to a current structure of two state agencies, The Water Commission and The Water Development Board. Figure 4 charts the evolution of State water agencies. In addition, other State agencies also have some jurisdiction over water resources.

The 1876 Constitution empowered only the State, counties or municipalities to levy taxes and expend public money, but even these fiscal powers were limited so as limit public investment in capital-intensive project, thereby limiting capital-intensive projects. However, in 1904, the amendment of Article 3, Section 52, and subsequently, Article 16, Section 59 which was adopted in 1917, opened the door for water development by providing constitutional legitimacy for political subdivisions of the State to raise funds unhampered by limits to tax or to incur debt (Hazelton, 1973). Moreover, both amendments provided constitutional legitimacy for the creation of water districts and authorities. Article 16, Section 59, referred to as the "Conservation Amendment", empowered the State with the constitutional right to engage in management of natural resources (Vernon's, 1955, see historical notes). The major impact of the amendment, however, was not the provision of statewide planning; rather, the amendment merely opened the door for public financing of water development projects (Hazelton, 1973). "Conservation" was not defined in the amendment, and so conservation could legally mean whatever

FIGURE 4

Evolution of Texas State Water Agencies



Source: Smerdon, Grounouski, and Clarkson, 1988 water administrators chose it to be. In practice, conservation would mean the capturing and storing of surface waters.

In 1957, the State's policy of water supply development was furthered by the creation of the Texas Water Development Board (TWDB). The Board was created by a constitutional amendment, Article 3, Section 49-c in order to give constitutional legitimacy to the Texas Water Development Fund. The purpose of the Water Development Fund is to provide financing for local government units in the construction of water related facilities. Section 49 as originally written had severely limited the State's ability to incur debt. Subsequent constitutional amendments to this section have increased the State's debt limit for various purposes, including water development projects.

In 1961 water management in Texas moved towards statewide planning when Governor Price Daniel directed the Texas Board of Engineers to prepare a statewide plan for meeting future water needs (Schoolmaster, 1987). In 1965, the water planning function was transferred to the Water Development Board which was directed by the Legislature to develop a long-range State water plan. The emphasis, however, would remain on development of supplies.

In 1968 TWDB released the first State water plan, the <u>Texas Water Plan</u>, which was formally adopted by the Board in 1969. Despite consideration of other management activities in the 1968 Water Plan, water management policy was clearly directed towards supply development strategies. The first paragraph of the Plan states:

> "Water planning is a means to an end and not an end in itself. Its objective is the development of water resources. . . ." [p. 1]

The 1968 Plan did address other management concerns such as water quality control, protection of bays and estuaries by maintaining adequate instream flows, and aesthetic and recreational benefits from water resources. However, the Plan took an almost crisis tone when assessing the available quantity of water supplies relative to future water demands. This crisis tone was aided by the equating of historical use with need. Importation of water from out of state sources, interbasin transfer and a continued strategy of surface water capture were the focal points. What the 1968 Plan did not address were the strategies of reducing demand, or reallocating water from one use to another, or increasing technical efficiency of existing supply sources through systems operations.

State water management policy began to move away from its supply development focus by the late 1970s. In 1977, in an update of the 1968 water plan, TWDB defined conservation to include reductions in use, as well as "wise management" (TWDB, 1977). Moreover, voter response to water development referenda and public opinion concerning the State water plan motivated both the Legislature and the TWDB to more seriously consider conservation. From 1969 through 1981 Texas voters failed three times to approve constitutional amendments intended to increase State funding for the water development projects as delineated in the 1968 water plan (Schoolmaster, 1984). Then, prior to amending the 1984 water plan, two surveys to obtain public input indicated support for an increased emphasis on water conservation in state planning (Intergovernmental Work Force, 1982; Belden Associates, 1982). One of these surveys documented public support for the notion that State financing of water projects should be dependent on recipients implementing desirable water resource policies, including conservation, thus laying the groundwork for legislation in 1985 which would require recipients of State financing to implement a water conservation plan.

The 1980s: Emphasizing Water Conservation

The 1980s in Texas witnessed formal consideration and adoption of nonstructural water management practices. In 1984, TWDB (then a part of the Texas Department of Water Resources) revised the State water plan. The new plan, Water For Texas, stressed water conservation as complementary to meeting water demands and defined conservation as a reduction in the quantity of water used. However, while conservation is an explicit part of the 1984 water plan, supply management remained a significant policy tool:

> "The development and use of ground-water resources and the construction of surface-water storage reservoirs have been and continue to be the primary methods of increasing water supplies. Although conservation is a viable method of extending water supplies, the development of additional sources, including unconventional sources . . . will be required to ensure adequate future water supplies." [Water for Texas, 1984, Vol. 1, p. 37]

Moreover, the burden of conservation is placed at the local level. The plan assumes that local authorities have the expertise and resources for determining which conservation methods are most appropriate and how best to implement a local program. Yet, it is worth considering that if local authorities had been both committed and able to implement conservation programs, they would have done so without Legislative mandates.

In 1985 the 69th Legislature ratified House Bill No. 2 (H.B. 2) which contained two provisions encouraging the trend towards nonstructural water management practices. First, conservation was defined to include decreases in use. Sections 17.001 and Section 15.001 of the Water Code were amended to read:

> "Conservation" means:
> (A) the development of water resources; and
> (B) those practices, techniques, and technologies that will reduce the consumption of water, reduce the loss or waste of water, improve the efficiency in the use of water, or increase the recycling and reuse of water so that a water supply is made available for future alternatives.

Thus, three definitions can be identified in the Water Code: development, reductions in use and improved technical efficiency.

The second provision of H.B. 2 required applicants to implement a conservation program as a condition for receiving State financing assistance for water supply or wastewater projects. Liability for this provision fell to the TWDB, since it is the agency responsible for administering financial assistance for water and wastewater projects.

Despite H.B. 2's mandate that conservation plans be implemented by recipients of State financial aid, the determination of what constitutes an adequate conservation plan and when implementation is deemed to have occurred is left to the TWDB's discretion. The TWDB, through the Administrative Code, formulates and adopts rules of criteria for the preparation, review, and enforcement of a financial aid applicant's water conservation plan. No unique conservation tactic such as water rates or plumbing codes is required by H.B. 2. Additionally, the TWDB can employ any one of three, competing legal definitions of water conservation: development, improved efficiency, and decreases in use. Also, H.B. 2 allowed the TWDB to grant exemptions given any of the three following conditions:

(1) an emergency exists as determined by the board;
(2) the amount of financial assistance to be provided is $500,000 or less; or

(3) the applicant demonstrates and the board finds that the submission of such a program is not reasonably necessary to facilitate conservation or conservation measures.

Thus, the TWDB was enabled with considerable influence in determining what role conservation would or would not play in water facility planning.

Conservation planning by State financial aid recipients

From January 1986 through October 31, 1989, 102 political units in Texas implemented water conservation plans as a requirement for receiving financial assistance from the TWDB. The first conservation plan was implemented in January, 1987. These 102 plans constitute the data set for assessing the scope and nature of conservation policy in Texas as overseen by the TWDB. In November of 1989, TWDB reorganized. This reorganization included a restructuring of the TWDB conservation program. Plans implemented under the new organizational structure are not examined in this study, as the organizational change poses the possibility of an internal policy change in the criteria for the review and approval of conservation plans. The 102 plans approved and implemented from January 1986 through October 1989 are considered to be a distinct population.

Political units, or subdivisions, of the State which may manage water facilities include municipalities, municipal utility districts (MUDs), water supply corporations (WSCs), water districts, and river authorities.

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of the political units under its jurisdiction and therefore each is part of the total 102 observation set, counting the populations for these six umbrella units would be doubling-counting populations.) Table 2 also indicates the type of project as for which financial assistance is sought--water supply or water quality (wastewater treatment). As Table 2 indicates, almost half of the political units, 49%, had populations of less than 5,000 at the time the plan was approved by the TWDB.

The next chapter explains the method employed for assessing the nature and role of municipal water conservation planning by the TWDB.

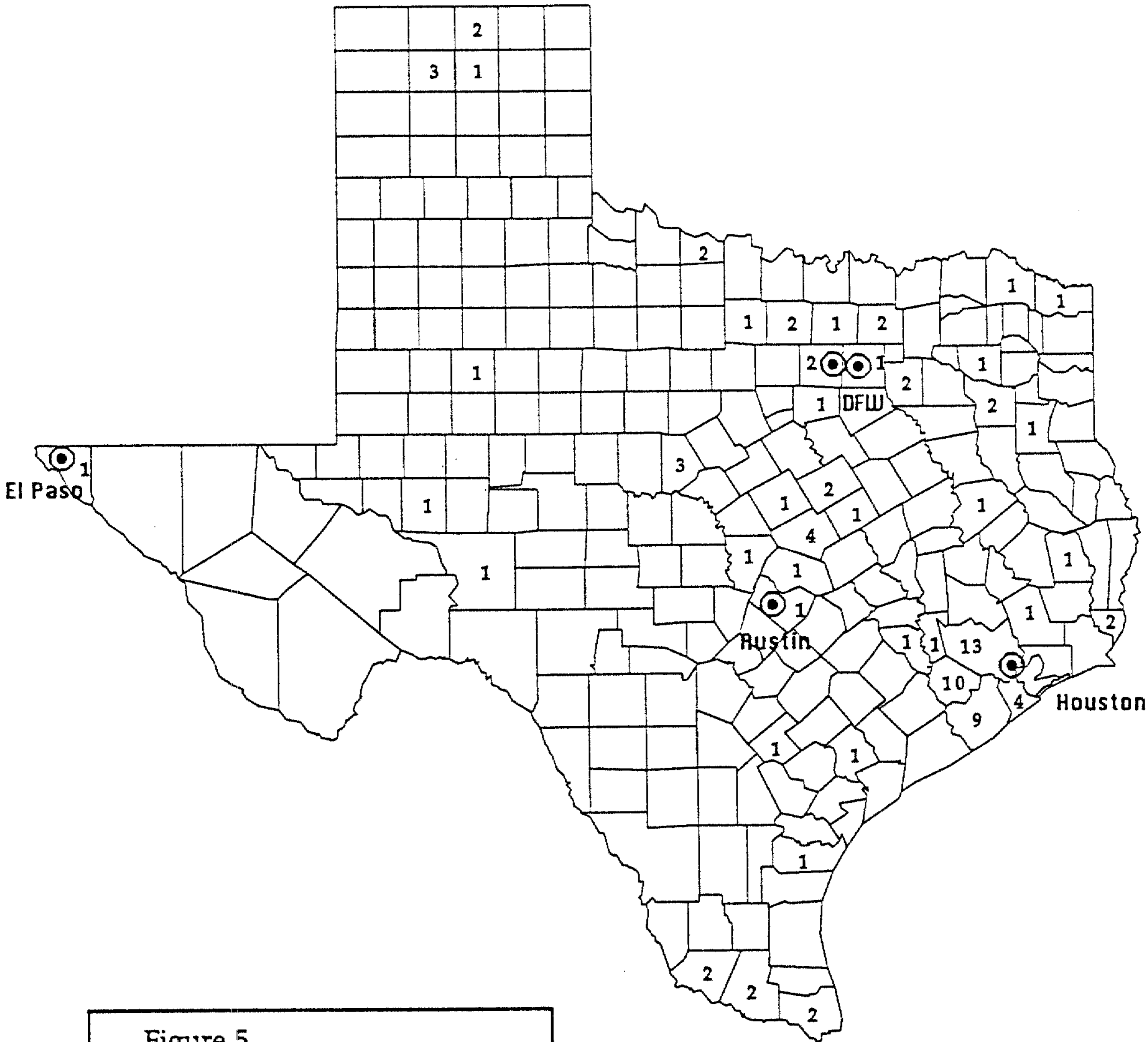


Figure 5
Location of Political Entities
w/Conservation Plans
Implemented under TWDB

TABLE 2

Population Distribution of Observations
and Type of Water Project
For Which TWDB Provided Financial Assistance

Total No. of Observations = 102

		DISTRIBUTION BY TYPE OF PROJECT				
		Water Suppl y	Water Quali ty	Both	missi ng value	TOTAL
100%		37%	42%	8%	13%	100%
Less than 5000	46%	40%	45%	9%	6%	100%
5001 to 10,000	16%	16%	19%	50%	6%	100%
10,001 to 25,000	18%	47%	21%	16%	16%	100%
25,000 to 100,000	9%	67%	33%	0%	0%	100%
100,000 or more	6%	17%	50%	0%	33%	100%
missing value	5%	20%	20%	0%	60%	100%

CHAPTER 4

ANALYZING WATER CONSERVATION POLICY

What is Being Analyzed

Given the definition of conservation as a decrease in use, it may seem only necessary to measure whether actual water use has decreased in order to assess the success of H.B. 2 conservation programs. However, while measuring whether actual decreases have indeed occurred would be part of a more comprehensive evaluation on conservation, this is not done here for two reasons.

The first is statistical. Of the 102 political units having implemented conservation programs, only 15 have had programs in place for at least 3 years, and only 47 have had programs in place for at least 2 years. It is contended that the effects of conservation are generally long-run, so that at least three or more years must pass before actual long-run demand decreases. Thus, the "best" potential data set for measuring significant reductions in water use contains only 15 observations. This data set would be too small for the number of independent variables which would have to be considered against water use: income, population, weather, and the various conservation strategies implemented.

More importantly, the second reason for not focusing on actual water use is that only determining whether absolute use has significantly decreased would overlook two of the objectives of this study and thus obscure indication of whether Texas is moving towards a more comprehensive water management policy. Those objectives, stated in Chapter 1 as numbers (2) and (3), are:

(2) Evaluate the degree to which conservation programs have been successfully implemented in Texas;

(3) Determine the existence and meaning of conservation planning in Texas.

The process whereby the TWDB has implemented the directives of H.B. 2 regarding urban conservation is evaluated for three reasons in this study. First is the need to establish whether substantive conservation programs exist before assessing impacts (Patton, 1986). Second, the implementation process itself is part of the policy-making process, and therefore, the **who**, **what**, **when**, and **how** of policy is often defined in this phase. Finally, focusing on the implementation process itself may provide insight for other water managers about how to proceed with designing and implementing a water conservation program (Sawyer, 1984). Each of these reasons is elaborated upon below, but first the importance of focusing on the implementation phase of policy is further illustrated by placing it within the larger context of policy evaluation.

Evaluation Research

Evaluation of the implementation of programs, "implementation evaluation", is a subset of evaluation research. Evaluation research refers to the assessment of public policy programs (Carley, 1980; Patton, 1986). The research agenda of policy evaluation can be classified along two dimensions: the particular stage of the policy process and the choice of evaluative criteria. Table 3 presents an organizational, heuristic scheme for characterizing evaluation research along these two dimensions. Table 3 is derived from concepts presented in Rossi and Freeman (1989) and from a similar table presented in Crane (1988). Each cell may constitute a singular research question, as well as each row and each column.

Evaluation research was initially and is still largely oriented towards assessment of program outcomes (Crane, 1988; Patton, 1986). Outcome evaluation considers what impacts occurred, whether these were the desired impacts, i.e., effectiveness, and whether the impacts were achieved efficiently. However, evaluation of policy formulation and program implementation have begun to receive greater attention in evaluation research for the same three reasons that this study focuses on implementation. The significance of focusing on the implementation of policy is related in the following two hypotheses:

> The implementation phase, and not just goal formulation and legitimation, often shapes policy.

TABLE 3

A Research Agenda for Policy Evaluation

VALUATION CRITERIA	PHASES OF THE POLICY PROCESS		
	Policy Formulation	Policy Implementation	Policy Outcomes
Effectiveness (adequacy)	Legitimation. Responsibility for programs. Can goal be feasibly achieved?	Program delivery.	What effects have occurred? Variance in outcomes?
Efficiency	Has correct problem been specified?	Are solutions correct? Complete?	Have outcomes been achieved efficiently?
Equity	Sources of problem identification and goal determination.	Variance in program delivery/treat ment by social class, ethnic group, etc.	Variance of outcomes by social class, ethnic group, etc.
Democratic involvement	Citizen input.	Citizen involvment.	Citizen input in providing feedback on effects.

> Implementation process is causally related to the achievement of goals and the occurrence, or lack, of impacts.

The lack of focus on implementation in policy studies can be attributed to theoretical and methodological considerations. There are few causal models, if any, linking program implementation with program effects. Moreover, analyzing the implementation process often demands qualitative methods, yet most policy analysis, and scientific inquiry, is biased towards quantitative methods (Carley, 1980; Strauch, 1976).

The need to evaluate the implementation of policy

The first reason for focusing on program implementation is that there is no point in assessing outcomes if, in fact, the program did not actually exist or was inadequate. Either specification of inappropriate strategies or poor delivery of those strategies will be insufficient for producing intended results. Poor program delivery may occur if administrators are not committed to achieving the stated goals, or if they do not have the necessary resources for program implementation.

The second reason for studying program implementation is to examine program implementation as a source of policy definition. That program implementation may also influence policy definition occurs because implementation denotes the operationalization of policy. Implementation requires specification of program <u>treatment</u>, program <u>delivery</u> and program <u>coverage</u> (Rossi and Freeman, 1989). Treatment refers to either the strategy(ies) or measure(s) which is suppose to produce the intended, and measurable, effect. Program delivery refers to the organizational arrangements and procedures for providing treatment. Program coverage considers whether the appropriate group has received treatment and whether a significant portion of the target group has received treatment.

Thus, administrators often have significant policy-making power where they have great latitude in specifying the treatment as well as clarifying (redefining) ambiguously stated goals. In regards to H.B. 2 and the TWDB, there are two levels of operationalizing a conservation policy which illustrate the influence of the TWDB in determining the efficacy of conservation plans adopted by individual political units. First, statutory law can be interpreted by administrators. Specifically, TWDB staff can choose among three legal, definitions of conservation. Second, the TWDB, in accordance with H.B. 2, determines the rules by which applicants prepare and submit a conservation plan to the agency for approval. Individual staff can provide the expertise (or lack of) for determining which conservation measures should be adopted (treatment) and by whom (coverage).

Finally, evaluating the implementation of policy serves the need to clarify the "how-to" of implementation. For example, with respect to conservation, understanding the benefits from conservation is not the same as knowing how to achieve those benefits and thereby design or enforce effective conservation measures. When outcomes are evaluated without knowledge of the implementation process, the results may not provide a direction for action because of a lack of understanding about what produced the observed outcomes, or lack of outcomes. A program's outcomes become meaningful if one knows what services were offered and how they were offered. A well-monitored but ineffective program may be ultimately more meaningful than an unmonitored or poorly monitored one that is effective (Brekke, 1987). Box 1 illustrates this point with a summary of a case study.

<u>Method</u>

The <u>object</u>, or <u>what</u>, of this study is implementation; method indicates the <u>how</u>. Common methods that are utilized in evaluation research exist across the spectrum of the social science disciplines and include inferential statistics, content analysis, and case studies. Yet, in the policy evaluation literature there is no well-established method for analyzing the adequacy of program implementation per se. Method is related to theory, and thus, the lack of a predominant method in implementation evaluation can be related to the lack of causal models linking implementation to policy determination and program outcomes (Brekke, 1987; Hargrove, 1975).

BOX 1

Failing to Understand Why Programs Work

While terminating a policy inappropriately is one possible error when only outcomes are used, enlarging a program inappropriately is also possile when decision makers have no real information about program operations and implementation. In one instance, a number of drug addiction treatment programs in a county were evaluated, collecting nothing but outcomes data on rates of readdiction for treated patients. All program had relatively mediocre success rates, except one program that had had 100% success for two years. The county board immediately voted to triple the budget of that program. Within a year, the readdiction rates for that program had fallen to the same mediocre level as other programs. By enlarging the program based on outcomes data, the county board had eliminated the key elements in the program's success--its small size and dedicated staff. The highly successful program had been a six-patient halfway house with one primary staff counselor who ate, slept, and lived that program . . . When the program was enlarged, he became administrator of three houses and lost personal contact with the clients . . . Thus, a highly effective program was lost because the county board acted without any information about actual program operations and without an assessment of the basis for the program's success.

Source: Patton, 1986, p. 128.

Choice of method involves the fundamental choice between "what is" and "what should be". This amounts to determining criteria for organizing and interpreting data and then drawing conclusions. To evaluate the implementation of H.B. 2 conservation directives by TWDB, four possible bases for comparison were identified:

(1) comparison with other states which have adopted a conservation policy;

(2) comparison with a priori specifications for evaluating the dimensions--treatment, delivery, coverage--of program implementation;

(3) comparison with the electric utility industry which is utilizing conservation strategies as an alternative to augmenting supply facilities;

(4) consideration of program delivery and design relative to policy goals, since the program itself is but a means to an end.

While it would be interesting to compare the TWDB's conservation activities to conservation policies of other state governments, no case studies were identified which have linked conservation achievements to policy implementation. Without linking outcomes to implementation, it can only be stated a priori which characteristics are important for effective implementation of any policy. Thus, this study primarily utilizes a priori specifications to describe and assess the TWDB's implementation of H.B. 2's conservation directives. However, the experiences of the electric utility industry in pursuing conservation strategies and the concept that conservation is a tool for achieving stated policy goals provide additional specifications, or characteristics, to be expected in the implementation of a program.

Table 4 lists characteristics of program implementation which are contended to be indicators of the adequacy of that implementation. These characteristics are listed vertically and are grouped into the three dimensions of program implementation--delivery, coverage and treatment.

Characteristics of program delivery include staff, technical assistance, monitoring and accountability. These characteristics for program delivery were derived from a survey of the policy evaluation field, including Evaluation Review, a policy journal. (This literature review evidenced the paucity of attention to, and case studies of, program implementation.) Concepts and implementation characteristics for program delivery and coverage have been discussed by Rossi and Freeman (1989), Brekke (1987), Leithwood and Montgomery (1980), Patton, (1986) and Sawyer (1984). These references were used to specify the program delivery characteristics used in this study and summarized in Table 4.

The experience of the electric utility industry in utilizing conservation planning provided the insight to look for the occurrence of "integrated planning" as one characteristic of program delivery. Like the water industry, the electric utility industry has been characterized by planning which focused on increasing supply

TABLE 4

Dimensions of Program Implementation

PROGRAM DIMENSION	PROGRAM CHARACTERISTICS	VALUE OF CHARACTERISTIC		
		Inadequate	Indeter-minate	Adequate
PROGRAM DELIVERY	Technical assistance available			
	Services to be provided clearly stated			
	Accountability for providing services			
	Staff/funding			
	Monitoring			
	Administrative response time			
	Means of compliance			
	Program integrated with other agency programs, with agency purpose			
PROGRAM COVERAGE	Has appropriate population been served			
PROGRAM TREATMENT	Specific strategies implemented which are related to desired effects			
	Uniformity of treatment provided			

capacity in order to meet increasing demands. However, in the 1980s utilities began to examine and rely on conservation strategies as a cost-effective alternative to making capital investments in supply facilities (Gellings, 1988). In 1989, 90% of publicly held electric utilities spent approximately $1 billion in conservation (Business Week, 1989). The industry aggressively engages in cost-benefit analysis and cost-effective analysis for conservation planning. Thus the industry incorporates the effects of decreases in use into projections for supply facilities, that is "integrated resource planning" (Chamberlin and Birnbaum, 1989).

Program treatment refers to the specific measures intended to produce a desired effect. In this study, treatment refers to conservation measures, identified in Chapter 2, which produce an improvement in water management efficiency and/or a decrease in water demanded. Table 5 presents the conservation measures and possible levels of effort which each measure might assume. These levels are used as nominal measurement values in this study because of a lack of empirical studies linking specific and varying conservation measures to outcomes. However, a 0 value does indicate that the specific conservation measure was not part of a given observation's conservation plan. Chapter 5 describes and analyzes the development of the TWDB's conservation policy according to each of three dimensions of policy implementation.

Data collection

In order to collect data on the programmatic characteristics of the TWDB's conservation policy, interviews were conducted with staff of the TWDB's Municipal Conservation Unit. To determine the actual conservation measures implemented by each of the 102 observations which adopted plans from January 1986 through October 1989, the specific elements of 89 of the 102 sampled plans were counted. (At the time of the survey, 13 plans were being reviewed by TWDB staff and were not available for this analysis.) It should be noted that only the conservation plan, that is, a document, was examined in order to account for which conservation measures were being approved by the TWDB and specified by local entities. Whether the 102 observations actually or correctly pursued each individual conservation measure specified in a stated plan was not verified. Such verification would have required a more comprehensive survey involving, at minimum, a mail-out questionnaire to each of the 102 observations.

Finally, water use characteristics, such as daily per capita use which is used to measure conservation effects, was not examined for three reasons. For any given plan, such water use data was either not available in the plans, or was ambiguously presented in a given plan, or was available for only one year rather than several.

TABLE 5

Definition of Conservation Measures

CONSERVATION MEAUSURE	LEVEL OF CONSERVATION MEASURE
Goals For Conservation	0: No goals stated, or ambiguous
	1: Yes, goals specified w/measurable objectives but no timeframe specified for achieving objectives
	2: Yes, goals and timeframe specified
Education Program	0: No program
	1: News articles to be published, & brochures made available in public facilities
	2: Level 1, and mailing of brochures
	3: Level 2, and at least one public meeting or seminar during first year of program
Plumbing code changes	0: No program
	1: Entity has no authority to adopt pluming code ordinance
	2: Changes to code, but no specific low use requirements established
	3: Plumbing code adopted that also specifies low use standards per type of fixture
	4: Plumbing code already in place and which also specifies low use standards per type of fixture
Leak detection	0: No program
	1: No equipment. Leak detection involves periodic sight inspections, reports by customers, etc.
	2: Have leak detection equipment, or will purchase
	3: Have sonic leak detection equipment
Water use audits	0: Not mentioned in conservation plan, or ambiguous
	1: Yes. Annually.
	2: Yes. Monthly.

TABLE 5 (cont.)

Definition of Conservation Measures

CONSERVATION MEAUSURE	LEVEL OF CONSERVATION MEASURE
Retrofit of Plumbing Fixtures	0: No program
	1: Education & public information program
	2: Retrofit ordinance adopted
	3: Retrofit kit distribution
Rate Structure	0: decreasing block (db)
	1: uniform block (ub)
	2: increasing block (ib)
Metering	0: No metering, or metering not universal
	1: 100% metering of residential only
	2: 100% metering of all uses except public
	3: 100% metering of all uses, and regular testing of meters
	4: 100% metering of all uses, and meter change out program
Xeriscape education	0: No.
	1: Yes.
Xeriscape ordinance(s)	0: No.
	1: No authority to adopt ordinance
	2: Yes.
Reuse strategy	0: No
	1: Yes
Enforcement Ordinance or Resolution	0: No ordinance or resolution adopted by political unit
	1: Not a city, but unit adopted resolution
	2: City adopted plan as official policy
	3: City adopts plan as official policy <u>and</u> establishes fines & penalties for noncompliance.

CHAPTER 5

ANALYSIS OF THE IMPLEMENTATION OF HOUSE BILL NUMBER 2 BY THE TWDB

In regards to the process of developing and implementing water conservation programs as stipulated by H.B. 2, communication might have occurred in a one-way linear manner between the Texas Legislature, the TWDB, statutory and constitutional law and, finally, local governments. Figure 6 illustrates how the policy process might occur linearly and passively. The Legislature determines goals and establishes policy via constitutional amendments and/or statutory mandate. The TWDB would oversee the implementation of policy specified by statute. The political subdivisions would passively receive the message to implement a program. Policy appears set and it seems a simple matter of passing the policy message along from the Legislature to the local water agencies via the TWDB.

Figure 6 assumes the more narrow definition of policy, as discussed in Chapter 2, that referring only to goals. The latitude which the TWDB possesses in executing the directives of H.B. 2 illustrates that the policy-making process can and does continue during the implementation of policy by administrators. Figure 7, a modification of Figure 6, illustrates this latitude. There are two key modifications. The first modification, (1), indicates that TWDB does not just passively receive laws but is able to actively interpret them. In regards to the directives of H.B. 2, the TWDB could choose among three legal definitions of conservation and specify which conservation measures were to be considered and adopted by applicants. Secondly, the manner in which the TWDB interfaces with each political unit is a part of the implementation process itself. This interfacing may also be two-way; political units are not necessarily expected to just receive a message to implement specific conservation strategies, though this is possible.

Because the TWDB possesses considerable latitude in policy-making, the degree to which H.B. 2 would affect water demands (conservation) depends upon the implementation process. This chapter describes and evaluates the adequacy of **what** is being passed along, program treatment (or content), **how** TWDB assists political units in the development of conservation programs, that is, program delivery and **who** is being targeted, program coverage.

Program Delivery

H.B. 2, Section 6.01, directed the TWDB to formulate and adopt conservation program rules for political subdivisions seeking loans. Two important actions were made by the Board in response to this directive. First, the Board amended the existing rules for applicants seeking financial assistance. Chapter 363 of the Texas

FIGURE 6

Linear Scheme of Policy Determination and Implementation

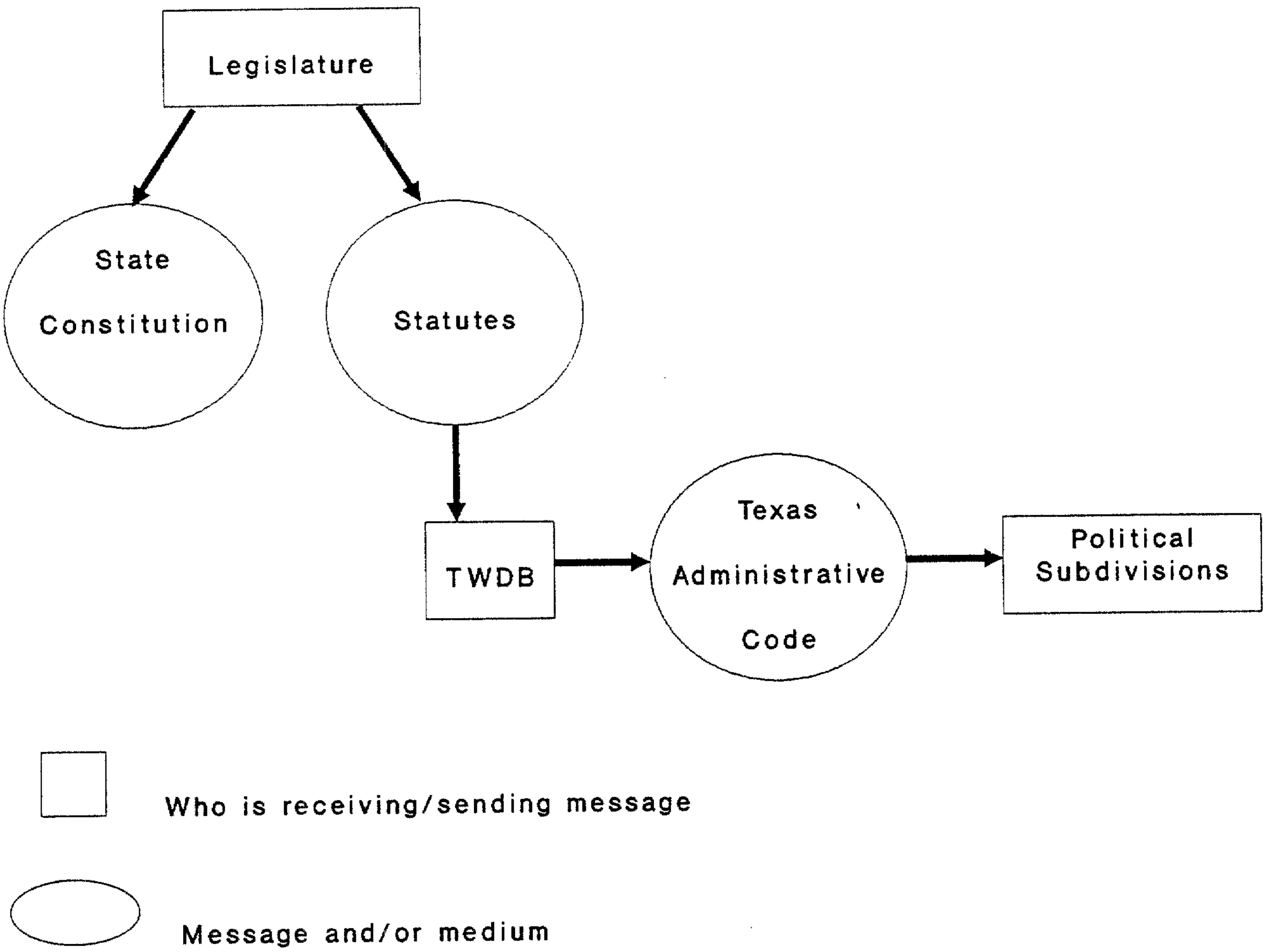
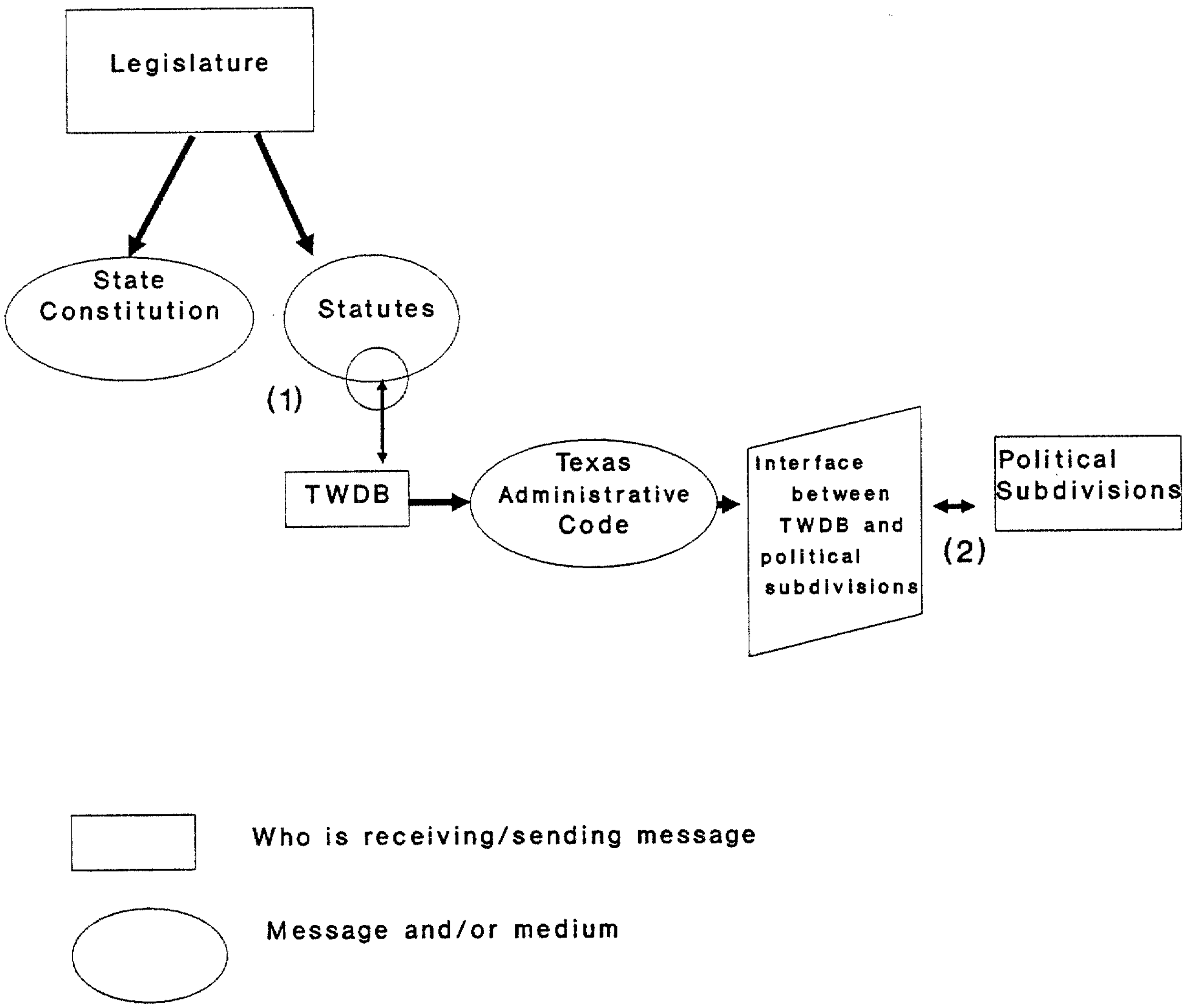


FIGURE 7

Policy Determination with Two-Way Interaction



Administrative Code (TAC), Rules Relating To Financial Applicants, lists these rules including the requirements for conservation plans. Chapter 363 explains what information is required of each financial applicant and the pre-requisites before funds may be released.

The second action taken was that responsibility for providing technical assistance and approval of an applicant's conservation plan was located within the Municipal Conservation Unit (MCU). Thus, by developing administrative rules and by locating responsibility for both assistance and plan approval, TWDB provided procedural rules for applicants developing a conservation plan.

Yet, the mere formulation of rules and guidelines does not guarantee the successful implementation of policy. An assessment of the implementation process also requires consideration of both the budgetary resources committed to implementation and an examination of the interaction between an agency and its target population for a given program. Such interaction is represented by modification 2 in Figure 7.

For example, in the first half of the year 1986 under the new law, H.B. 2, the MCU did not have a standardized procedure for assisting applicants. Thus, despite the changes to Chapter 363, such a vague, one-page plan as presented in Box 2 was approved. Note that the goal of this plan, a 10% reduction in water use, does not specify either the time frame or choice of measure for appraising goal achievement (reduction per capita? reduction by connection?). The plan does not incorporate, or even address, pricing strategies or changes to the local plumbing code. In general, even though the plan may reference education and leak detection, there is a lack of specificity especially vis a vis most of the subsequent programs. Finally, there is no indication that the plan was officially adopted as a policy of the political unit.

As often is the case, bureaucracies need time for internal adjustment. By June of 1986, the MCU possessed a full-time staff of six for providing technical assistance in conservation planning not only for loan applicants but also other political subdivisions of the State requesting assistance in conservation planning. Moreover, one staff member had been hired explicitly for the purpose of serving as a liaison between the TWDB and applicants. The MCU developed a strategy for working with applicants "face-to-face" in developing conservation plans (Fries, 1988; Dayton 1988). This strategy depended upon the interfacing between the MCU and applicant via the new liaison. As a result, the procedure for providing technical assistance was standardized. This contributed to uniformity among the conservation programs.

Standard procedure for loan applicants during the time frame under study, January 1986 through October 31, 1989,

BOX 2

A Sample Water Conservation Plan Approved by TWDB

The goal of the conservation program is to reduce water use and wastewater flows by 10 percent.

Water Conservation shall be encouraged by educating the consumer. Some tools to be used to promote general water-conservation concepts shall include: regular printed inserts mailed to customers periodically, as with water bills; have brochures available to be distributed upon request; posters suitable for classroom walls and other prominent public display to keep the message before the public; request the local radio station and T V cable system to contribute spots for water conservation announcements; provide speakers to community groups to give speeches and show films and slide shows on water conservation topics; use volunteer groups, such as Boy Scouts, and others to provide the energy and manpower to distribute conservation information and materials. Employees of major governmental consumers shall be trained in water conservation gardening. A water conservation-education program shall be integrated into existing curriculums in the public school system. The water conservation program will include elimination of loss within the system. A program of leak detection and repair will be undertaken. All wells or well fields should be considered.

Since the ---------------------------------- presently has an adequate water supply, the institution of a water consumer education program is all that is necessary for the foreseeable future. A plan for other measures will be implemented when and if water supplies become inadequate. Trigger conditions will be established as follows: Stage I, A minor to Moderate emergency condition exists if the water level in the wells is recorded at 364 ft. below ground level or the distribution system pressure as recorded at the office gage drops below 40 psi. Stage II, a moderate to severe emergency condition exists if the water level in the wells is recorded below 370 ft. below ground level or the distribution pressure drops below 35 psi: Stage II, Mandatory lawn water restrictions and outside use curtailment would be implemented by the District. Stage III, A critical emergency condition would be in effect if Stage II, conditions persist over a seven day period: The penalty charges and a total ban on outside water use would be issued.

required that applicants begin the process with a pre-application meeting (TAC, 363.52a). A pre-conservation planning meeting also coincided or immediately followed. At this first meeting, the Municipal Conservation Unit began its "face-to-face" interaction with representatives of the political subdivisions. Applicants were presented with a "Plan Outline" and examples of what staff considered to be well-formulated plans. One significance of the "pre" planning meetings is that while applicants are gathering engineering and other relevant data, they may simultaneously be developing conservation plans. Thus, in the time needed to conduct the engineering studies, six months to a year, MCU staff considered the applicant to have sufficient time for developing a conservation plan. Therefore, for the time frame considered, no exemptions to the conservation requirement were granted. Theoretically, this would also encourage integration of water conservation into engineering studies and facility plans.

The philosophy behind the face-to-face interaction between the MCU and individual clients reflects a helpful attitude of "holding their hand the whole way." The goal behind this personal approach was to educate, not lecture, applicants that it is in applicant's best interest to conserve. The MCU's stated, overall objective was to institutionalize conservation planning in Texas. However, such success in this regard also depends on the degree to which local officials themselves are committed to conservation. The requirement of conservation plans could be viewed by loan applicants as a greater burden -- fostering a sense of alienation from the State government. But by interacting with applicants, the MCU could define a role for the TWDB other than dictator of rules and requirements.

Monitoring of individual conservation programs after implementation by the local unit consists of annual reports prepared and submitted by the local political unit. No TWDB staff were devoted to verifying whether loan applicants actually implemented the strategies as stated in the annual reports. Furthermore, in cases of non-compliance, there is no enforcement mechanism other than reliance upon a reprimand letter reminding the loan recipient of its obligation to implement conservation strategies.

Program Coverage

Coverage refers to whether those who participate in a program are part of the appropriate target population, i.e., in need. In this study, three possible measures of coverage were identified.

First, coverage may have been measured relative to the population of the State. Second, coverage may be measured by noting whether applicants were located in geographical areas which might be experiencing high water use relative to projected supplies. Thus, if a "signficant" portion of the State's population came under the jurisdiction of the conservation plans being implemented by local political subdivisions, or if those loan recipients implementing conservation plans were located in areas experiencing relatively high water use <u>and</u> decreasing supplies, then it appears valid to conclude that the apropriate population is being targeted by H.B. 2.

The third possible measure of coverage utilizes the concept presented in Chapter 2, that conservation is a means to an end. For the loan applicants surveyed, conservation could be either an alternative or complement to extending existing water supply, procuring an additional water supply, or increasing the capacity of water and wastewater facilities. This is the preferred measure of coverage for this study, because it relates to the concept that water conservation is a management tool for realizing more efficient use of water resources.

The public support behind H.B. 2 rested partially upon the intention that water agencies should begin to give greater consideration to conservation as an alternative for meeting water and wastewater demands (Belden Associates, 1982; Intergovernmental Work Force, 1982). Planning for water demands would include an appraisal of all alternatives to meet those demands, including conservation. Thus, each loan applicant seeking funding from the TWDB for water supply or wastewater improvements is an appropriate target for water conservation planning in that conservation should have been evaluated as either an alternative to or complement to the particular project for which financial assistance was being sought. However, in the plans themselves or in the files examined, there is no evidence that conservation was evaluated as an alternative for meeting all or a portion of the loan applicant's water or wastewater demands.

As a matter of record, and as discussed in Chapter 3, total population for 97 of the 102 participants represents 25% of the total State population. (Again, population figures for 5 of the observations could not be ascertained.) However, this 25% figure includes the City of Houston, fourth largest city of the United States; excluding Houston, total population represents 14% of the State population. Whether these figures represent significant portions of the State's population is not manifest.

For almost all of the observations, water use characteristics data, notably per capita water use and unaccounted-for water, were not present in the plans or files examined. Thus, determination of whether applicants had high water use or demands could not be made.

Program Content

Table 6 presents a summary distribution of conservation measures specified in the 89 conservation plans examined. In their plans, some political units indicated that some conservation measures (e.g., universal metering) were already being practiced at the time a conservation plan was specified. However, most of the conservation measures listed in Table 6 were implemented as a result of the political units seeking financial assistance from the TWDB. Changes in plumbing codes and rate structures as a result of program implementation are explicitly noted in Table 6. Notably, one conservation "measure" pursued by the TWDB required each political subdivision, as a prerequisite to the release of State monies, to pass an ordinance or resolution adopting the conservation plan as an official policy of the subdivision. (MCU staff distinguished between a "plan" and a "program". A plan is a document which relates what will be done; a program is a plan which has been implemented, or at least, officially adopted.)

A close examination of Table 6 indicates that the main measures adopted have been education, plumbing code changes, and leak detection. Of the three levels (or types) of education programs, the most common (62%) was that which required the second greatest amount of resources, Level 2. This level of education programming included the printing of news articles regarding the benefits of conservation and the periodic mailing of conservation brochures. Most political units which could legally change their plumbing codes did so and thus required low use plumbing fixtures in new construction. Most often, Appendix J of the Standard Plumbing Code, 1985 edition, was adopted or modified into the city

TABLE 6

Summary Distribution of Conservation Measures Specified in Conservation Plans of Observations

Number of observations = 89[1]

CONSERVATION MEASURE AND LEVEL	PERCENT
GOALS FOR CONSERVATION	
0: No goals stated, or ambiguous	12%
1: Yes, goals specified w/measurable objectives but no timeframe specified for achieving objectives	73%
2: Yes, goals and timeframe specified	15%
EDUCATION PROGRAM	
0: No program	0%
1: News articles to be published, and brochures made available in public facilities	3%
2: Level 1, and mailing of brochures	62%
3: Level 2, and at least one public meeting/seminar for first year	35%
CHANGES TO PLUMBING CODE	
0: No program	2%
1: Entity has no authority to adopt plumbing code ordinance	16%
2: Changes to code, but no specific low use requirements established	2%
3: Plumbing code adopted that also specifies low use standards per type of fixture	72%
4: Plumbing code already in place	8%
LEAK DETECTION	
0: No program	1%
1: No equipment. Leak detection consists of periodic sight inspections	68%
2: Have leak detection equipment, or will purchase	19%
3: Have sonic leak detection equipment	12%
WATER USE AUDITS	
0: Not mentioned in conservation plan, or ambiguous	24%
1: Yes. Annually.	12%
2: Yes. Monthly.	64%
RETROFIT OF PLUMBING FIXTURES	
0: No program	3%
1: Education & public information program	95%
2: Retrofit ordinance adopted	0%
3: Retrofit kit distribution	2%

[1]At the time of survey 13 conservation plans were not available for examination.

TABLE 6 (cont.)

CONSERVATION MEASURE AND LEVEL	PERCENT
RATE STRUCTURE (observations = 85)[2]	
Before plan adopted:	
0: decreasing block	16%
1: uniform block	60%
2: increasing block	19%
missing value	5%
After plan adopted:	
0: decreasing block	9%
1: uniform block	47%
2: increasing block	41%
missing value	3%
DISTRIBUTION OF CHANGES TO RATE STRUCTURE[3]	
**decreasing to decreasing	8%
decreasing to uniform	4%
decreasing to increasing	4%
uniform to decreasing	0%
**uniform to uniform	42%
uniform to increasing	18%
increasing to decreasing	0%
increasing to uniform	0%
**increasing to increasing	19%
missing value	5%
NO CHANGE IN RATE STRUCTURE, BUT OBSERVATION CHANGED PRICES AS FOLLOWS:	
decreased	0%
increased	19%
no change	73%
missing value	8%

[2]Four observations are wholesalers and so were excluded from this variable.

[3]That is, as '**' indicates, 69% (8% + 42% + 19%) of the observations did <u>not</u> change their rate structure.

TABLE 6 (cont.)

CONSERVATION MEASURE AND LEVEL	PERCENT
METERING	
0: No metering, or metering not universal	4%
1: 100% metering of residential only	1%
2: 100% metering of all uses except public	10%
3: 100% metering of all uses, and regular testing of meters	49%
4: 100% metering of all uses, and meter change out program	18%
missing value	18%
XERISCAPE EDUCATION	
0: No.	7%
1: Yes.	93%
XERISCAPE ORDINANCE	
0: No.	80%
1: No authority to adopt ordinance	18%
2: Yes.	1%
missing value	1%
REUSE STRATEGY	
0: No.	78%
1: Yes.	22%
ENFORCEMENT ORDINANCE OR RESOLUTION	
0: No ordinance or resolution adopted by political unit	1%
1: Not a city, but unit adopted resolution	23%
2: City adopted plan as official policy	17%
3: City adopts plan as official policy <u>and</u> establishes fines & penalties for noncompliance	42%
missing value	17%

ordinance (see Box 3). Only two plans (2% of the observations) did not mention plumbing code changes in their plans. Finally, most plans stated that a leak detection program would be undertaken; but the majority of the plans (68%) specified a leak detection strategy which relied on a combination of monthly water use accounting, visual inspections of meters, and monitoring of elevated tanks, and not the utilization of leak detection equipment. Box 4 presents a typical leak detection program reproduced from one of these conservation plans. Sixty-four percent of the plans utilized monthly water use audits, which can be used to indicate leaks, as well as theft and other problems.

Retrofitting existing homes and commercial buildings with water conserving plumbing devices was not seriously pursued since 95% of the units only provided educational information on retrofitting. Most units were already metering all connections but many (49%) proposed a program for regular testing of meters to be included in the conservation program. Changes in the rate structure or prices themselves were not emphasized as much as structural and operational conservation strategies. Of those units which did **not** change their rate structure 73% of these also failed to change prices. Thus, 51% of all the plans examined did not propose either changes in the rate structure or changes in prices. Furthermore, although not shown in Table 6, the review of the conservation plans

BOX 3

Sample Plumbing Code

APPENDIX J

WATER CONSERVATION

J101 - General

Automatic flushing devices of the siphonic design shall not be used to operate urinals.

J102 - WATER CLOSETS

Water closets, either flush tank or flushometer operated, shall be designed, manufactured and installed to be operable and adequate flushed with no more than 4.0 gal per flushing cycle when tested in accordance with applicable standards.

J103 - URINALS

Urinals shall be designed, manufactured, and installed to be operable and adequate flushed with no more than 1.5 gal of water per flush.

J104 - LAVATORY FACILITIES

J104.1-PUBLIC FACILITIES
Faucets for public lavatories shall be equipped with outlet devices which limit the flow of water to a maximum of 0.5 gpm or be equipped with self-closing valves that limit the delivery to a maximum of 0.25 gallons of hot water for recirculating systems and to a maximum of 0.5 gallons for non-recirculating systems.

EXCEPTION: Separate lavatories for physically handicapped persons shall not be equipped with self-closing valves.

J104.2-PRIVATE FACILITIES
Faucets for private lavatories shall be designed, manufactured and installed to deliver water at a flow rate not to exceed 3.0 gpm when tested in accordance with applicable standards.

J105 - SHOWER HEADS

Showerheads shall be designed, manufactured, and installed to deliver water at a rate not to exceed 3.0 gpm when tested in accordance with applicable standards.

J106 - SINK FAUCETS

Sink faucets shall be designed, manufactured, and installed to deliver water at a rate not to exceed 3.0 gpm when tested in accordance with applicable standards.

BOX 4

A Sample Leak Detection Program

VII. <u>Leak Detection and Repair</u>:

The System currently has a leak detection program which will be maintained. The program includes:

A. Monthly water use accounting by the billing computer which identifies high water use after the service meters indicating leaks,

B. Constant monitoring of elevated tanks which identifies major water main breaks,

C. Visual inspections by meter readers and System employees who keep a constant watch out for abnormal conditions indicating leaks,

D. An adequate maintenance staff which is available to repair any leaks.

VIII. <u>Water Audit</u>

The Water Department prepares a monthly Water Accountability Report, which compares water pumped to water billed and illustrates "unaccounted for" water losses.

revealed that only one plan specified different rate schedules for summer versus winter seasons.

The question of whether appropriate conservation measures were being specified brings up a related question of whether recipients utilize similar measures. However, whether uniformity across conservation plans would be desirable is not clear a priori. However, observed similarity (attributable to the fact that applicants were provided with copies of others' plans) suggests that the individual situation of an applicant was not taken into account. In fact, after an initial trial period with providing guidance to entities requesting assistance in the development of conservation plans, previously approved plans became the model for later plans to be submitted to the TWDB. No discussions are evident in the plans, or file notes, about which measures might be pursued to meet the peculiar problems of an applicant; e.g., reducing a relatively high percent of unaccounted for water might singularly serve to effectively increase supply capacity and reduce facility requirements. Likewise, an applicant which has demonstrated low-unaccounted for water arguably has no need to implement additional leak-detection measures.

Table 7 presents a break-down of conservation measures specified in the plans according to the population size of the political units. A cursory examination of Table 7 does

TABLE 7

Distribution by Population Size of Conservation Measures Adopted by Individual Political Subdivisions

Conservation measure and level of measure adopted:	Political subdivisions with Population: (Number of observations = 88[1])				
	less than 5001 (n = 43)	5001 to 10,000 (n = 14)	10,001 to 25,000 (n = 19)	25,001 to 100,000 (n = 8)	100,000 or more (n = 4)
GOAL STATEMENT:					
0: No goals stated, or ambiguous	16%	7%	11%	13%	0
1: Goal(s) specified but no timeframe	70%	79%	78%	74%	50%
2: Measurable goals & timeframe specified	14%	14%	11%	13%	50%
EDUCATION PROGRAM:					
0: No program	0	0	0	0	0
1: News articles to be published, and brochures available at public facilities	3%	0	5%	0	0
2: Level 1, and mailing of brochures	67%	79%	53%	37%	25%
3: Level 2, and at least one public meeting	30%	21%	42%	63%	75%
PLUMBING CODE CHANGES:					
0: No program	5%	0	0	0	0
1: No authority to adopt ordinance	9%	29%	5%	63%	0
2: Changes to code, but no specific low use requirements established	5%	0	0	0	0
3: Code adopted which also specifies low use standards per fixture	79%	71%	84%	24%	25%
4: Code already in place	2%	0	11%	13%	75%
LEAK DETECTION:					
0: No program	5%	0	0	0	0
1: No equipment. Leak detection determined by sight inspection	60%	79%	73%	63%	50%
2: Have leak detection equipment or will purchase	21%	14%	16%	12%	50%
3: Have sonic equipment	14%	7%	11%	25%	0

[1]Of the 89 conservation plans examined, population for 1 of these could not be ascertained.

TABLE 7 (cont.)

Distribution by Population Size of Conservation Measures Adopted by Individual Political Subdivisions

Conservation measure and level of measure adopted:	Political subdivisions with Population: (Number of observations = 88[1])				
	less than 5001 (n = 43)	5001 to 10,000 (n = 14)	10,001 to 25,000 (n = 19)	25,001 to 100,000 (n = 8)	100,000 or more (n = 4)
WATER USE AUDITS:					
0: Not mentioned in plan, or ambiguous	26%	15%	21%	50%	0
1: Yes. Annually.	7%	21%	16%	12%	0
2: Yes. Monthly.	67%	64%	63%	38%	100%
RETROFIT FOR PLUMBING FIXTURES:					
0: No program	2%	7%	0	13%	0
1: Education and public information program	98%	93%	95%	87%	75%
2: Retrofit ordinance adopted	0	0	0	0	0
3: Retrofit kit distribution	0	0	5%	0	25%
RATE STRUCTURE:					
Before:					
0: decreasing block	19%	14%	11%	0	25%
1: uniform block	63%	72%	57%	25%	25%
2: increasing block	16%	14%	16%	37%	25%
missing value	2%	0	16%	38%	25%
After:					
0: decreasing block	10%	0	11%	0	0
1: uniform block	44%	57%	46%	25%	50%
2: increasing block	44%	43%	32%	37%	25%
missing value	2%	0	11%	38%	25%

[1] Of the 89 conservation plans examined, population for 1 of these could not be ascertained.

TABLE 7 (cont.)

Distribution by Population Size of Conservation Measures Adopted by Individual Political Subdivisions

Conservation measure and level of measure adopted:	Political subdivisions with Population: (Number of observations = 88[1])				
	less than 5001 (n = 43)	5001 to 10,000 (n =14)	10,001 to 25,000 (n = 19)	25,001 to 100,000 (n = 8)	100,000 or more (n = 4)
CHANGES TO RATE STRUCTURE:					
decreasing to decreasing	9%	0	11%	0	0
decreasing to uniform	2%	7%	0	0	25%
decreasing to increasing	5%	7%	0	0	0
uniform to decreasing	0	0	0	0	0
uniform to uniform	42%	58%	41%	25%	25%
uniform to increasing	19%	14%	11%	0	0
increasing to decreasing	0	0	0	0	0
increasing to uniform	0	0	0	0	0
increasing to increasing	16%	14%	16%	37%	25%
missing value	7%	0	21%	38%	25%
NO CHANGE IN RATE STRUCTURE, BUT CHANGED PRICES AS FOLLOWS:					
decreased	0	0	0	0	0
increased	17%	30%	15%	20%	0
no change	76%	70%	77%	80%	50%
missing	7%	0	8%	0	50%
METERING:					
0: No metering, or metering not universal	2%	0	0	25%	0
1: 100% metering of residential only	0	7%	0	0	0
2: 100% metering of all uses except public	9%	14%	16%	0	0
3: 100% metering of all uses, and regular testing of meters	58%	36%	47%	50%	25%
4: 100% metering of all uses, and change out program	12%	7%	32%	13%	75%
missing value	19%	36%	5%	12%	0

[1]Of the 89 conservation plans examined, population for 1 of these could not be ascertained.

TABLE 7 (cont.)

Distribution by Population Size of Conservation Measures Adopted by Individual Political Subdivisions

Conservation measure and level of measure adopted:	Political subdivisions with Population: (Number of observations = 88[1])				
	less than 5001 (n = 43)	5001 to 10,000 (n = 14)	10,001 to 25,000 (n = 19)	25,001 to 100,000 (n = 8)	100,000 or more (n = 4)
XERISCAPE EDUCATION:					
0: No	14%	0	0	0	0
1: Yes	86%	100%	100%	100%	100%
XERISCAPE ORDINANCE:					
0: No	88%	64%	89%	37%	75%
1: No authority to adopt ordinance	10%	36%	11%	63%	0
2: Yes	2%	0	0	0	0
missing value	0	0	0	0	25%
REUSE STRATEGY:					
0: No.	84%	93%	58%	63%	75%
1: Yes.	16%	7%	42%	37%	25%
TYPE OF ORDINANCE/RESOLUTION TO ADOPT CONSERVATION PLAN:					
0: No ordinance or resolution adopted	0	0	0	13%	0
1: Not a city, but unit adopted resolution	26%	29%	11%	38%	0
2: City adopted plan as official policy	12%	7%	32%	13%	50%
3: City adopted plan as official policy and establishes fines & penalties for noncompliance	40%	64%	41%	23%	25%
missing value	22%	0	16%	13%	25%

[1]Of the 89 conservation plans examined, population for 1 of these could not be ascertained.

not reveal a preference for specific conservation measures according to population size.

Assessment of Program Implementation

TWDB's overall response to overseeing the implementation of H.B. 2's directives may well have been very liberal: vague rules on design of conservation plans, little informational and technical assistance, and frequent use of H.B. 2's exemption clause. Moreover, the TWDB's State water plan, Water For Texas, had determined that conservation efforts would remain primarily the responsibility of the local level, further underscoring the minimal attention which conservation might have received in State water management policy. In light of what each plan did propose to do with respect to conservation measures, would these efforts be enough for decreasing future water demands either locally or statewide? Table 8 presents a summary of the program characteristics, as first presented in Table 4, for each dimension of policy implementation discussed above. The descriptions above for program delivery, coverage and treatment indicate the adequacy of the TWDB's conservation activities for affecting water demands within the State. While it is concluded that some of the individual characteristics of program implementation were adequately pursued by the TWDB, overall the effectiveness of the conservation policy implemented by the TWDB is indeterminate.

TABLE 8

Summary of the TWDB's Conservation Program

PROGRAM DIMENSION	PROGRAM CHARACTERISTICS	VALUE OF CHARACTERISTIC		
		Inadequate	Indeterminate	Adequate
PROGRAM DELIVERY	Technical assistance available			x
	Services to be provided clearly stated			x
	Accountability for providing services			x
	Staff/funding	x		
	Monitoring	x		
	Administrative response time		x	
	Means of compliance	x		
	Program integrated with other agency programs, with agency purpose	x		
PROGRAM COVERAGE	Has appropriate population been served			x
PROGRAM TREATMENT	Specific strategies implemented which are related to desired effects		x	
	Uniformity of treatment provided			x

It is suggested that the strongest aspect of the implementation of H.B. 2 was the interfacing between the TWDB and political subdivisions, that is, the manner in which technical assistance was provided in program delivery. Interviews with staff of the Municipal Conservation Unit revealed both a positive attitude towards program development as well as a specific strategy for providing assistance to political subdivisions.

There is indication that the quantity of TWDB staff and resources devoted to conservation planning is inadequate for significantly impacting water demands across the State. A key indicator is the lack of monitoring for verifying whether loan recipients actually implemented their stated conservation measures and for evaluating the effectiveness of individual programs. In interviews, MCU personnel attributed the lack of monitoring to an insufficient number of staff. Another indicator of inadequate staffing is that no cost-benefit analyses are included in the plans; conservation as a tool for supplying water demands was not integrated into facility planning. Staff devoted to providing technical assistance in evaluating conservation benefits and costs might advance the formal evaluation of conservation as an alternative to investments in water facilities.

Data on administrative response time for approving each plan were not collected; thus, the adequacy of the agency's processing of plans remains indeterminate. As discussed above, adequate monitoring did not occur. In regards to compliance, where applicants, in their annual reports, indicated that conservation measures had not been pursued, the enforcement mechanism utilized by the TWDB consisted of a reprimand letter reminding the loan recipient of its obligation to implement conservation measures. The effectiveness of this mechanism for ensuring compliance is doubtful.

The last characteristic under program delivery, the integration of the approval of conservation plans with other administrative functions is determined to be inadequate for effecting a meaningful conservation policy within the agency. Such an administrative procedure as, for example, only approving funds for facility capacity based on conservation effects would integrate the two functions of financial assistance and promoting conservation as State policy. Moreover, it would legitimize the touted benefit of conservation as an alternative to making capital investments in water facilities. However, as already described, there is no evidence that, due to decreases in water demand, applicants were encouraged to reevaluate the need for and size of water facilities.

That each financial recipient was an appropriate target for a conservation program derives from the argument that conservation is a reasonable alternative to investing in water facilities and should be formally evaluated as such an alternative. However, there is no manifest datum for determining whether the 102 observations represent a significant portion water users across the State.

The conservation plans approved by the TWDB emphasized structural conservation measures, namely, plumbing code regulations and leak detections programs. However, the TWDB has also encouraged that an education program, a behavioral modification measure, be a significant part of a conservation plan. There is no consensus in the water conservation literature as to which measures will produce long-term reductions in demand, again emphasizing the need for monitoring of conservation programs (Martin, 1990). However, experience elsewhere suggests that effective conservation programs require a combination of strategies. Education alone, for example, may not produce lasting changes in demand, as was illustrated by Martin, et al., (1984) case study of Tucson's experience with implementing a water conservation program. In the 1970s Tucson initiated a "Beat the Peak" educational campaign which was initially successful in decreasing per capita water use consumption. However, a few years later per capita consumption returned to its previous level in part because water rates had not kept pace with inflation; water price decreased in real terms. The lesson to be learned from the Tucson experience is that pleas for conservation accompanied with decreasing (or constant) real water prices, or with relatively low prices, send conflicting signals to the consumer about the scarcity of water. Furthermore, decreases in water use may not occur with plumbing fixture changes without accompanying price increases: the consumer may transfer the water savings from the low-use plumbing fixtures to other home uses. Moreover, pricing strategies offer the advantage of allowing the consumer to choose how much water and how much water saving technology is best for him. Thus, pricing, education, low-use plumbing fixtures and other conservation measures are considered necessarily complementary.

Again, the effectiveness of the conservation policy implemented by the TWDB is indeterminate. On the one hand, the personal nature of the technical assistance provided by TWDB staff may be adequate for producing an attitude change at local levels so that conservation would come to be regularly utilized locally in meeting water demands. This is important if indeed the responsibility for conservation will ultimately be the responsibility of local water authorities. Also, the TWDB encouraged that an array of conservation measures be simultaneously pursued, though the emphasis was on structural measures, as noted. On the other hand, in light of the lack of front-end planning and program monitoring, lack of enforcement and little emphasis on pricing as a conservation tool, the realization of significant decreases in water demand across the political subdivisions surveyed is suspect. As it was suggested in Chapter 3, if prior to H.B. 2 local officials had been committed to conservation, they should not have needed the impetus of H.B. 2 to utilize conservation planning.

The implementation of H.B. 2's directives by TWDB has served as a surrogate measure for anticipating whether significant decreases in water demand, i.e., conservation, would indeed occur at the local level. However, the varying adequacy of each characteristic for implementing policy demonstrates a need to link policy outcomes (decreases in demand at the local level) to policy implementation. Monitoring of water use and the effectiveness of local conservation programs needs to occur and be linked to State conservation policy and related activities.

Nonetheless, examination of the implementation of a conservation policy by TWDB has provided some insights and conclusions relative to implementation of policy in general. Also, by examining the TWDB's implementation of H.B. 2's conservation mandates, some conclusions can be made regarding the actual role of conservation within the State's overall water management policy, the purpose of this study. Chapter 6 presents these insights and conclusions.

CHAPTER 6

CONCLUSIONS

This study was designed to assess the nature and role of municipal water conservation within the context of water management in general and in Texas in particular. The year 1985 witnessed the hailing of a new era in Texas water management when H.B. 2, "the water package", was approved by the Texas Legislature. Part of that package required recipients of State financing for water development loans to implement water conservation plans. The TWDB was delegated authority for reviewing and approving those plans. Thus, the TWDB became a possible instrument for institutionalizing water conservation planning at both the State and local levels. In order to assess the degree to which conservation is becoming a more significant tool in Texas water management this study examined the procedure whereby TWDB implemented the municipal conservation directives of H.B. 2

In summary, Texas State water managers, and local managers also, have yet to incorporate conservation as a significant planning tool for the achievement of water management goals. Neither the water industry nor water managers habitually perform either cost-benefit analysis or cost-effective analysis for conservation alternatives. Moreover, conservation effects, that is decreases in demand, are not incorporated into the planning for and design of supply facilities. Integrated resource planning does not occur. This final conclusion was reached by working through each of the following three objectives as presented in Chapter 1:

(1) Provide an overview of water resource management and conservation;

(2) Evaluate the degree to which conservation programs have been successfully implemented in Texas;

(3) Determine the existence and meaning of conservation planning in Texas.

A recapitulation of each of these objectives is presented below. Then, this chapter concludes with a discussion for the fourth and final objective presented in Chapter 1, namely, recommendations regarding water management policy and further research.

Objective 1: An overview of water resource management and conservation

Chapter 2 presented a framework for considering the scope of water management activities. Water management occurs whenever a society utilizes a water resource. Water "problems" occur because of scarcity, a function of both demand and supply. Allocating water among various uses, both consumptive and non-consumptive, represents the fundamental challenge to water managers. Conservation is but one tool available to efficiently allocate water.

An operational definition of conservation is one meaning reductions in use. Moreover, because conservation is but one tool for attaining water management goals, it follows that conservation makes sense so long as the benefits exceed the costs. In order to capture the benefits from conservation, analysis of conservation strategies and their effects must occur at the front-end of water management planning.

Objective 2: The degree to which conservation programs have been successfully implemented in Texas

Evaluation of conservation planning occurred at two levels: the State level per the TWDB, and the local level per municipalities. The implementation of H.B. 2's directives by TWDB was examined in order to (1) assess State policy regarding conservation, and (2) to anticipate the use of conservation at the local level. For, what the State is doing with regards to conservation planning is expected to indicate what is occurring at the local level with respect to conservation. The TWDB is in a unique position to encourage the use of conservation because it must review and approve conservation plans as a prequirement for State financial assistance in water projects. While the Texas Water Commission (TWC) may require conservation plans from surface water permit holders, TWC has yet to develop a progressive policy congruent with this administrative ability. The implementation of H.B. 2's directives by TWDB, then, has served as a surrogate measure for anticipating whether significant decreases in water demand, i.e., conservation, would indeed occur at the local level. This surrogate measure for evaluating local effects from conservation programs derives from the premise that the implementation process is part of the policy-making process and affects outcomes.

Chapter 5 concluded that the adequacy of the local conservation plans could not be determined from examining the process whereby the TWDB implemented the directives of H.B. 2. Such indeterminacy can be attributed to a lack of empirical references as to what characteristics of policy implementation are sufficient and/or necessary for achieving stated goals. The TWDB's technical assistance program may well be adequate for realizing an acceptance of conservation among local water managers. Yet, while the TWDB has strongly encouraged the adoption of plumbing code ordinances, leak detection programs and education programs, the lack of emphasis on pricing measures, lack of monitoring and lack of front-end planning may counteract the effectiveness of those conservation measures which are pursued by local water managers. In sum, the TWDB's own conservation activities lead to contradictory predictions about the effectiveness of those municipal conservation plans being implemented locally.

Moreover, the TWDB as a whole does not appear to be substantively committed to conservation. There are five indications of TWDB's overall lack of commitment to water conservation.

First, if the TWDB is committed to the use of conservation as a planning strategy, then it is expected that a substantial portion of TWDB staff and funds would be devoted to conservation planning. Yet, for the time period under observation, fiscal years 1987, 1988 and 1989, the Municipal Conservation Unit was allocated only 3%, 2.4% and 2.2% of the total agency budget. This occurred at a time when one would expect agency resources committed to conservation to increase, as evaluation and monitoring studies are undertaken. Yet, as noted in Chapter 5, post-evaluation and monitoring of individual applicants conservation programs did not, in effect, occur.

Second, a reorganization of the TWDB on November 1, 1989 shifted the approval of water conservation plans to the engineering division while a municipal conservation unit (contained within the planning division) retained responsibility for reviewing the annual reports. This reorganization resulted in even fewer staff, four as opposed to six, working within the Conservation Unit and who were assigned additional duties besides conservation activities. The reorganization occurred at a time, three and a half years into the program, again, when both monitoring and internal evaluation studies would be expected to increase substantially.

In fact, the lack of the TWDB's monitoring of local conservation programs is the third indication of the TWDB's lack of commitment to conservation. Monitoring is important for two reasons: for confirming compliance and for planning. If the benefits from conservation are to be factored into meeting management goals, then monitoring and evaluation studies are essential. Yet, at the TWDB, monitoring the individual programs of loan recipients consists only of self-reports by the loan applicants. More importantly, no post-evaluative studies of individual programs have been undertaken by the TWDB. Such studies would serve to quantify the benefits of conservation so that water planners could more rigorously weigh conservation against alternative supply-side strategies.

Fourth, towards the end of 1986 the TWDB considered changing the procedural rules for approval of loan applications. With the adoption of H.B. 2, Chapter 363 had been amended to require applicants to submit a conservation plan at the same time the application for financial assistance is submitted. As a result, conservation plans tended to be developed at the same time that other relevant data for the proposed project were being gathered and prepared. However, the change proposed towards the end of 1986 would have allowed applicants to file conservation plans <u>after</u> the TWDB approved funding for a project. As testimony by the Lone Star Chapter of the Sierra Club, who opposed the change, noted, the procedural change would impair the "ability of both the applicant and the agency to include water conservation as an integral part of decision-making about a community's water resources needs and about the necessity of state financial assistance to address those needs" (Sierra Club, 1986). In sum, water conservation would be a "back end" or "after the fact" consideration and not part of comprehensive water management planning. Moreover, the Sierra Club also opposed the procedural change on the grounds that the change would betray the voter support of the 1985 water legislation.

Finally, if one considers the context within which H.B. 2 was created, TWDB's attitude towards conservation becomes even more suspect. The so called "management" provisions of H.B. 2 (i.e., conservation, groundwater management, bay and estuary protection, etc.) were essentially the result of a political compromise between the water industry and other interest groups (Texas Water Resources, 1986; Personett, 1990). For the water industry, the primary policy goal was to expand the State's role in the financing of water and wastewater projects, particularly in light of the shrinking Federal role. Other interest groups, particularly environmental groups, insisted that an expanded State role in water project financing be accompanied by an expanded State role in other areas of water resource management such as conservation. Hence, a quid pro quo was established in which opposing interest groups each obtained a desired objective in exchange for support of the other group's policy objective. In a sense, then, the conservation provisions of H.B. 2 were imposed on the TWDB and the water industry by "outside" interests.

Objective 3: Determine the existence and meaning of conservation planning in Texas

Since the 1980s, water conservation in Texas has referred to decreases in use, but the meanings of improved technical efficiency and development are just as common. With adoption of the 1984 water plan and subsequently H.B. 2 in 1985, greater utilization of conservation was implicated thus promising a significant step forwards toward integrated resource management. Yet the use of conservation in Texas as a significant water management strategy is suspect, as indicated by the evaluation of the TWDB's implementation of H.B. 2's conservation directives.

The TWDB's lack of commitment to conservation is important for four reasons. First, a lack of commitment to conservation contradicts the stated objective of the TWDB's expressed water conservation policy. The objective of this policy is to "reduce the quantity of water used in each function or purpose. . ." (Water For Texas, Vol. 1, p. 29). On the one hand, conservation assumes significance as a management tool in the TWDB's State water plan, prepared by the Board as a flexible guide for water management policy. Water conservation is emphasized even more in the 1990 update of the water plan. Yet, as discussed above, the Board does not appear to be convincingly committed to promoting or requiring conservation strategies. This poses the question as to whether the revised water plan will indeed be a further step towards a State water management policy which equally makes use of traditional and nontraditional water management strategies.

Second, the TWDB can and does shape water management policy in Texas, including the successful utilization of conservation. It is hoped this case study has illustrated that policy formulation can and does occur in the implementation of programs. At least in the case of water management, policy refers both to goals for allocating water and the various strategies for achieving the benefits from water use. Determination of which is the "best" strategy, or strategies, for achieving goals is often made by administrators. The TWDB, in the review and approval of conservation plans, possesses considerable discretion in determining which conservation measures, if any, an applicant is to pursue. Also, the TWDB possesses the ability to restrict funding of projects based on anticipated conservation effects from an implemented plan. Again, the TWDB did not, and does not, engage in such front-end planning.

Third, the Board's own attitude towards conservation may be important for encouraging conservation planning among local water authorities. Local initiatives with respect to conservation were not significantly occurring statewide prior to H.B. 2, nor can such local initiative be expected. Even while Texans have preferred local governmental control of policy choices, the use of conservation, consideration of environmental impacts and other water issues have not been, in the main, addressed by local officials at their own initiative. Conservation can provide benefits and may be a significantly cost-effective alternative, but local water managers may not possess either the inclination or, more importantly, the resources for considering nontraditional strategies to water management. Moreover, if TWDB's weak commitment towards conservation is conveyed to local authorities, then one cannot expect those local authorities to seriously pursue conservation strategies. This is especially true if the TWDB continues to provide financial assistance for projects which do not incorporate conservation effects.

Fourth, public sentiment for increased emphasis on conservation was indicated by public input to the 1984 Texas water plan and in voter approval of the constitutional amendments which enabled H.B. 2. The TWDB, as a State agency, is accountable to the public's policy choices.

Recommendations for Policy and Further Study

Two types of recommendations are made: those relative to water management policy in Texas and those indicating directions for further research.

In regards to water policy in Texas, it is recommended that the TWDB consciously and aggressively assume a progressive lead in promoting and requiring water conservation as an alternative to increasing the capacity of water facilities. The TWDB needs to exercise leadership in moving Texas towards nonstructural approaches to water management problems. As noted above, the TWDB can shape a State conservation policy, has delineated conservation as a necessary tool in its own water plan, and has a responsibility to the increasing public support for water conservation.

In order to realize a progressive water conservation program, the TWDB should integrate water conservation into water management planning via four additional recommendations. First, the TWDB should increase funding and staff for water conservation activities, particularly technical assistance for the evaluation of conservation programs. Evaluation would be significant to implementing the second recommendation: that cost-benefit analyses be performed in order to compare conservation alternatives to investment in water supply and wastewater facilities. Thirdly, the TWDB should require an integrated analysis of conservation relative to the loan applicant's project and request for financial assistance. Specifically, the TWDB should assess the need for financial assistance in consideration of achievable conservation effects. An applicant's facility plan should explicitly incorporate conservation effects and the Board should only commit State funds to a project that is justifiable after conservation effects are accounted for. Fourthly, the TWDB should maintain an on-going monitoring program of both water use and conservation strategies being utilized by municipal water users. Monitoring water use is necessary to evaluate the utility of water conservation, and monitoring the effectiveness of conservation strategies would make-up for the lack of empirical data regarding the efficacy of conservation programs and specific measures.

Hopefully this research provides insight for water managers who have expressed interest in the experience of others in developing conservation policies and programs. However, there is still a need for empirical research which attempts to relate conservation measures to actual changes, of lack of changes, in water use. Research regarding the effectiveness of conservation measures could take several approaches. First, actual water use and unaccounted-for water, the traditional parameters for gauging water demand, could be linked to the simple binomial (yes, the entity has a program, no, it does not) occurrence of water conservation programs without linking observed changes in the parameters to specific conservation measures (i.e., leak detection, education, etc.). This would side-step the issue of how to measure individual conservation measures such as education programs and so forth. A problem occurs in measuring many conservation measures because of qualitative differences from entity to entity. More importantly, individual conservation measures are probably not linearly related to water demands. For example, a water conservation education program may be a necessary component of an effective conservation plan, but alone it may not affect any changes in water demands. However, research attempts to investigate the efficacy of specific conservation measures for affecting water demand would be useful for planning purposes.

Another research study might attempt to relate various levels of a given conservation measure to water demand. Chapter 4 of this research presented various levels of effort which specific conservation measures may assume. These levels were assumed to be nominal but it would be useful for planning purposes to investigate whether these levels are ordinal. For example, in order to impact outdoor water demands for landscape irrigation, how extensive ("how much") should a xeriscape program be: i.e., what percent of the population must install xeriscape landscapes.

Finally, as a by-product of this research, a conceptual scheme for characterizing and assessing the implementation phase of the policy-making process was developed. Implementation can be described in terms of program delivery, program treatment and program coverage. This scheme serves to organize data on implementation, at least descriptively, and fills a void created by the lack of models for assessing program implementation. Additional case studies assessing the implementation process for any type of program could illustrate the usefulness of conceptualizing implementation in the descriptive characteristics for program delivery, treatment, coverage as utilized in this study.

REFERENCES

Athearn, Robert G., 1986, The Mythic West in Twentieth Century America, Lawrence, Ks.: University Press of Kansas.

Baumann, D.D., J.J. Boland and J.H. Sims, 1984, "Water Conservation: The Struggle Over Definition" Water Resources Research, Vol. 20, No. 4.

Belden Associates, 1982, A Statewide Public Opinion Study Regarding the Texas Water Plan, Dallas, Texas.

Black, Peter E., 1987, Conservation of Water and Land Related Resources, 2nd ed., N.J.: Rowman and Littlefield.

Boland, John J., 1978, "Forecasting the Demand for Urban Water" in Municipal Water Systems: The Challenge For Resource Management, David Holts and Scott Sebastian, eds., Bloomington: Indiana University Press.

Brekke, John S., 1987, "The Model-Guided Method for Monitoring Program Implementation", Evaluation Review, Vol. 11, No.3, pp. 281-299.

Browning, Waltraut F., 1986, Landscape Style, Irrigation Patterns, and Water Use: An Exploratory Study, Austin, Texas: Browning and Associates.

Business Week, 1989, "Utilities Are Making More by Selling Less", January 9, 1989, p. 90.

California DWR (Department of Water Resources), 1988, Landscape Water Conservation Guidebook No. 8, Sacremento, California: California Department of Water Resources.

Carley, Michael, 1980, Rational Techniques in Policy Analysis, Suffolk: Richard Clay Ltd.

Chamberlin, John H. and Ira Birnbaum, 1989, The Role of Conservation and Load Management at Electric Utilities, Oakland, Calif.: Barakat, Howard and Chamberlain Inc.

Crane, John A., 1988, "Evaluation As Scientific Research", Evaluation Review, Vol. 12, No. 5, pp. 467-482.

Dayton, Steve, 1988, Texas Water Development Board, Personal interview.

Dery, David, 1984, Problem Definition in Policy Analysis, Lawrence, Kansas: University Press of Kansas.

Ely, Richard T. and George S. Wehrwein, 1964, Land Economics, 2nd edition, Madison, Wisconsin: University of Wisconsin Press.

Flack, J. Ernest, 1978, "Management Alternatives for Reducing Demand" in Municipal Water Systems: The Challenge For Resource Management, David Holts and Scott Sebastian, eds., Bloomington: Indiana University Press.

Fries, Jim, 1988, Texas Water Development Board, Personal interview.

Gibbons, Diana C., 1986, The Economic Value of Water, Washington, D.C.: Resources for the Future.

Gottlieb, Robert, 1988, A Life of Its Own: The Politics and Power of Water, New York: Harcourt Brace Javonovich Publishers.

Griffin, Ronald C. and Chan Chang, 1989, Community Water Demands In Texas, College Station, Texas: Texas Water Resources Institute.

Griffin, Ronald C. and John Stoll, 1983, "The Enhanced Role of Water Conservation in Cost-Benefit Analysis" Water Resources Journal, pp. 447-457.

Grisham, Alice and William M. Fleming, 1989, "Long-Term Options for Municipal Water Conservation", Journal AWWA, Vol. 81, No. 3.

Governor's Report: Natural Resource and Environmental Agencies in Texas: A Report to the 64th Legislature. Austin, Texas: Office of the Governor, Division of Planning Coordination. April 1974.

Hargrove, Erwin C., 1975, The Missing Link: The Study of the Implementation of Social Policy, Washington, D.C.: The Urban Institute.

Hollon, Eugene, 1966, The Great American Desert, Then and Now, New York: Oxford University Press.

Ingram, Helen M., Dean E. Mann, Gary D. Weatherford and Hanna J. Cortner, 1984, "Guidelines for Improved Institutional Analysis in Water Resources Planning", Water Resources Research, Vol. 20, No. 3, pp. 323-334.

Intergovernmental Work Force, 1982, Public Input To Amend The Texas Water Plan, Austin: Texas Department of Water Resources.

Keith, Gary A. and Robert J. King, 1989, Cleaning Texas Water Through Conservation and Wastewater Reuse, Austin, Texas: Texas Department of Agriculture.

Kelso, Maurice M., 1967, "The Water Is Different Syndrome, or What Is Wrong with the Water Industry?", in Proceedings of the Third Annual American Water Resources Association Conference, Urbana, Illinois.

Kelso, Maurice M., William E. Martin and Lawerence E. Mack, 1973, Water Supplies and Economic Growth in an Arid Environment, Tucson: University of Arizona Press.

Kindler, J. and C.S. Russell, eds., 1984, Modeling Water Demands, London: Academic Press Inc.

Kramer, Kenneth W., 1986, "The Texas Water Package: The Beginning Of A New Era Or 'Business As Usual'?" Environmental Law Journal, Vol. 16, No. 3., pp. 57-63.

Leithwood, Kenneth A. and Deborah J. Montgomery, 1980, "Evaluating Program Implementation", Evaluation Review, Vol. 4, No.2, pp. 193-214.

Luecke, Daniel F. and David W. Fanning, 1988, "Perspectives on impacts of water resources development: Is water a variable in the regional development equation?" in Water Planning and Financing For the 21st Century: Conference Proceedings, Dallas: Center for Urban Water Studies.

Maddaus, William O., 1990, "Integrating Water Conservation Into Total Water Management". Journal AWWA, Vol. 82, No. 5.

Marlatt, Richard M., 1990, "Communtiy Planning Water Resources Planning and Water West of the 100th Meridian". In Proceedings of Conserv 90: The National Conference and Exposition Offering Water Supply Solutions for the 1990s. Phoenix, Arizona.

Martin, Mary J., 1990, "Practical Aspects of Quantifying Water Conservation Savings in Denver". Presented at the Annual American Society of Civil Engineers National Conference, Fort Worth, Texas.

Martin, William E., Helen M. Ingram, Nancy K. Lang and Adrian H. Griffen, 1984, Saving Water in a Desert City, Washington, D.C.: Resources for the Future.

Mather, John R., 1984, Water Resources: Distribution, Use and Management, New York: John Wiley and Sons.

McCool, Daniel, 1987, Command of the Waters: Iron Triangles, Federal Water Development, and Indian Water, Berkeley: University of California Press.

Mitchell, Bruce, 1979, Geography and Resource Analysis, New York: Longman, Inc.

Mood, Alexander M., 1982, Introduction to Policy Analysis, N.Y., N.Y.: Elswier Publishing Co., Inc.

Moore, Michael R., 1991, "The Bureau of Reclamation's New Mandate for Irrigation Water Conservation: Purposes and Policy Alternatives", Water Resources Research, Vol. 27, No. 2, pp. 145-155.

Nagel, Stuart S., 1984, Public Policy: Goals, Means and Methods N.Y., N.Y.: St. Martin's Press, Inc.

Office of the State Auditor, 1990, Management Audit of the Texas Water Development Board, SAO Report Number 1-027, Austin, Texas.

Patton, Michael Quinn, 1986, Utilization Focused-Evaluation, 2nd ed., Beverly Hills, Calif.: Sage Publications, Inc.

Personett, Michael, 1990, Lower Colorado River Authority, Personal interview.

Peterson, Margaret, 1984, Water Resource Planning and Development, Englewood Cliffs, N.J.: Prentice-Hall, Inc.

Prasikfa, David W., 1988, Current Trends in Water-Supply Planning, New York, New York: Van Nostrand Reinhold Co., Inc.

Reisner, Marc, 1986, Cadillac Desert, New York: Viking Penguin Inc.

Roberts, Mark, 1976, " Institutions and objectives on the Water, Energy, Environment Interface" in Economic Modelling for Water Policy Analysis Evaluation, Robert M. Thrall, et. al, (eds.), Amsterdam: North-Holland Publishing Co.

Rossi, Peter H. and Howard E. Freeman, 1989, Evaluation: A Systematic Approach, 4rth ed., Beverly Hills, Calif.: SAGE Publications.

Sawyer, Stephen W., 1984, "State Water Conservation Strategies and Activities", Water Resources Bulletin, Vol. 20, No. 5, pp. 679-685.

Schoolmaster, F. Andrew, (1984), "Water Development Referenda and Planning in Texas", Social Science Quarterly, Vol. 65, No. 4, pp. 1147-1156.

Schoolmaster, F. Andrew, (1987), "A Cartographic Analysis of Water Development Referenda in Texas, 1957-85", Growth and Change, Volume 18, No. 4, pp. 20-43.

Smerdon, Ernest T., John A. Gronouski and Judith M. Clarkson, 1988, "Approaches to Water Resource Policy and Planning in Texas", Water Resources Bulletin, Vol. 24, No. 6, pp. 1257-1262.

Smerdon, Ernest T., John A. Grounouski and Marilyn S. Hunt, 1987, "Instituitional Arrangements to Facilitate Better Water Resources Management", Public Affairs Comment, Volume 33, No. 2, Lyndon B. Johnson School of Public Affairs, The University of Texas at Austin.

Starling, Grover, 1979, The Politics and Economics of Public Policy: An introductory analyses with cases, Dorsey Press: Homeward, Illinois.

Stegner, Wallace Earle, 1987, The American West As Living Space, Ann Arbor: The University of Michigan Press.

Stone, Andrew W., 1990, "Water Water Everywhere. . . Have You Looked?" In Proceedings of Conserv 90: The National Conference and Exposition Offering Water Supply Solutions for the 1990s. Phoenix, Arizona.

Strauch, Ralph E., 1976, "A Critical Look at Qualitative Methodology", Policy Analysis, Vol. 2, No. 1, pp. 121-144.

Texas Almanac 1988-1989, 1987, Dallas, Texas: The Dallas Morning News.

Texas Water Development Board, 1968, The Texas Water Plan, Austin, Texas.

Texas Water Development Board, 1977, Continuing Water Resources Planning and Development For Texas, Austin, Texas.

Texas Water Development Board, 1984, Water For Texas, Austin, Texas: Texas Department of Water Resources.

UNESCO, 1987, The role of water in socio-economic development, W. E. Cox, ed., Paris, France: United Nations Educational, Scientific and Cultural Organization.

Vernon's Annotated Constitution of the State of Texas, 1955, Kansas City, MO., Vernon Law Book Co.

Viessman, Warren Jr. and Claire Welty, Water Management: Technology and Institutions, N.Y., N.Y.: Harper and Row, Publishers, Inc.

Wade Miller Associates, Inc., 1987, Infrastructure Policy Issues in Water Supply, Submitted to: The National Council on Public Works Improvement.