A STUDY OF WATER CONSUMPTION PRACTICES IN HOUSEHOLDS

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ABSTRACT

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By

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The purpose of this study was to obtain information about the amount of water used in households and the ways in which it is used, and to explore possible relationships between the amount of water used and certain family characteristics. Water is a finite natural resource, used in many household activities. Increasing per capita consumption of water has put greater demands on limited supplies. The amounts of water used vary among households. This study was concerned also with the extent to which family decisionmakers perceive limitations on the supply of water, and whether they consciously attempt to control their use of this resource.

Data on water use practices and water consumption were collected from 100 middle class families, residents of a Michigan city which provided metered water service to each family. All of the families were composed of husband, wife, and two children of varying ages. They were selected from developed subdivisions with fairly homogenous types of

housing. Information was collected from wives through interviews, and from husbands through mailed questionnaires. Wives and husbands were questioned about their knowledge of water supply and demand, and their belief in their ability to control. Data on the amount of water consumed during the preceding year by each family were obtained from the records of the municipal utility. This revealed a mean annual consumption per family of 14,767 cubic feet, a median annual consumption of 13,800 cubic feet, and a mean daily consumption of 302 gallons.

The following hypotheses were tested by means of regression analysis:

1. The amount of water that families use will be related to the ages of their children.

2. The amount of water that families use will be positively related to their possession of water-using equipment.

3. The amount of water that families use will be positively related to their socioeconomic status.

4. The amount of water that families use will be positively related to the ways in which they perform certain activities in the home.

5. The amount of water that families use will be positively related to husband's and wife's belief in fate.

6. The amount of water that families use will be negatively related to the levels of water awareness of husbands and wives.

7. The more conscious attempts to conserve water that a family makes, the less water they will use.

8. Conscious attempts to conserve water made by families will be positively related to the beliefs in fate held by, and the levels of water awareness of, husband and wife.

Results indicated a positive relationship between the amount of water used by families and their socioeconomic status (especially family income), their possession of water-using equipment and fixtures, and the age of their older child. The amount of water consumed increased 2,373 cubic feet for each additional $5000. of income, 1,599 cubic feet for each additional piece of equipment, and 352 cubic feet for each additional year of age of the older child.

No relationship was discerned between the amount of water used by the families and the way in which they performed selected activities, their attempts to conserve water, the level of water awareness of husbands and wives, or the beliefs in fate held by husbands and wives. A relationship was indicated between the level of water awareness of wives and attempts made to conserve water.

The results of this study suggest that the amount of water that a family uses is influenced by their level of income, by the life style associated with their educational attainment, occupation, and area of residence, and by their stage in the family life cycle. Knowledge of water resource limitations may encourage attempts to conserve water, but without more knowledge of amounts consumed in specific activities and alternative approaches to such activities, families may not make significant reductions in the amount of water used.

The results of this study offer implications for the design and purchase of appliances and fixtures, for public policy on water supply and pricing, and for educational programs on resource management.

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By

Anne Elizabeth Field

A THESIS

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DEDICATION

To my mother,
who helped me learn to appreciate
the resources of this earth.

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CHAPTER I

INTRODUCTION

Statement of the Problem

Present consumption patterns in the United States as well as in other industrialized countries require an ever-increasing amount of natural resources to sustain them. The supply of all these material resources is finite, and some are nonrenewable, yet the demand for them is growing. This increased demand for inputs of resources for human consumption, and the increased output flow of wastes (transformed resources) resulting from consumption processes, place ever greater stress on the biosphere which is the basic life support system of man as well as all other living creatures. Part of this swelling demand is due to an increase in per capita consumption which has led, if externalities are not counted, to a higher level of living for most consumers.

One of the most important finite resources is water, once characterized as an abundant "free good." Water is essential to all living things, and no human being could exist much longer than a few days without it (U.S. Department of Agriculture, 1955, p. 3; Vallentine, 1967, p. 13). Yet there is a great difference between the few pints

needed to sustain that human life for a day (U.S. Department of Agriculture, 1955, p. 3; Bradley, 1962, p. 489), and the sixty-plus gallons which the average member of an urban American household consumes each day (Federal Housing Administration, 1967, pp. A2-A3; U.S. Department of Interior, 1965, p. 22).

Per capita consumption figures, which have tripled in the United States since 1900 (Wright, 1966, p. 19), include many indirect uses of water by industry and agriculture in the production of goods and services utilized by man. Yet even direct residential consumption of water has increased. Since water can be substituted for other resources for some purposes, it is, with the aid of fossil fuel-derived energy, replacing some human energy and time in the performance of such household tasks as dishwashing and laundering. Higher standards of cleanliness, sanitation, comfort, and pleasure require the use of more water to attain them. Concentration of population in urban centers leads to higher demands upon the limited water resources of a given geographic area. And while water is renewable since it can be reused unless it evaporates, energy and dollar costs of making it satisfactory for reuse are also increasing. Land and mineral resources are also required for purification processes.

The patterns of household water consumption, therefore, become important to municipalities attempting to plan adequate water supply and treatment systems, and to all

who are concerned about the present and future quality and quantity of water resources in any area. Changes in those life styles which carry high environmental costs may be required. But first the need is to understand what are patterns of water use within households, and possible factors affecting them.

Human ecologists are concerned with: the use of resources by families and ways in which those uses affect both the quality of life within the household and the environment from which those resources come; the extent to which family decisionmakers perceive limitations on the supply of these resources; and whether family decisionmakers attempt to control their use of these resources, consciously allocating them among competing wants. Human ecologists are interested in evaluating levels of living in terms of stresses placed on the natural environment of man. They need more information about the ways in which natural resources, such as water, are used in households--how much is consumed, for what purposes, and the effect of different factors in increasing or decreasing that consumption.

Purpose of the Study

The purpose of this study was to obtain information about the amount of water used in households and the ways in which it is used, and to explore possible relationships between the amount of water used and certain family characteristics. This information would be useful in

developing educational programs or other strategies to assist in conservation of water resources.

Specific objectives of the study were:

1. To determine whether there is any relationship between the amount of water used by families and the ages of their children.

2. To determine whether there is any relationship between the amount of water used by families and their socioeconomic level.

3. To determine whether there is any relationship between the amount of water used by families and their possession of certain household equipment.

4. To determine whether there is any relationship between the amount of water used by families and the way in which they carry out activities.

5. To determine whether there is any relationship between the amount of water used by families and their beliefs about the nature of the world.

6. To determine whether there is any relationship between the amount of water used by families and their awareness of water as a limited resource.

7. To determine whether there is any relationship between the amount of water used by families and their attempts to conserve water.

8. To determine whether there is any relationship between the attempts families make to conserve water, their

awareness of water as a limited resource, and their beliefs about the nature of the world.

Conceptual Framework

Management in the family is directed toward the efficient use of resources to achieve goal satisfaction. Gross and Crandall (1963) indicated that the managerial function within families can be used to increase satisfactions gained from resource use. Fitzsimmons (1950) suggested that greater satisfactions can be achieved when one deliberately decides to maximize. Many decisions about use of resources do not yield maximum satisfactions nor reduce waste because such decisions are made on the basis of habit or incomplete knowledge about the supply of resources.

If a family has sufficient resources to meet present needs, is economizing necessary? Fitzsimmons (1950) stated that:

> Perhaps even the fortunate cannot be sure of meeting needs in the future as they are able to do in the present. . . . For the entire social group to satisfy its needs, economizing will probably continue to be necessary (p. 301).

The inefficient use of scarce resources in the family is believed to result not only in loss of utility for the family but for the society as a whole.

The reservoir of material resources is not inexhaustible. Material resources in the environment are limited, although some may be more abundant than others. Yet the wants of families, which these resources could be

used to satisfy, are virtually unlimited. As McConnell (1963) stated:

> Two fundamental facts provide a foundation for the field of economics. . . . The first fact is this: human material wants are virtually unlimited or insatiable. Secondly: economic resources are limited or scarce (p. 22).

McConnell included in economic resources all human, man-made, and natural resources used to produce goods and services for human consumption. Natural resources include "free gifts of nature," such as water, land, and minerals which come from the natural environment, and which, though in large supply, are still finite.

The problem of economizing (with which economics is concerned) is that of:

> . . . using or administering scarce resources (the means of producing) so as to attain the greatest or maximum fulfillment of our unlimited wants (the goals of producing) (McConnell, 1963, p. 25).

Economizing may be regarded as a process of making economic decisions, allocating limited or scarce resources among unlimited and often competing wants. In order to be useful, the resource must possess the necessary characteristics to attain a desired goal, and must also be available to be so used. Because resources can be used for alternative ends, frequently one resource may be substituted for another in attaining the same end.

In theory, the manager in the household will know the state of supply of his resources, will allocate resources first to more important ends, and will be able to

control the entire use of the resource. However, in the real world, these conditions may be limited in any of several ways.

First, the decisionmaker may possess less than perfect knowledge of the situation. His information may be false or he may perceive only a part of the whole truth.

Second, the decisionmaker may not believe that he has power to control what happens in his life, including the use of resources. Halliday (1964) found that homemakers who saw themselves as able to exert more control over their environment tended to use a more rational approach to decisionmaking, evaluating alternatives on the basis of available information.

The field of choice for alternative resource uses may also be limited by cultural standards which define what is right and proper behavior. Herskovits (1952) drew, from many cultures, examples of different patterns of ordering wants and of designating resources which can be used to satisfy them. These examples illustrate that the goals which are considered important, and the resources that can be allocated toward them, may be accepted as the only ones which can be considered by a decisionmaker in a particular cultural tradition.

Deising (1962) suggested that a decisionmaker will not attempt to control those commodities which are not considered neutral in his culture. If custom controls the use of a certain resource, then the decisionmaker cannot easily

reallocate that resource to other uses. Even in a society which believes that it operates on the basis of reason, custom may influence the way some resources are viewed and the uses to which they may be put (Deising, 1962, Chapter 2).

Families may use resources in different ways in different physical, social, and economic environments. The views they hold on the use of resources will be shaped by their beliefs about the nature of the world and by the state of their knowledge. Earlier decisions about their physical surroundings, and acceptance of certain cultural standards, will set limits around the possible ways in which resources can be used. The degree to which families comprehend the matter-energy flows and cycles that eventually bring to their door water, food, electricity, clothing, and other resources may influence the way in which these resources are used when they come under their control in the household. Their stage in the family life cycle may affect their needs. Their access to monetary resources may affect the manner in which they consume real resources, such as water.

Management in the family is predicated on the notion that events do not need just to happen. They can be controlled. The degree to which control is possible is influenced in part by knowledge about the factors which affect resource use.

Assumptions

The assumptions upon which the study was based are:

Homemakers are aware of how water is used in their households.

Information about how water is used in households can be attained through interviews.

The Brim "Test of Epistemological and Instrumental Beliefs" is a valid measure of respondents' beliefs about their ability to control.

CHAPTER II

REVIEW OF LITERATURE

Three areas in the literature will be reviewed here: first, some aspects of general water resource supply and demand; second, changes in per capita and per household consumption for domestic purposes; and third, factors affecting consumption in households.

General Water Resources--Supply and Demand

Water is one of the essential resources provided on this earth. Frank wrote:

> All life depends on water. For us today water is as necessary for life and health as it was for our prehistoric ancestors. . . . One of the basic conditions for life on earth is that water be available in liquid form (U.S. Department of Agriculture, 1955, p. 2).

Water has been available in rivers, lakes, flowing wells, replenished by rain and snow. Where it was abundant, it was so readily available that it was not viewed as a limited resource. Overman (1969) stated that water has been regarded as a "free good," a gift of nature. The only problem facing humans was that of transporting it to the place of use, a process which has evolved from taking a bucket to the river to the modern system of pumps and pipes bringing water to the home.

> Unlike the majority of nature's gifts, there was no processing, no factory involved, until man began to pollute nature's supply more rapidly than nature could purify it. If we have to pay a water rate today, it is chiefly a handling and purification charge (Overman, 1969, p. 5).

Man has used nature's supply more and more rapidly as his numbers increased and the ways in which he used water to support his level of living changed. Wright (1966) suggested that population growth, both in the United States and throughout the world, has placed increasing pressures on supplies of fresh water. At the same time, increasing direct and indirect per capita uses of water have intensified these population pressures. Wright cited an increase in total United States daily water consumption from 40 billion gallons in 1900 to 360 billion gallons in 1965 (1966, p. 19).

The Milnes cited examples of several urban centers throughout the world that face periodic shortages of water for their populations. Yet they pointed out that European cities were using about one-fourth as much water per resident as cities in the United States, and the trend was upward on both continents (1964, p. 41). Vallentine contrasted the gallon or so of water used by the subsistence village dweller to the 400 gallons, excluding food production, needed to sustain the life of the average urban dweller today (1967, p. 13).

Are "needs" which vary so widely always defined without regard to supply restrictions? Gysi and

Loucks (1971) wrote:

> Isn't an ample supply of water and power a minimal right of every person in modern society? When the demands relative to the supplies are low, the answer may often be yes. However, when the demands for often limited supplies are growing rapidly, the answer may not be so obvious. . . . "Needs" or "requirements" are the usual terms for consumption quantities that must be met at any price. Since the requirements normally defined by water utility planners (say 50-250 gal./capita/day) are far in excess of the physiological minimum for survival, the concept of water needs in this range is subject to question (p. 1371).

Some recognition of this nagging question was evident in public responses to the principles and standards for planning water and related land resources proposed by the U.S. Water Resources Council. These responses included suggestions for reusing renewable as well as nonrenewable resources, rather than merely seeking additional new resources to meet a growing demand (U.S. Water Resources Council, 1972).

Hanke (1970), in reporting results of a pricing change in Boulder, Colorado, from flat-rate to metered charges, which reduced water demand, says we have too often approached water as a unique good. Because it is so essential to life, we have not treated it as an economic good affected by pricing policy. Instead we have taken a requirements approach, considering present levels of consumption as essential and projecting future needs from them without question. Hanke said:

> The forecasting technique assumes that the technical, economic, and behavioral characteristics of the community are stable, an assumption that is

> demonstrably incorrect. The elasticity of demand for water is not zero (p. 1254).

The necessity of questioning demand projections is reinforced by Bradley's (1962) discussion of the point at which demand could be contained by the finite limits on supply. He calculated the minimum subsistence water cost of keeping a human being alive, including producing his food, as somewhere between 300 and 2500 gallons a day, depending on his diet composition. Added to that are the vast amounts of water used to produce goods and services and flush away wastes under our present style of consumption, including what he called "consumption luxuries" such as automatic washers and flush toilets, and it seems obvious that population and per capita demand cannot continue to increase indefinitely.

Changes in Per Capita and Household Consumption

Per capita water consumption has increased steadily in the United States. Most per capita figures come from public water utilities which may supply domestic household, commercial, public, and some industrial uses. Each individual shares proportionately in all those uses. A 1960 U.S. Department of Commerce projection estimated urban per capita consumption would rise to 192 gallons per day in 1980, while rural domestic uses including livestock care would average 116 gallons (U.S. Department of Commerce, 1960, p. 4). A 1970 U.S. Geological Survey report estimated an average use of 166 gallons per day per person was

drawn from public supplies for the United States as a whole, and 188 gallons per person in the Great Lakes area. The United States average represented a 13 per cent increase between 1965 and 1970 (U.S. Department of Interior, 1972, p. 31).

These amounts are much greater than the five to six pints per day estimated to be the minimum needed for a moderately active man in a temperate climate just to stay alive (U.S. Department of Interior, 1965, p. 22). Setting aside, for purposes of this study, any further consideration of industrial, commercial, and agricultural uses, five to six pints is a great deal less than is used in modern household or domestic consumption. How much water is actually needed, per person and per household, and how much is used?

A Yale researcher in 1939 calculated 20 gallons per person as the daily minimum amount needed. This included one gallon for drinking, six gallons for laundry, five gallons for personal care (without a tub bath or shower), and eight gallons for two toilet flushes. Whenever a tub bath was taken, it would add 25 gallons to this total, and a shower would add five gallons per minute (U.S. Department of Agriculture, 1955, p. 651). Thirty gallons per person has been estimated as the absolute daily minimum for domestic consumption under our sanitary standards (Grava, 1969, p. 32). Over the past decade, 50 gallons has been estimated as the average daily personal domestic consumption (Fair,

Geyer, and Okun, 1966, pp. 5-7; Babbitt, Doland, and Cleasby, 1962, p. 7; Grava, 1969, p. 32). Almost half of this total may be used only to flush away wastes (Grava, 1969, p. 32).

Dunn (1962), in a 1958 study of Illinois families, found an average household consumption per day of 148 gallons, with an average of 157 gallons used by a four-person household. Household consumption varied from 39 gallons for one two-person household to 369 gallons for one family of six (Dunn, 1962, p. 72). The extensive Johns Hopkins studies carried out for the Federal Housing Administration (1967) in 41 residential areas across the United States during 1963-65 showed a mean annual use of 398 gallons per household per day for the 2,373 dwellings included in these 41 areas. Residential areas in Des Moines, Iowa, the only midwestern community included, averaged 221 gallons per household per day for in-house and sprinkling uses combined (Federal Housing Administration, 1967, pp. A-2, A-3).

Yet the variation in amount used among the households in these two studies suggests important questions. Total residential areas, rather than individual households, were studied by the Johns Hopkins researchers. Mean daily use varied from 191 gallons per apartment in the five apartment areas, and 310 gallons per house in the 13 areas studied in the eastern United States which had metered public water and public sewers, to 692 gallons per house in the eight areas which had flat-rate public water and public sewers (Federal Housing Administration, 1967,

pp. A-2, A-3). Dunn, in examining consumption of individual households, found, for the 48 four-person households within her sample, a range of 59 to 293 gallons average per day (1962, p. 72). What factors might help explain some of these differences?

Factors Affecting Consumption in Households

One factor that will affect household consumption of water is the size of the family, since it has already been noted that there is some minimum requirement per person. Yet the total family consumption may not be the exact sum of the total individual requirements, for there may be some economies of scale in larger households (Clark, 1965, p. 32). Furthermore, Dunn found a wide range in amount of water consumed by families of the same size (1962, p. 72).

Woolrich and Courtless (1965), in studying specific activity uses of water among Maryland farm families, found that the total amount of water used for laundering and frequency of washing floors increased with the size of the family, but that frequency of washing dishes or of preparing food under running water did not. Grima (1972) suggested that size of household ought to be the most important variable since the greatest domestic use of water over most of the year is for bathroom purposes, and this use is a function of the number of persons. He believed results in the literature he analyzed might have been clearer if studies had also included data on the number of days spent

away from home by family members, and if persons in the household were classified as adults or children.

Dunn found slightly higher water demand for families with children of pre-school age (1962, pp. 83-87). Woolrich and Courtless found that families with children under six had the greatest laundry load, but that households composed entirely of adults used more water per person each week for laundering than did other families (1965, pp. 722-723).

The Johns Hopkins studies pointed to the importance of price in affecting amount of lawn sprinkling, but concluded that demand for in-house uses was relatively inelastic (Federal Housing Administration, 1967, pp. 51-53). A possible reduction in sprinkling resulting from metering and/or price increases could be important to a utility which must provide costly additional pumping treatment and storage capacity to meet this peak demand, which usually occurs in summer. The studies indicated that in some areas, lawn sprinkling could account for as much as 75 per cent of total water use for the day in hot, dry weather (Wolff, 1961). Whitford (1972) suggested that sprinkling probably is excessive even when price is a consideration, and that educational programs could be used as well as price to reduce this use to a necessary level.

Hudson, et al. examined household use records for several cities covering the period 1939-1956, and found a steady increase in amount of water used, of about 2 per cent a year. An examination of types of uses in one city,

Wichita, Kansas, showed an increase in basic uses within the house, not attributable to sprinkling or air conditioning (1958, p. 1411).

Grima (1972) stated:

> The amount of water used by a household at a given time is the direct result of the consumer's ability and willingness to purchase and use household goods such as baths, sinks, showers, and garden space. Residential water use is complementary to other household activities.
>
> Residential water demand is a composite demand. The total demand is the sum of the water used to complement activities such as gardening, washing, and waste disposal. In addition it is useful to note that there is a hierarchy of water-complementary activities. The consumer would give up the least preferred complementary activity first if he had to. . . .
>
> The composite and complementary nature of residential water use results in gradual changes in the individual household's patterns of water use over time since the purchase of semi-durable water-using appliances does not adjust instantaneously to changes in price or income or technology (pp. 78-79).

Jordan stated in 1955, in discussing the increasing urban household demand for water:

> Contributing to the increase are air-conditioning installations, home laundry machines, automatic dishwashers, garbage grinders, lawn sprinkling installations, and so on. Such demands may increase or flatten off as economic conditions improve or become static. All are what may be termed luxury uses of water. They probably will continue to increase (U.S. Department of Agriculture, 1955, p. 652).

Economic status of consumers was found to be related to water use in the Johns Hopkins studies (Federal Housing Administration, 1967; Wolff, 1961; Linaweaver, Geyer, and Wolff, 1967). They suggested a higher income level may influence water use in several ways: through the purchase of more water-using appliances, through more frequent uses

of water, and greater time duration for each use (Federal Housing Administration, 1967, p. 29). Yarborough (1956) analyzed water records in Dansville, Illinois, looking at five zones with differing property valuations. He found that the highest water consumption was not in the area of highest property value but in the area of upper middle class homes, indicating the importance of socioeconomic status. Meyers and Mangan (1969) suggested that property value is related to probable water consumption:

> The value of a home is a general indicator of the user's ability to buy more water, both through purchase of water-using devices and through the more liberal use of water (p. 406).

Dunn (1962) found a positive association between such socioeconomic indicators as education, occupation, income, and assessed valuation and water use.

If one result of higher income is the ability to buy more water-using appliances, what associations have been discerned between ownership of equipment and water consumption? Dunn (1962) found that households with a higher water demand had a shower, an automatic washer, a waste food disposer, a dishwasher, or possibly a wading pool. Woolrich and Courtless (1965) found a higher weekly consumption of water when automatic rather than nonautomatic washers were used.

Total water consumption for an automatic washer cycle was reported to average 35 gallons by Van Zante (1964, p. 161). Consumer Reports (1971, p. 513) reported

washers ranging from 34 to 57 gallons per cycle, with a mean of 48 gallons. Newer washers could use more water for large loads, but offered more flexibility in adjusting water levels for smaller loads. Automatic dishwashers were reported to consume 12 to 16 gallons per normal cycle (Consumer Reports, 1971, p. 662). Food waste disposers were reported to use 4.2 gallons per day with an average of 3.9 daily uses, in a General Electric study (Anderson, 1967, p. 1235).

Wolff (1961) suggested that more bathroom fixtures in a house would not necessarily increase water consumption. Some houses are built with excess bathroom capacity so that fixtures in some of these are used less frequently than others.

Dunn (1962), however, concluded that:

> However individualistic domestic water consumers may appear in their water consumption habits, this study suggests that these may differ but slightly from the consumption patterns of the socio-economic group of which they are a part. In this study the possession of equipment making a high household water demand appears to have been strongly influenced by one or more of the three factors of (1) income, (2) stage in the family formation cycle, and (3) age of dwelling. Nevertheless, it is not the inventory of water using fixtures or equipment but these mechanisms as applied which make the differences in the water consumption patterns between households (p. 368).

Woolrich and Courtless (1965) studied practices in performing certain household activities using water and found among those activities, greatest demands on water supplies were made by laundering and personal care. Amounts of water used for various activities were calculated.

Watson (1963) reported a detergent company study of hand dishwashing showed averages of 5.7 quarts of water used for dishpan washing, 8.8 quarts for double-bowl sink washing, and 10 quarts for single-bowl sink washing. No estimate was made on rinsing, which could vary greatly depending on the method used. He compared this with an Ohio study that reported use of 20.2 quarts for washing and rinsing one batch of dishes by hand (1963, p. 559).

The General Electric study of home use of appliances showed an average use of the automatic washer of 0.7 times per day, and 0.8 uses per day of the dishwasher (Anderson and Watson, 1967, p. 1235).

Konecci (1967) suggested that the activity patterns adopted by the average American family waste a great deal of water. He said:

> We permit the continuous running of water to wash our hands or faces and have adopted, as a national method of hygiene, that water waster called the shower. In turn we use about five gallons of water to flush our toilets and let the water intended for the garden run off aimlessly into the gutter (p. 231).

Such patterns may be influenced by such communications as the following example from an industry association news story:

> Shower baths are excellent for cleansing provided they are taken properly. Don't just jump under and out of the shower, however, and call yourself clean. Soap yourself thoroughly and turn on moderately warm water. Lather freely and scrub with brush or washcloth <u>while the warm water is running</u>. [Italics mine.] Then slowly cool the shower till all the soap is rinsed away and you feel tingly and refreshed (Cleanliness Bureau, 1970, p. 3).

Francis (1970) tested fixture unit recommendations, and found optimum flow rate for 50 feet of garden hose and one sprinkler was five gallons per minute.

Woolrich and Courtless (1965) found one-third of the farm families interviewed made special efforts to conserve water, especially during summer months, mentioning most frequently being careful about letting water run and repairing leaks.

Leaks can consume water not attributable to any use. A faucet which leaks only one drop per second can waste four gallons a day, while a leak into a toilet bowl could waste over one gallon an hour (Leopold, 1960, pp. 2-3).

Belief in ability to control versus being controlled by fate may affect one's actions to change present use of resources. Brim (1962) and his associates developed the "Test of Epistemological and Instrumental Beliefs," which tests, through the respondent's agreement with selected proverbs, the strength of his belief in 16 areas, including belief in fate. Halliday (1964) used this test in her study of decisionmaking, and found a negative correlation between belief in fate and rationality in decisionmaking.

Summary

The review of the literature indicated that per capita water consumption has increased steadily over time, and that there is considerable variation among households

in the amount of water they consume. Such family characteristics as socioeconomic status and age of children and number of persons in the household seem to be related to water use. Water use also appears to be related to age and value of dwellings, and to the inventory of equipment and fixtures they contain. Variations in practices in using this equipment were reported. One study reported that homemakers made special efforts to conserve water in household use during the season when they knew that water supplies were more likely to be low.

In addition, some relationship was indicated between belief in control and general behavior in use of resources.

CHAPTER III

PROCEDURES

The procedures used in this study are discussed in six sections, the first of which explains the establishment of criteria for selection of the sample. Other sections discuss selection of the sample, description of the sample, development of measures, procedures for obtaining data, and procedures for analysis of data.

Criteria for Selection of the Sample

The sample of families to be studied was selected to meet certain standards related to the objectives of this study, rather than being randomly selected from the total population. They were to be middle-class families whose incomes would allow them bounded flexibility in purchasing goods and services; although within the broad category of middle class, they should represent varying levels of socioeconomic status so that possible effects of such variation could be examined; and they should pay directly for the amount of water used in their household so that they would have some monetary measure of the cost of this water use.

The following criteria were established to meet these objectives:

1. The families would be middle class, with average value of housing in their census tract used as a preliminary indicator of socioeconomic status.

2. Two census tracts with different average valuations of housing would be sampled.

3. The tracts should be in areas supplied with water by the municipal utility so that records of water consumption could be obtained.

4. Each family must live in an owned or rented house in which they pay their own water bill directly, since most residents of apartments and mobile home parks would not have their water consumption metered separately for each household, but would instead pay rent that included an estimated cost of water consumption.

5. Families selected must have resided in the same area for at least one year, in the same house or in a similar house in the same census tract.

Criteria established to reduce the influence of variables that were not to be examined in this study were:

1. Census tracts were to be selected that were as homogeneous as possible in type of housing, being made up of developed subdivisions, rather than a mixture of old and new housing that could vary extensively in value and condition.

2. Family size and composition would be held constant. A four-person family composed of husband, wife, and two children was selected as being culturally representative. Ages of children would not be controlled in order that that variable might be examined in the study.

Selection of the Sample

In order to obtain data on the amount of water consumed by each family, it was essential that the municipal water utility be willing to cooperate and that the census tracts from which the sample would be drawn were served by this utility. The municipality from which the sample was taken was Lansing, the capital city of Michigan, a commercial, industrial, and governmental center with a population of 131,000. Officials of the Lansing Board of Water and Light were very cooperative and helpful, both in supplying water consumption data and general information about the Lansing water supply system, and in pointing out residential areas that might fit the criteria for the sample. Two census tracts located near each other in the southwest section of Lansing, both having been largely developed since World War II, and differing in valuation of housing, were recommended as the best locations in which to begin selecting the sample of 100 families. A city official from another department supported this recommendation. A scattered check of some of the subdivisions in each tract in the city assessor's office, and a drive through the areas, indicated

that housing differences did exist. The drive also indicated that many children lived in both areas. When preliminary census block data became available in the fall of 1971, it confirmed these assumptions of variations in housing valuation and of large numbers of children. The census data also indicated that each tract contained a sufficient number of four-person families, of two-parent families, and of owned or rented houses that it should be possible to find 50 families meeting the criteria in each tract who would cooperate in the study.

Since information was not available on which families in each tract were the desired size and composition, it was not possible to develop a list from which a sample could be randomly selected and then contacted by means of a preliminary letter or phone call. The alternative sampling procedure devised was to number all blocks in each tract and randomly assign them to an order of priority in interviewing. All four-person families composed of husband, wife, and two children in the first block in the order were to be interviewed, then all in the second block, and so on until a total of 50 families was reached in each tract. To locate the four-person families within these blocks, the interviewer would begin at the first home at one corner of the block, briefly explain the study, inquire if that family was the desired composition, and also inquire about neighboring homes. She would check with each four-person family thus identified, then also inquire at the first home

which was unknown to her informant, and so continue until the whole block was covered. Return visits were made to houses where no one was at home but which had been pointed out as housing four-person families, and also to houses where no one was at home and no information had been obtained about the family, until all four-person families in a block had been contacted. If the name and/or phone number of a four-person family not at home could be obtained from a neighbor, a phone call was made to set up an appointment.

A total of 126 families were contacted. Of these, eight refused to be interviewed. Husbands in 18 families where the wife had been interviewed refused to answer all or part of the questions left for them to complete, and so new families had to be interviewed to replace them in the study.

Of the eight families who refused to grant an interview, three wives said they did not want to get involved, one said she was interested but too busy, two changed their minds after first agreeing to an appointment, one husband told his wife not to grant an interview after she had made an appointment, and one wife made an appointment but asked to be dropped when an emergency illness arose in her family. One family identified by neighbors as four-person was not found at home on three visits and had an unlisted phone. On a fourth visit, much later, it was found they had moved away.

Some of the husbands who did not complete and return their questionnaires objected to completing the test of beliefs. Some did not return the questionnaires and the reason was not given. All who did not return the questionnaires were contacted by phone, by letter if the family had an unlisted phone, or by return visit if the husband could be found at home. Some of those personally contacted, by phone or visit, promised to return their questionnaires but did not, while others refused to do so. However, several other husbands who had initially refused to answer their questionnaires, or had neglected to do so, did answer and return them after being contacted by the interviewers.

No data on family characteristics could be obtained on the eight families who refused to be interviewed, but they were equally divided between the two census tracts.

Of the 18 families in which the husband refused to answer questions, 13 came from the census tract with lower average property valuation. Husbands and wives in these 18 families were the same ages as those in the sample, but they had lower average educational attainment and occupational classifications. None had graduated from college, and none had occupations in the top classification. They represented all levels of income, but their average family income was lower. Their mean score on the Two-Factor Index of Social Position (Hollingshead, 1957) was 37.3, 11 points lower on the scale than the mean score of 37.3 of the families in the study. However, since over two-thirds of these

18 families came from the census tract with generally lower levels of socioeconomic status, the differences in family characteristics cited above reflect a greater proportion of refusals among husbands in that census tract.

Description of the Sample

The sample consisted of 100 middle-class families, composed of four persons each--husband, wife, and two children--living in a house they either owned or rented, where they received water from a municipal utility and paid their own water bill. Half of the families lived in Census Tract 17 and half in Census Tract 36.01 in the city of Lansing, Michigan.

The largest numbers of both husbands and wives were in the age group 30-39 years, as shown in Table 1. More than half of the parents in the sample were under the age of 40. No wife and only one husband was in the age group 60 and over.

Table 1.--Ages of husbands and wives.

Age Group	Percentage of Husbands	Percentage of Wives
Under 20 years	0	0
20-29 years	20	27
30-39 years	40	39
40-49 years	29	31
50-59 years	10	3
60 years and over	1	0
Total	100	100

Educational attainments of husbands and wives are shown in Table 2. Nearly all of the husbands and wives had graduated from high school. The largest group of both husbands and wives was those who had not had any further formal education beyond high school, with the next largest group having had some college education. Two husbands and two wives had ended their formal education after completing the eighth grade, but no one had less than an eighth grade education. Almost one-fifth (18 per cent) of the wives and one-third (34 per cent) of the husbands had graduated from college and/or taken postgraduate work.

Table 2.--Educational attainment of husbands and wives.

Educational Attainment	Percentage of Husbands	Percentage of Wives
Completed 8th grade	2	2
Partial high school	3	2
High school graduate	32	54
Partial college	29	24
College graduate	19	14
Graduate professional training	15	4
Total	100	100

Occupational roles of husbands were fairly well distributed among all categories above the level of unskilled labor, as shown in Table 3. Only 30 per cent of the wives were employed at a paid job, and over half of these were employed in clerical and sales jobs. Most of the rest were employed in such "lesser professional" occupations as teachers and nurses. Occupational classifications

are taken from Hollingshead's "Two Factor Index of Social Position" (1957).

Table 3.--Occupations of husbands and wives.

Occupational Level	Percentage of Husbands	Percentage of Wives
No paid employment	0	70
Unskilled employees	1	0
Machine operators and semi-skilled employees	15	3
Skilled manual employees	18	0
Clerical, sales, technicians, and owners of little businesses	22	17
Administrative personnel, small independent businesses, and minor professionals	18	1
Business managers, owners of medium-sized businesses, and lesser professionals	11	9
Higher executives, owners of large businesses, and major professionals	15	0
Total	100	100

Table 4 shows the number of days wives spent away from home in employment or in community activities. Half of those who worked away from home worked a five-day week. One worked for pay but did her work at home. The mean number of days for those who did work outside the home was 4.1. Slightly over half of the wives (52 per cent) spent one or more days outside the home in community activities. The majority of these women spent a total of one day per week in community activities. Very few spent more than two days

a week. The mean number of days spent outside the home on community activities was 1.7 days.

Table 4.--Number of days wives spent outside the home in employment and community activities, per week.

Number of Days Outside Home Per Week	Employment-- Percentage of Wives	Community Activities-- Percentage of Wives
0	71	48
1	2	32
2	5	13
3	3	3
4	1	0
5	16	4
6	1	0
7	1	0
Total	100	100

The distribution of income among the families in the sample is shown in Table 5. Of the 88 families reporting their annual income, slightly more than one-half (51 per cent) had incomes of $15,000 or more. More families in this sample were in higher than in lower income brackets. Yet the largest single group, almost two-fifths (39 per cent) had incomes between $10,000 and $14,999.

The other indicator of socioeconomic status besides income was Hollingshead's Two Factor Index of Social Position (1957), a weighted composite score of educational attainment and occupational category. Hollingshead stated that it is assumed that occupation reflects the skill and power possessed by individuals, and that education reflects both knowledge and cultural tastes, and that the proper

combination and weighting of these factors can indicate the approximate social position occupied by an individual in the status structure of American society.

Table 5.--Levels of family income.

Level of Income	Percentage of Families
No response	12
$ 0 - $ 4,999	0
$ 5,000 - $ 9,999	8
$10,000 - $14,999	34
$15,000 - $19,999	24
$20,000 - $24,999	11
$25,000 and up	11
Total	100

The distribution of family scores shown in Table 6, therefore, may be used to describe the relative social position of the families in this sample, rating them by means of the index on the basis of the husband's occupation and education. Only the characteristics of the husband were used in scoring, since 70 per cent of the wives were not employed in any of the paid occupations used in scoring. Lower numbers on the index indicate a higher social position. The possible range of scores on this index is 11-77, with 11 representing the highest social position. Families in this sample ranged from 11 to 73, almost the total possible spectrum, but more families were in the highest than in the lowest social class.

Family scores are here classified by social class according to Hollingshead's procedures in order to describe

the sample more clearly. However, in hypothesis testing, the continuum of scores was used, rather than the score groups presented here.

Table 6.--Index of social position of families by social class.

Social Class	Range of Scores	Percentage of Families
Class I	11-17	15
Class II	18-27	12
Class III	28-43	32
Class IV	44-60	37
Class V	61-77	4
Total		100

Seventy per cent of the sample was in Classes III and IV. Each census tract contained some families from each class, except that there were no families from Class V in the tract with higher property valuation. Eighty per cent of the families in that tract were from Classes I, II, and III, while 78 per cent of the families in the other tract were from Classes III and IV. The mean Social Position Score for the total sample was 37.3 with a standard deviation of 15.6.

Environment of Families

Houses in which families lived had numbers of rooms, exclusive of bathrooms, varying from five to ten, as shown in Table 7. More than half of the houses (56 per cent) had five or six rooms. Three-fourths (76 per cent) had five to

seven rooms. No house had fewer than five rooms. Three houses had ten rooms.

Table 7. Number of rooms in houses.

Number of Rooms	Percentage of Houses
Under 5	0
5	29
6	25
7	22
8	10
9	11
10	3
Total	100

The amount of rainfall in the Lansing area is one environmental factor which could affect use of water for maintenance of lawns and other vegetation. Average yearly rainfall is 31.8 inches. National Weather Service records for the six spring and summer months of 1971 during which most landscape maintenance activity is carried on show the following variations from average precipitation in the Lansing area.

Table 8.--Rainfall for spring and summer months of 1971.

Month	Rainfall in Inches	Departure From Normal
April	1.50	- 1.37
May	1.93	- 1.80
June	5.13	+ 1.79
July	4.82	+ 2.24
August	2.50	- 0.55
September	5.25	+ 2.65

The deficiency in precipitation during the first two spring months would have adversely affected lawns during a period when they usually grow rapidly, and so additional watering may have been done during the second quarter of the year to maintain lawns.

Lansing has had a public water system since 1885, to which was later added a municipal electric utility. Water is pumped from city wells, treated, and supplied to over 36,000 customers, residential, commercial, and industrial. Wastewater is treated in a sewage treatment plant operated as a separate city public service. Charges for sewage treatment are calculated as a proportion of water costs, and charges for both are included on one bill. Customers are billed quarterly.

Development of Instruments

Two instruments were used to collect data in this study. One, an interview schedule covering family characteristics and practices in water use, was developed specifically for this study. A test, the "Test of Epistemological and Instrumental Beliefs" (See Appendix A), was used with the permission of Stanford University Press.

The interview schedule was used to collect data on social and demographic characteristics of the family; ownership of equipment and fixtures; practices in using water in selected activities of personal care, laundering, food preparation, landscape and vehicle maintenance and

recreation; and conservation practices. The 64 questions covered activities of the preceding year. Most of the information obtained was directly related to the research hypotheses formulated for the study, with some additional explanatory and general information also included. Development of the questions was based on consideration of the purposes of the study, and on review of research on household water consumption, with the studies of Dunn (1962) and Woolrich and Courtless (1965) being especially helpful at this stage.

Consultation with the guidance committee, with the chief water engineer for the Lansing Board of Water and Light, and with a professor in agricultural engineering helped to refine and improve the content and organization of the questionnaire. The questionnaire was designed so that the first questions covered general characteristics of the family and the house. These questions were easy to answer and were not threatening. Subsequent groups of questions covered water-using activities, inside and outside the house, with questions on water conserving following all of the questions on regular use. Final questions covered characteristics of age, education, and occupation of husband and wife, and family income.

Specific questions were designed to test knowledge of husbands and wives about water supply and demand. Included were aspects of local municipal supply, general water supply and demand, waste water disposal, contributions

of household uses to demand for water, and ways of dealing with supply limitations. Respondents were also questioned about their personal experience with restrictions on water supply. A set of questions and appropriate answers were developed (See Appendix A, Part VII of interview schedule), based on information in the literature and information obtained from the Lansing Board of Water and Light and the Lansing sewage treatment plant. The completed questionnaire was checked with the chief water engineer of the Board of Water and Light and with an agricultural engineering professor for accuracy.

The "Test of Epistemological and Instrumental Beliefs" developed by Brim and his associates (1962) (which will hereafter be called "Test of Beliefs") was used with husbands and wives to measure the strength of their belief in fate. Although most of the 16 belief subtests included in this instrument were not directly related to the purposes of this study, it was necessary to administer all of them to maintain reliability of the instrument. However, because the rest of the interview was fairly long, and the test of beliefs was not the major focus of this study, the shortened version of the test was used, a version which had been previously used by Halliday in her study of decisionmaking (1964). This shortened version includes the three items out of the five in each subtest which Brim indicated had greatest discriminatory power in measuring that belief. The three items used to measure

belief in fate, and their t values, were: 3 (6.2), 12 (6.1), and 21 (5.0) (Brim, 1962, pp. 72-73). (Appendix A)

The interview schedule was pretested with three homemakers in three different communities, and subsequently a number of revisions in wording were made to clarify questions asked, and to facilitate coding of possible responses. Then both the interview schedule and the Test of Beliefs were pretested with eight wives and two husbands in East Lansing, and some further revisions were made. Pretesting also indicated that an interview with the wife would require approximately an hour to complete the interview, and that the husband would require 20 to 30 minutes to complete the questions on awareness of water supply and demand and the Test of Beliefs. Pretesting did not indicate the possibility of a two-hour interview with some wives, a situation which occurred occasionally in the actual study and which caused some scheduling problems.

Procedures for Obtaining Data

All data except the amount of water consumed were collected directly from the families by the researcher and one other interviewer, a graduate student in the College of Human Ecology. The interviewers selected alternate blocks in the order of interviewing within each tract, except that when nearing the fiftieth interview in the first tract, and the hundredth interview in the second tract, both interviewers worked on the same block, covering

different sides of it, so that parts of blocks would not be left out. One interviewer assigned odd numbers to the families she interviewed, and one assigned even numbers. When it proved necessary to schedule additional interviews to replace earlier ones in which complete data could not be obtained from both husband and wife, these were conducted by the researcher, since the other interviewer was not able to devote more time to the project at that point. Interviews were begun in December, 1971, and completed in July, 1972, with most of them conducted January through April, 1972.

Contacting families began by ringing a doorbell, briefly explaining the purpose of the study, and asking if the family was composed of four persons: husband, wife, and two children. If the family met these criteria, the interviewer explained what was involved in an interview and asked if they would be willing to participate. If they were, an appointment was made and written on a card left with the homemaker. The card contained the interviewer's phone number and address in the event the appointment had to be changed. Several interviews were conducted on the spot, when homemakers suggested they were willing to be interviewed right then.

Most families were very cooperative, glad to help, and interested in the study. Both interviewers used their university identification cards, and found on several occasions that this was a deciding factor in the homemaker's

willingness to talk to them, especially in neighborhoods which had been visited by door-to-door salesmen, petition drives, and/or criminal activity. One homemaker said: "I probably wouldn't have let you inside the door without that identification card."

Interviews were conducted with the wife. The interviewer first asked her all of the questions on the interview schedule covering ownership of equipment and fixtures, practices in using water, demographic characteristics, and awareness of water supply and demand. Then the Test of Beliefs was handed to the wife and she was asked to complete it. Copies of the questions on awareness of water supply and demand and the Test of Beliefs were left for the husband to complete and mail in a stamped envelope. The wife was asked not to discuss her answers with her husband until after he had filled out both instruments. A few wives did not know the sizes of their water heaters or swimming pools, and so those questions were added to the husband's questionnaire to be filled out. On the few occasions when a wife who worked during the day was interviewed at night and her husband was also present, he was asked to take his set of questions to another room and fill them out while the wife was being interviewed. If this room was not sufficiently far away to be out of earshot, he was asked to complete the questions on awareness of water supply and demand before the wife was questioned on this topic.

Twelve families of the 100 in the study refused to give data on their income. Otherwise, families seemed to try to answer questions as honestly as possible, and to cooperate with the study. Each person interviewed was shown the card on which his name and address were recorded separately. The questionnaires were identified only by number, to protect the confidentiality of the respondents. Each family was offered the opportunity to receive a summary report of findings after the study was completed. All but one expressed interest in receiving such a summary.

Data on annual water consumption in cubic feet, obtained from meter readings, were secured from the municipal utility records. Names were submitted to the utility alphabetically so that there was no link between this list and the numerical ordering of the interviews. Data on quarterly consumption for the four quarters of the year were obtained for 73 of the 100 families. One or more quarterly readings had been missed for the other 27 families, so that their records for the year contained a reading covering six or more months, and it was felt that quarterly consumption could not be accurately estimated from such data.

Procedures for Analysis of Data

Data collected on the schedules were coded and key-punched for computer analysis. Some data were also used to develop composite scores, which served as indicators of certain variables included in some hypotheses.

A Water Awareness Score was developed for each wife and each husband, based on the answers they gave to 16 questions on water supply and demand in Part VII of the general interview schedule. Criteria were developed by the researcher for scoring possible responses to each question (see Appendix B). Criteria were tested on responses obtained from wives in three of the families that had not been included in the study because data could not be obtained from the husband. After revisions, responses from wives in five other families not included in the study were scored independently using the criteria, by the researcher and by two judges who were slightly familiar with the research project but were not in any way involved with the study. Inter-item agreement among the three judges was 87.5 per cent, and the inter-rater reliability of the criteria was considered adequate. The criteria were used without any further revision to score the responses of husbands and wives on water awareness.

A method of rating the way water was used in performing selected activities in the home was developed by the researcher. A score of 1 was assigned to ways of performing each activity that suggested lower water use, a score of 2 for ways of performing that suggested moderate water use, and a score of 3 for ways that suggested higher water use (see Appendix B). A composite score for each family was computed by rating them on each activity, and dividing the sum of their scores by the number of activities

they performed, since not all families engaged in all activities, such as using a dishwasher or watering gardens. Validity of this method of measuring overall performance of activities was assessed by comparing it with another approach to measuring the same variable. Forty families' general questionnaires were subjectively evaluated as a whole on ways of using water in performing activities, and were rank ordered, using a sorting technique. The correlation between the two approaches was calculated to be 0.73.

A numerical score was assigned to conscious attempts to conserve water on the basis of answers to item 58 on the interview schedule, of specific conserving practices spontaneously mentioned during the interview, and of indications of relative promptness in repairing leaks which had occurred during the year which were given in responses to item 54 on the schedule (see Appendix B).

The Test of Beliefs was scored for each husband and wife according to procedures devised by Brim and associates (1962, p. 74).

Relationships between variables proposed in the hypotheses were tested by means of regression analysis, on the CDC 3600 computer in the Michigan State University Computer Center, following least squares routines as outlined in STAT Series Descriptions 7-12 (Agriculture Experiment Station, 1966).

Means and standard deviations were computed for demographic data and amount of water used.

CHAPTER IV

FINDINGS

This chapter contains the results of the analysis of data. In the first part, data describing the variables included in the study are presented. In the second part, the results of statistical testing of the research hypotheses are presented. The third part includes an examination of results of testing relationships among some other variables.

Description of Variables

Relationships between eight variables associated with the families studied were included in the hypotheses tested. These variables were: amount of water consumed, ages of children, socioeconomic status, number of items of equipment and fixtures owned, ways in which household activities were performed, belief of husband and wife in fate, water awareness level of husband and wife, and water-conserving practices of families. Indicators of socio-economic status, income, and social position were described in Chapter III.

Amount of Water Consumed

The amount of water consumed by these four-person families varied widely, as shown in Table 9. The minimum family consumption was 5,800 cubic feet for the year. The maximum was 53,200 cubic feet. Mean consumption for the year was 14,767 cubic feet, with a standard deviation of 6,161. The median consumption was 13,800 cubic feet, with the mode being in the 13,000 to 14,999 cubic feet category. Average daily consumption for these families was 302 gallons.

Table 9.--Cubic feet of water consumed in one year.

Cubic Feet of Water	Percentage of Families
Under 7,000	1
7,000- 8,999	9
9,000-10,999	17
11,000-12,999	12
13,000-14,999	20
15,000-16,999	17
17,000-18,999	9
19,000-20,999	7
21,000-24,999	4
25,000-29,999	2
30,000-39,999	1
Over 40,000	1
Total	100

Peak demand was highest for the 73 families for whom quarterly data were available in the third quarter of the year, covering most of July, August, and September. Average daily consumption for these months was 393 gallons per day. Next was the second quarter of the year, covering most of

April, May, and June, with an average daily consumption of 332 gallons.

Ages of Children

Each family studied had two children living at home. Since variation in age was one of the variables to be examined, no attempt was made to control the ages of the children included in the sample, which ranged from an infant less than one year to 25 years old. Most children over 20 living at home were college students, but in one case an older child had been severely injured and required care at home. (Table 10.)

Table 10.--Ages of children.

Age Group	No. Younger Children	No. Older Children	Percentage of All Children
Under 5 years	33	15	24.0
5 to 10 years	34	31	32.5
11 to 15 years	24	28	26.0
16 to 19 years	7	12	9.5
20 to 25 years	2	14	8.0
Total	100	100	100.0
Mean age	7.9	11.5	
Std. Dev.	5.1	5.9	

Number of Items of Equipment and Fixtures

The number of items of equipment using water in their operation, plus the number of selected fixtures that offered potential for using a great deal of water, were recorded for each family. Equipment recorded included washer, dishwasher, food disposer, and sprinkler. Fixtures

recorded included bathtubs, showers, toilet stools, wading pools, and swimming pools. No data were collected on possession of humidifiers, aquariums, kitchen sinks, lavatories, or laundry tubs. Data were collected on activities that involved the use of the last three items.

Table 11 shows the number of items from the selected list possessed by families in the sample. Table 12 shows the kinds of equipment and fixtures found in these homes. The basic items owned by families who had only four items included a bathtub, toilet stool, washer, and waste disposer. (Disposers have been included in all homes built in Lansing since 1960.) The mean number of items owned by a family was 7.4, and the mode was seven items, representing slightly over one-third of the sample. This inventory included the basic four items listed above, plus a lawn sprinkler, and usually two of the following three items: a dishwasher, a pool, or a second toilet stool.

Table 11.--Number of items of equipment and fixtures.

Number of Items in Home	Percentage of Families Possessing That Number
4	2
5	10
6	17
7	35
8	13
9	6
10	9
11	7
12	1
Total	100
Mean = 7.4 items	
Std. Dev. = 1.8	

Only five families owned two tub-shower combinations, and all resided in the census tract with the higher property valuation. Also residing in this tract were 22 of the 23 families with a separate additional shower, the 19 families with more than two toilet stools, and half of the families with two toilet stools. Three-fifths of the families in the tract with the lower property valuation had one toilet stool in their homes; the other two-fifths had two toilet stools.

Table 12.--Kinds of equipment and fixtures owned by families.

Kinds of Equipment and Fixtures	Percentage of Families Owning One or More
Automatic washer	98
Nonautomatic washer	2
Dishwasher	55
Food disposer	98
Tub with shower	98
Tub without shower	2
Separate shower	23
Toilet stools	100
Lawn sprinkler	91
Wading pool	37
Swimming pool	13

Socioeconomic Status

Data about income and social position, which were used as indicators of this variable, were presented in Chapter III under Description of the Sample.

Ways in Which Activities Are Performed

The manner in which selected activities were performed in the household was rated for each family. Possible

family scores could range from 1.00, representing lower water use in activities, to 3.00, representing higher water use in activities. For example, in hand dishwashing, lower water use meant washing and rinsing in stoppered sink bowls or dishpans, moderate use meant washing in a stoppered sink bowl or pan and rinsing under the faucet, and higher water use meant both washing and rinsing under the faucet. Specific criteria were developed for rating each activity included in scoring (see Appendix B). This was not another approach to measuring total water consumption, since the activities included would not require equal amounts of water, as, for example, tooth brushing and tub bathing. Rather, it was an attempt to discern whether general patterns of water use existed among these families, and the relative degree to which such patterns would reflect a free or a conservative approach to using water in household activities. (Table 13.)

Belief in Fate

One of the 16 subtests in the Test of Beliefs was used to measure the strength of belief in fate of the husband and the wife in each family. Possible scores ranged from 3 to 15. Higher scores indicate a stronger belief in fate. Distribution of scores is shown in Table 14.

Table 13.--Way activities were performed using water.

Score Groups	Percentage of Families
1.00 to 1.40	0
1.40 to 1.49	2
1.50 to 1.59	9
1.60 to 1.69	10
1.70 to 1.79	17
1.80 to 1.89	20
1.90 to 1.99	5
2.00 to 2.09	22
2.10 to 2.19	6
2.20 to 2.29	3
2.30 to 2.39	4
2.40 to 2.49	1
2.50 to 2.59	1
2.60 to 3.00	0
Total	100
Mean score = 1.88	
Std. Dev. = 0.23	

Table 14.--Belief in fate subtest scores.

Score	Percentage of Wives	Percentage of Husbands
3	1	5
4	1	5
5	7	7
6	13	15
7	15	14
8	24	18
9	16	13
10	7	11
11	6	9
12	7	2
13	2	0
14	0	0
15	1	1
Total	100	100
Mean Scores =	8.2	7.7
Std. Dev. =	2.1	2.4

Level of Water Awareness

The husband and the wife in each family were questioned on their knowledge of water supply and demand. Scores were assigned to levels of water awareness as measured by the 16 questions asked. The distribution of scores is shown in Table 15. Possible maximum score was 48, and possible minimum score was 16. The mean score for the 100 wives was 32.2, and for the 100 husbands 32.9, both near the midpoint of possible scores and each very close to the other mean, indicating little difference between husbands and wives. Yet there were differences in overall distribution of scores between husbands and wives, as shown in the table.

Table 15.--Water awareness levels of husbands and wives.

Score Groups	Percentage of Wives	Percentage of Husbands
16 to 21	0	0
22 to 24	6	5
25 to 27	7	11
28 to 30	23	17
31 to 33	23	18
34 to 36	27	24
37 to 39	12	19
40 to 42	1	5
43 to 45	1	1
46 to 48	0	0
Total	100	100
Mean scores =	32.2	32.9
Std. Dev. =	4.4	4.9

Water Conserving Behavior

To determine extent of water conserving behavior, points were assigned to each family for general efforts to

conserve water, specific conserving practices carried out, and prompt repair of leaks. Points were subtracted for leaks not repaired promptly.

Conserving practices most often mentioned included: not letting faucets run, teaching children to shut off water not being used, cutting down on length of showers, washing full loads of laundry and so washing fewer loads, sprinkling the lawn less often, and keeping cold water to drink in the refrigerator. Conserving practices mentioned by only a few families included: not watering the lawn at all or only a few times all summer, not using a dishwasher, emptying the wading pool on the garden, and rinsing dishes in a stoppered sink or all at once with a spray attachment.

Testing of Hypotheses

The following research hypotheses were formulated and tested by means of regression analysis:

1. The amount of water that families use will be related to the ages of their children.
2. The amount of water that families use will be positively related to their possession of water-using equipment.
3. The amount of water that families use will be positively related to their socioeconomic status.
4. The amount of water that families use will be positively related to the ways in which they perform certain activities in the home.
5. The amount of water that families use will be positively related to husband's and wife's belief in fate.

6. The amount of water that families use will be negatively related to the levels of water awareness of husbands and wives.

7. The more conscious attempts to conserve water that a family makes, the less water they will use.

8. Conscious attempts to conserve water made by families will be positively related to the beliefs in fate held by, and the levels of water awareness of, husband and wife.

Hypothesis 1

The amount of water that families use will be related to the ages of their children.

Table 16.--Relationship of water use to age of oldest child.

For age of older child:	
Multiple Correlation Coefficient R2 =	0.1147
Regression Coefficient =	352.317
Standard Error of Coefficient =	98.873
Significance Level =	0.001

Finding: There was a positive relationship between the age of the older child and the amount of water used by the family. Approximately 11 per cent of the water consumed by these families may be explained by the age of the older child. Water use increased as the age of the older child increased: an increase of 352 cubic feet of water for each additional year of age. The hypothesis was supported.

Hypothesis 2

The amount of water that families use will be positively related to their possession of water-using equipment.

Table 17.--Relationship of water use to possession of water-using equipment.

Multiple Correlation Coefficient R2 =	0.2236
Regression Coefficient =	1599.400
Standard Error of Coefficient =	301.058
Significance Level =	0.0005

Finding: There was a positive relationship between the number of items of water-using equipment and fixtures possessed by the families and the amount of water they consumed. Approximately 22 per cent of the water consumed by these families may be explained by the number of pieces of water-using equipment and fixtures they possessed. Water use increased 1,599 cubic feet for each additional piece of equipment. The hypothesis was supported.

Hypothesis 3

The amount of water that families use will be positively related to their socioeconomic status.

Table 18.--Relationship of water use to social position.

Multiple Correlation Coefficient R2 =	0.0815
Regression Coefficient =	112.857
Standard Error of Coefficient =	38.284
Significance Level =	0.004

Table 19.--Relationship of water use to income.

Multiple Correlation Coefficient R2 =	0.1912
Regression Coefficient =	2373.700
Standard Error of Coefficient =	526.483
Significance Level =	0.0005

Finding: There was a positive relationship between socio-economic status and the amount of water consumed by a family. In this study family income seemed to indicate more clearly the relationship between socioeconomic status and water use than did the weighted scoring of education and occupation combined in the Two-Factor Index of Social Position. Approximately 19 per cent of the water consumed by these families may be explained by their level of income. Water use increased 2,373 cubic feet for each additional $5,000 of family income. Since larger numbers in the Index of Social Position represent lower socioeconomic status, the negative regression coefficient indicated a positive relationship between socioeconomic status and water use. Water consumption increased 113 cubic feet for each one-digit increase in the Index of Social Position. The hypothesis was supported.

Hypothesis 4

> The amount of water that families use will be positively related to the ways in which they perform certain activities in the home.

Table 20.--Relationship of water use to performance of activities in the home.

Multiple Correlation Coefficient R2 =	0.0112
Regression Coefficient =	2830.857
Standard Error of Coefficient =	2682.513
Significance Level =	0.294

Finding: Only about 1 per cent of water used by these families could be explained by the way in which they performed activities in their homes. The findings were not significant. The hypothesis was not supported.

Hypothesis 5

> The amount of water families use will be positively related to husband's and wife's belief in fate.

Table 21.--Relationship of water use to husband's belief in fate.

Multiple Correlation Coefficient R2 =	0.0156
Regression Coefficient =	96.954
Standard Error of Coefficient =	278.628
Significance Level =	0.729

Table 22.--Relationship of water use to wife's belief in fate.

Multiple Correlation Coefficient R2 =	0.0156
Regression Coefficient =	313.451
Standard Error of Coefficient =	310.140
Significance Level =	0.315

Finding: Only slightly over 1 per cent of the water used by these families could be explained by the belief in fate held by husbands and wives. The findings were not significant. The hypothesis was not supported.

Hypothesis 6

> The amount of water that families use will be negatively related to the levels of water awareness of husbands and wives.

Table 23.--Relationship of water use to husband's level of water awareness.

Multiple Correlation Coefficient R2	= 0.0007
Regression Coefficient	= 32.755
Standard Error of Coefficient	= 127.244
Significance Level	= 0.797

Table 24.--Relationship of water use to wife's level of water awareness.

Multiple Correlation Coefficient R2	= 0.0214
Regression Coefficient	= 205.430
Standard Error of Coefficient	= 140.368
Significance Level	= 0.147

Finding: This variable explained very little of water use in these families, though the wife's level of awareness seemed to be more closely related than was the husband's. Neither relationship was significant, although the relationship between the wife's level of awareness and water use is approaching significance; however, it is a positive rather than a negative relationship. The hypothesis was not supported.

Hypothesis 7

> The more conscious attempts to conserve water that a family makes, the less water they will use.

Table 25.--Relationship of water use to conscious attempts to conserve water.

Multiple Correlation Coefficient R2	= 0.0057
Regression Coefficient	= 186.735
Standard Error of Coefficient	= 248.668
Significance Level	= 0.454

Finding: No amount of water use could be explained by this relationship. The indicated relationship was negative, in agreement with the hypothesis, but was not significant. The hypothesis was not supported.

Hypothesis 8

> Conscious attempts to conserve water made by families will be positively related to the beliefs in fate held by, and the levels of water awareness of, husbands and wives.

Table 26.--Relationship between conserving practices and husband's belief in fate and level of water awareness.

Multiple Correlation Coefficient R2	= 0.0168
Regression Coefficient for Belief in Fate	= 0.0566
Standard Error of Coefficient	= 0.1107
Significance Level	= 0.610
Regression Coefficient for Water Awareness	=-0.0533
Standard Error of Coefficient	= 0.0533
Significance Level	= 0.320

Table 27.--Relationship between conserving practices and wife's belief in fate and level of water awareness.

Multiple Correlation Coefficient R2	= 0.0554
Regression Coefficient for Belief in Fate	=-0.0245
Standard Error of Coefficient	= 0.1174
Significance Level	= 0.835
Regression Coefficient for Water Awareness	= 0.1317
Standard Error of Coefficient	= 0.0567
Significance Level	= 0.022

Finding: No relationship was indicated between conscious attempts to conserve water, and the beliefs in fate of husband and wife, or the husband's level of water awareness. The proportionally large standard error figures indicate a great amount of scatter around the regression line. These relationships were not significant.

A positive relationship was suggested, however, between conscious attempts to conserve water and the wife's level of water awareness, which was significant. A second test was made of this relationship only, omitting the variable wife's belief in fate, with the results reported in Table 28.

Table 28.--Relationship between conserving practices and wife's level of water awareness.

Multiple Correlation Coefficient R2	= 0.0550
Regression Coefficient	= 0.1334
Standard Error of Coefficient	= 0.0559
Significance Level	= 0.019

Finding: The second analysis confirmed a positive relationship between conscious attempts to conserve water and the wife's level of water awareness. Approximately 5 per cent of attempts to conserve water made by these families could be explained by the wife's awareness of water supply and demand. The relationship was significant. Part of the hypothesis was supported.

Possible Relationships of Other Variables to Water Use

Certain other variables besides those examined in the eight hypotheses might have had an effect upon water use. Possible relationships between two variables, person-nights at home and leakage, and annual water consumption were examined by means of regression analysis.

Person-Nights

A family of four who took no overnight vacations away from home would spend 365 nights per person or 1,460 person-nights at home during the year. To this base was added the number of person-nights spent by others in the home, either as short-term guests or as longer-term residents (as some families had relatives living with them for extended periods of time). Person-nights spent away from home by family members on vacations or business were subtracted from this figure to give the total person-nights at home, which could be presumed to affect amount of water used. (Data on numbers of person-nights away from home and

guests in the home were probably not completely accurate when families had many such short-term experiences throughout the year but wives estimated these to the best of their recall ability.)

The number of person-nights at home per household ranged from 1,104 to 1,671, with a mean of 1,433, slightly below the expected normal figure, suggesting that these families spent more nights away from home than they had guests in their homes. No significant relationship was found between number of person-nights at home and amount of water consumed.

Leaks

No significant relationship was found between number and length of time leaks existed in faucets or toilet stools, and the amount of water consumed annually by these families. Most leaks existed for a relatively short period of time in comparison to the whole year. However, during that time, even a small faucet leak might waste four gallons a day, while a toilet stool leak could waste as much as 36 gallons a day, or over one-tenth of the average daily household consumption (U.S. Department of Interior, 1960, pp. 32-33).

Equipment, Fixtures, and Activities

A strong relationship had been indicated between possession of equipment and fixtures and water use

(Hypothesis 2). Further examination was made of two items that varied considerably among the sample and offered means for consuming quite a bit of water. One item was the automatic dishwasher, which was owned by 55 per cent of the sample; the other was total number of bathroom fixtures (tubs, showers, toilet stools), which varied from four to twelve per family. Also, since other studies had shown lawn sprinkling to be a very important component of water demand, the possible relationship between numbers of hours of sprinkling per week in the summer quarter and the annual consumption of water was examined. Results of regression analysis of these three relationships are presented in Table 29.

Table 29.--Relationships of selected variables to water use.

Variable	Multiple Correlation Coefficient R2	Regression Coefficient	Standard Error of Coefficient	Level of Signif.
No. of bathroom fixtures	0.3071	2780.316	421.862	0.0005
Dishwasher	0.0883	3670.779	1191.179	0.003
Hours of lawn sprinkling in summer	0.0367	162.294	83.996	0.056

Significant relationships were indicated in each case. A stronger relationship might have been indicated

for lawn sprinkling if the number and kinds of sprinkling equipment had also been compared.

CHAPTER V

SUMMARY AND CONCLUSIONS

This chapter includes a summary of the findings presented in the preceding chapter, some conclusions drawn from these findings, a discussion of the findings and conclusions in relation to the conceptual framework and the literature reviewed on water usage, and some implications for further research.

Summary of Findings

Water use was found to vary extensively among the sample of families of the same size in the same urban community. The top three users among the 100 families studied consumed 53,200, 32,500, and 28,800 cubic feet, respectively; the bottom three users consumed 5,800, 7,000, and 7,100 cubic feet, respectively. The consumption totals on the far ends of the continuum may be regarded as extreme and unusual cases. Nevertheless, the family third from the top in water usage consumed 28,000 cubic feet in the same year that the family ninety-eighth from the top consumed 7,100 cubic feet--a fourfold increase.

Mean water consumption for the year was 14,767 cubic feet, while the median consumption was 13,800 feet,

with the mode being in the 13,000 to 14,999 cubic feet category. Two-thirds of all families in the sample consumed between 9,000 and 16,999 cubic feet, a 8,000 cubic foot spread. Mean daily consumption for the year was 302 gallons per family.

Results of the study indicated that water use varied among families in relation to their possession of water-using equipment and fixtures, their socioeconomic status (especially family income), and the age of their older child. No relationship was discerned in this study between the amount of water used by families and the way in which they performed selected activities, belief in fate of husbands and wives, level of water awareness of husbands and wives, or attempts to conserve water in the household. A relationship was indicated between the level of water awareness of the wife and attempts made to conserve water.

Conclusions

From the findings of this study, the following conclusions have been drawn:

1. The ability to pay, to obtain resources in the marketplace, strongly influences consumption of water. The consumer with more dollars is able to pay higher water bills, to buy more equipment which requires water each time it operates and more bathroom fixtures which increase opportunities for simultaneous uses of water in the household, and to live in a larger house with a larger lot that requires more water to maintain.

2. The amount of water a family uses is influenced by its stage in the family life cycle. The families with older children used more water. Small children may increase laundry loads for diapers and quickly soiled play clothes; but older children may add as much to laundry baskets with a multitude of special-care garments that are worn once and tossed into the hamper. They may also use more water for personal-care activities and have more control over water use than do younger children. They run their own baths, to the depth they desire (or stay in the shower a very long time), and usually no one checks on the faucet running while they are in the bathroom, as parents might do with young children.

3. Socioeconomic status of a family may be related to water consumption of a family in more ways than just their ability to pay for resources. Educational experiences, occupational associations, and the community in which they reside may influence their choice of the goods and services they buy. Many but not all families who rank higher on the Index of Social Position or reside in certain neighborhoods may adopt a life style which requires more water to maintain.

4. Knowledge of the water resource limitations, and of the demand households make upon this supply, may encourage attempts to conserve water. But unless families understand the relative amounts of water consumed in specific uses, and unless they are willing to change some of

their priorities for water use, they may conserve water in activities where relatively little is used, while continuing to use great amounts of water in other activities where conservation would be feasible. They may feel satisfied that they are doing "something," but they may effect little, if any, change in their total consumption of water.

5. Belief in fate did not appear to be related to the amount of water used nor to attempts to conserve water. It may be that those who believe, not in fate but rather in their own ability to control what happens in their lives, do not view the use of water as an area in which they could or should try to exercise control.

Discussion

The strong relationship between socioeconomic status and consumption of water found in this study is similar to findings in other studies of residential consumption. The Johns Hopkins studies (Federal Housing Administration, 1967), which examined residential areas rather than individual households, concluded that economic level of consumers as indicated by property valuation was very important. Yarborough's (1956) findings suggested that social class was even more important than property valuation as a predictor of water consumption. Dunn (1962) found a relationship between water demand and income, educational level, occupational level, and property valuation.

Dunn (1962) also found a relationship between water demand and possession of equipment and fixtures, citing

specifically possession of an automatic washer, dishwasher, shower, and number of toilet stools. In the present study, nearly every family owned an automatic washer, but relationships were found between water consumption and ownership of a dishwasher and number of bathroom fixtures, as well as total number of appliances and fixtures.

The relationship between hours of lawn sprinkling and annual water consumption found in this study agrees with the findings in the Dunn (1962) and Johns Hopkins studies (Federal Housing Administration, 1967).

A relationship was found between age of children and water use, as was found in Dunn's study (1962). However, while she found higher water demand to be associated with children under six, this present study found a positive relationship between age and water use, which might be partially explained by a greater degree of control over water use exercised by older children and different patterns of water use for personal and clothing care in the 1970's.

Although the total consumption of water by households nationally ranks behind that of agricultural irrigation and industry (both of which are producing other goods to be consumed by families), it is still a sizeable amount. Wright listed a figure for municipal supplies of 16.7 billion gallons, to which could be added uses from private wells (1966, p. 60). A 1970 government estimate of municipal consumption equalled 27 billion gallons per day, of

which about 10 billion gallons would be used in households (U.S. Department of Interior, 1972, pp. 3-4). Of concern also is the amount of fuel-powered energy required to pump, treat, store, and transport this water to millions of residences, and to transport and treat waste water from these homes after use. An increase in water consumption in households also means additional increases in energy consumption for these processes.

The variations in amount of water used in the families studied, and findings from other studies, suggest considerations for human ecologists, engineers, manufacturers, and government decisionmakers. If price is a deterrent to use, how can pricing policies be established to deter excessive use without penalizing poorer families who need a certain amount of water even though they do not have two bathrooms and a large lawn? Most municipal water price structures, like those for electric power, reward large users with a discount rate, thus already penalizing the small user and encouraging consumption. The Johns Hopkins studies (Federal Housing Administration, 1967) suggested that price influenced only landscape maintenance, not in-house domestic use. Others have suggested water demand may be more price-elastic than has been supposed. Husbands and wives in the sample, when asked to choose from alternative strategies for coping with a hypothetical community water shortage, most often chose the action of increasing the price, suggesting this is one action people

will notice. Water rates had been raised in Lansing about a year and a half before the study began, and the utility reported that action had brought an immediate drop in consumption, followed by a return the next quarter to former levels of consumption.

Most husbands and wives who responded to the hypothetical shortage did not favor any form of rationing, either in total amount allowed to a user, or in the time it would be available to residences. Over and over, some variation of this viewpoint was heard: "But you have to have water! You just can't get along without it!" Husbands and wives who had experienced some prolonged restrictions on water consumption in the past did not want to get along on limited water supplies unless necessary, but they did usually recognize that people could get along with less water than they were accustomed to using. Indeed, one cannot get along without water, and most American families would find it very difficult to exist on the gallon or so required for bodily survival. Yet if some families in this study managed to maintain a household on about 7,000 cubic feet a year, why did others require three or four times as much?

Decisions, once made, may limit the field of choice for subsequent decisions. Since a strong relationship was indicated between ownership of equipment and use of water, the choice of a washer, a dishwasher, a pool, a second shower--both the decision to get one and the model selected--

may alter the amount of water used from that time forward. Should we then attempt to discourage the purchase of such items in order to reduce water demand? Would such a strategy succeed? Or would it be more effective to attempt to redesign fixtures and appliances so that they require less water to operate? Some models of flush toilets use far less water than the five to six gallons required by those currently installed in most American homes and which use a large proportion of the water consumed in those homes (some estimates are as high as 41 per cent) (Grava, 1969, p. 32). Shower heads are available that release less water per minute. Bathtubs could be smaller, and appliances might be designed to conserve water.

Other types of decisions can limit the field of choice of water use. Fabrics and garments purchased that require laundering separately from other items may increase water use unless the family has a sufficient number to make up a full load or unless water levels on the washer can be adjusted downward for small loads. And instructions for "wash and wear" garments often suggest that they emerge from the washer more wearable if they have not been too crowded in the washload, meaning more water for fewer clothes.

An example of a limiting central decision was found in several neighborhoods in one of the census tracts. The developer had seeded the lots around these homes with Merion Bluegrass, a variety which, as one perceptive wife pointed out, "takes a lot of water to keep it looking nice." A

check with a turf grass specialist confirmed her statement. Merion Blue, if cared for properly, produces a most attractive lawn, but proper care means frequent watering, feeding, and mowing. Other grasses may not look as attractive as Merion Blue at their peak of perfection, but they will look better in drier periods. So the developer who planned that environment restricted the options of residents to basically two: water more when it doesn't rain, or have a less attractive lawn than they could have with ordinary grasses.

How much control can families exert over the use of water resources in their homes? Are they limited by decisions made by others--the design of the washer, the capacity of the toilet bowl, the variety of grass on their lawn? Halliday (1964) suggested that decisionmakers who view their world as subject to control may be more likely to attempt to control what happens. No relationship between belief in fate and behavior in using water was discerned in this study. Perhaps the instrument may not have measured all the feelings about control held by husbands and wives in this study. Or perhaps they did not view most of the areas of domestic water use as subject to their control.

Deising (1962) suggested that man will not attempt to control commodities not viewed as neutral in his culture. Families may not view all the uses of water as neutral and therefore subject to reallocation. Perhaps some uses of water are controllable. It is all right and even

commendable to turn off the faucet in the bathroom lavatory and the kitchen sink, and to teach children to do so. It may be commendable, if not personally desired, to reduce the length of shower time, and to fill the bathtub less full. But it may not be "all right" or "commendable" to bathe less frequently, to teach children not to flush the toilet after each use. Such uses of water may not be viewed as neutral by many American families. For some families in this study, water used for lawn sprinkling was a neutral commodity, and, for financial or environmental reasons, they sharply reduced the amount of sprinkling they did. But to other families, this use of water was not questioned, even though they were aware that it required much water. A typical comment was: "But you have to have a nice lawn!" Water, in different uses, may or may not be a neutral commodity, and those uses, therefore, may or may not be controlled.

Attempts to conserve water may be influenced by the benefits one feels he may expect. Woolrich and Courtless (1965) found that one-third of their sample made efforts to conserve water, but these were farm families who depended on their own private wells, and would be seriously inconvenienced if those wells ran dry. Families who receive water from a public supply can only estimate direct benefits in terms of a few cents saved, since water prices are cheap in relation to other goods and services. All of the families who were aware of water supply limitations did not seem

to perceive the relationships between this situation and their own behavior. Urban man today is far removed from the source of most of the goods he consumes, and it may be difficult for him to understand how much he depends upon the natural resources of the earth and how his consumption affects quantity and quality of those natural resources. This limited view of the relationship between household resources and the natural environment was illustrated in responses to question number 66 on the interview schedule: "Where does your water supply come from?" (See Appendix A.) Many respondents answered: "The Board of Water and Light--I don't know where they get it from"; or "I have no idea. I just turn on the faucet and it's there."

Should we be so concerned about the amounts of water families use and the ways in which they use it? Fitzsimmons warned that inefficient use of scarce resources will result in loss of utility for the whole society (1950). And Wright (1966) wrote, in reviewing urban water shortages:

> In speaking of water we are considering not merely a desirable commodity, we are speaking of the truly necessary ingredient without which no life is possible (p. 63).

This study supported the need to be concerned about the amount of water consumed in households, even in communities where there is no shortage of water at the present time. The public goal of supplying pure, high quality water to American families for essential health and comfort needs, at a low cost, may not necessarily also mean

supplying unlimited quantities of such water for any and all wants. Families should be made more aware of their dependence upon natural resources, and of the alternatives open to them for effectively conserving water without appreciably lowering the quality of life. Such knowledge can improve managerial skill in adapting to a no-growth economy. The field of choice for family decisions about water use could be altered for all families by designing appliances and fixtures to require less water per use. Professionals in human ecology, health, and related fields need to consider the costs of their recommendations for personal care, laundering, and house maintenance in terms of increased water consumption. Conservation, in the sense of wise use of resources over time, should become a priority in our use of water as well as other limited resources.

Limitations

Limitations associated with this study were:

Water meters were not always read each quarter, so that while annual consumption data could be obtained for all families, seasonal variations in consumption could not always be obtained.

Husbands were not available to be interviewed in many families, so that a different procedure had to be used to obtain information about water awareness and about beliefs from husbands. Instruments were left for the

husband to complete and mail in, while the information from the wives was obtained during an interview.

Implications for Future Research and Education

This study may have raised more questions than it attempted to answer. Much information is needed about the web of relationships between human managerial behavior in the household and the amount of water that flows into a house each day.

In the behavioral area, possible relationships between knowledge, attitudes, and behavior in the management of such scarce resources as water and energy fuels should be explored. More needs to be discovered about the ways in which consumers approach activities which involve the use of these resources. Some relationships may exist between the way certain activities are performed and water consumption which were not revealed in this study.

Family members' perception of control over resources, and factors which may affect such perceptions, invite serious interdisciplinary study, involving such fields as human ecology, anthropology, psychology, economics, and engineering. Do family members perceive water or other natural resources as limited? As controllable? Do they understand what alternatives are open to them for controlling their use of water? Would families make greater attempts to control if they were given more information? If they were offered other motivations for doing so?

The indication in the study that past experience with restriction on water use made one recognize the possibility of living on less than the usual amount of water suggests that more research could be done on the possible effects of different kinds of restriction experiences. Do such experiences make people fear limitation of resources, or accept it? Do such experiences help people to develop coping behavior, and become aware of alternatives? Are people who have had such experiences more likely to attempt to control allocation of scarce resources?

In the technological area, more metered studies of specific uses, and losses, should be conducted in households. Practical methods of lowering water requirements for appliances and activities should be investigated, methods that will demand less water without significantly lowering the quality of life, if this is possible. With a possible shortage of energy fuels, research is needed on the energy costs of procuring, treating, and transporting water to the home, of heating water for various household activities, and of purifying waste water for reuse. Such energy cost studies should also focus on waste resulting from leakage and inefficient arrangement of pipes and fixtures in the home.

Studies need to be conducted, at the individual household level, like those carried out by Dunn, Woolrich and Courtless, and others. They should be conducted in a variety of community environments, among different

socio-economic groups and families in different stages of the life cycle. Comparative studies using the same basic design could be most informative. Field experiments might be conducted, using different educational approaches as intervention strategies, and measuring any behavioral changes related to water use. Case studies of families carried out by frequent detailed daily observations of household activities could provide more exact information on patterns of water use.

As far as our present limited state of knowledge allows, such studies should be based on an ecological systems approach, viewing the family and household interacting with the biophysical and socioeconomic environments which furnish its life support.

Educational programs, from the early elementary grades to continuing education and extension for adults, could put more emphasis on understanding the limited supply of natural resources including water, man's dependence on these resources, and alternative consumption patterns which satisfy human needs but demand fewer resources.

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APPENDICES

APPENDIX A

Interview Schedule: "Water Consumption Practices in Households"

Interview Schedule: "General Questions on Water"

Test of Epistemological and Instrumental Beliefs

No._____

Date_____

WATER CONSUMPTION PRACTICES IN HOUSEHOLDS

I. Household Occupancy & Living Space

1. How long have you lived here? _____

2. What are the ages of your children? _____ _____

3. a. Did any other persons live in this house during the past year?
   If yes, how many?

None	_____	Four	_____
One	_____	Five	_____
Two	_____	Six	_____
Three	_____	Seven or More	_____

   b. How many were children under 18?

What were their ages?	Ages	Number
		None _____
	_____	One _____
	_____, _____	Two _____
	_____, _____, _____	Three _____
	_____, _____, _____, _____	Four _____
	_____, _____, _____, _____, _____	Five _____
	_____, _____, _____, _____, _____, _____	Six _____
	_____, _____, _____, _____, _____, _____, _____	Seven or More _____

   c. During which months did they live here?

   Ja F Mr Ap My Jun Jul Au S O N D

4. Did your family have any long periods of illness during this past year?

   Yes _____ No _____ If yes, what? _____

   Was anyone confined to bed for a long time?

   Yes _____ No _____

   If yes,
   When did these illnesses occur?

   Ja F Mr Ap My Jun Jul Au S O N D

5. How many rooms are in the living space of this house (excluding bathrooms)?

   Not reported

One	_____	Five	_____
Two	_____	Six	_____
Three	_____	Seven	_____
Four	_____	Eight	_____
		Nine or more	_____

II. Water-Using Fixtures, Equipment, and Household Habits Inside the Dwelling

6. Do you have water softening equipment? None _____ Is it owned or rented? Owned _____ Rented _____

7. What is the size (in gallons) of your water heater?

None	_____	50 - 59	_____
Under 30	_____	60 - 69	_____
30 - 39	_____	70 - over	_____
40 - 49	_____		

8. Is any of the family laundry done away from home?
None _____ Some _____ All _____
If some, about what percent? _____

9. a. Do you have a washing machine?
Yes _____ No _____

If yes,
b. Is it a wringer or automatic? Wringer _____ Automatic _____

c. What brand is it? _____

d. About what year? _____

If automatic
e. Does it have a Sudssaver? Yes _____ No _____

f. How many water levels can you set the machine for? _____

10. a. What days of the week is the laundry done?
S M T W Th F Sat

b. What time of day is it usually done?
6-9 am ___, 9-12 am ___, 12-3 pm ___, 3-6 pm ___,
6-9 pm ___, 9-12 pm ___, 12-6 am ___

11. If the automatic washer is used, how many loads are usually done each week?
Less than one ___, one ___, two ___, three ___,
four ___, five ___, six ___, seven ___, eight ___,
nine ___, ten ___, eleven ___, twelve ___,
thirteen ___, fourteen ___, fifteen or more ___, (no. ____)

12. If the automatic washer is used, how often do you use extra cycles (as soaks, extra rinses)?
always ___, frequently ___, about half the time ___,
occasionally ___, never ___

13. If the wringer washer is used, how many tubs of water for washing and rinsing are used each week?

Less than one ___, one ___, two ___, three ___,

four ___, five ___, six ___, seven ___, eight ___,

nine ___, ten ___, eleven ___, twelve ___,

more than twelve ___, (no. _____)

14. a. Was there any period this past year when you had more washing than usual? (if yes, check month) Yes ___ No ___

Ja F Mr Ap My Jun Jul Au S O N D

b. How many additional loads of clothes, or tubs of water (wringer washer) were used each week during that period?

Loads _____ or Tubs _____

One ___, two ___, three ___, four ___, five ___,

six ___, seven ____, more than seven ___ (no. _____)

c. For how many weeks in that month?

one ___, two ___, three ___, four ___

15. a. What brand (or brands) of detergent do you use for your laundry?

b. About how much do you use for each washload (in automatic) or for each tub (in wringer washer)?

c. How do you know when you have enough detergent for a washload?

16. a. What other laundry products do you usually add when washing?

Product	Add During:
bleach _____ (kind _____)	
water conditioner _____	
fabric softener _____	
bluing _____	
enzyme presoak _____	
other _____	

b. When, in the washing process, do you usually add them?

17. Do you have any special stain-removal techniques?

Yes ___ No ___

If yes, describe them?

18. How do you dry washed clothes?

dryer _____, line outdoors _____, line inside _____,

other _____

19. What kinds of items do you wash together in the same load?

20. What special laundry problems do you have?

21. a. Are there items you wash by hand? Yes ___ No ___

List:

b. How many times a week do you do this?

less than one ___, one ___, two ___, three ___,

four-six ___, seven (every day) ___,

more than once a day ___

c. Where do you do this?

bathroom lavatory ___, tub ___, kitchen sink ___,

laundry tub ___, other ___

d. What detergent do you use?

22. Do you wash dishes by hand or in an automatic dishwasher?

hand ___ automatic dishwasher ___

23. a. If you have an automatic dishwasher, what brand is it?

b. Is it portable or built-in?

portable ___ built-in ___

c. About what year? _____

24. If you have an automatic dishwasher:

a. How many loads are run in the dishwasher each day?

less than one ___, one ___, two ___, three ___,

four ___, five or more ___

b. When are they usually run?

6-9 am ___, 9-12 am ___, 12-3 pm ___, 3-6 pm ___,
6-9 pm ___, 9-12 pm ___, 12-6 am ___

c. How often do you use extra cycles (soaks, washes, rinses)?

always ___, frequently ___, about half the time ___,
occasionally ___, never ___

25. a. If you wash dishes by hand, how often do you usually do this each day?

less than one ___, one ___, two ___, three ___,
four ___, five or more ___

b. What method do you use?

_____ wash and rinse in stoppered sink bowls;
_____ wash and rinse in dishpan;
_____ wash in stoppered sink bowl or dishpan and rinse under faucet;
_____ wash and rinse under faucet;
_____ other (describe)

26. a. Do you prepare any foods, such as fresh fruits and vegetables, chicken, etc. by cleaning under a running faucet?

yes ____ no ____

b. If yes, how often do you do this each day?

less than one ___, one ___, two ___, three ___,
four or more ___

27. a. Do you have a waste food disposer unit (garbage grinder)?

yes ___ no ___

b. What brand is it? _____

c. How many times a day do you use it?

less than one ___, one ___, two ___, three ___,
four ___, five or more ___

28. How many bathtubs with shower do you have?

none ___, one ___, two ___, three ___, four or more ___

29. How many bathtubs only?

none ___, one ___, two ___, three ___, four or more ___

30. How many showers only?

none ___, one ___, two ___, three ___, four or more ___

31. How many toilet stools?

none ___, one ___, two ___, three ___, four or more ___

32. a. How many tub baths are usually taken each week?

none ___, 1-5 ___, 6-10 ___, 11-15 ___, 16-20 ___,
21-25 ___, 26-30 ___, 31 or more ___

b. What size is the tub? (tubs?)

c. How full is it usually filled ?

less than ¼ full ___, ¼ full ___, ½ full ___,
3/4 full ___, more than 3/4 full ___

33. a. How many showers are usually taken each week?

none ___, 1-5 ___, 6-10 ___, 11-15 ___, 16-20 ___,
21-25 ___, 26-30 ___, 31 or more ___

b. How many minutes does the water usually run for each shower?

1 ___, 2 ___, 3 ___, 4 ___, 5 ___, 6 ___, 7 ___,
8 ___, 9 ___, 10 ___, 11 or more ___ (give no. min. ___)

34. a. <u>If there is a baby</u> in the household:

a. Where is he usually bathed?

tub ___, sink ___, bathinette ___, other ___

b. How many times a week?

1 ___, 2 ___, 3 ___, 4 ___, 5 ___, 6 ___, 7 ___,
8 ___, 9 ___, 10 ___, 11 ___, 12 ___, 13 ___,
14 ___, 15 or more ___

35. a. How many family members usually wash their hands under a running faucet?

none ___, one ___, two ___, three ___, four ___

b. How many usually wash their hands in a stoppered basin?

none ___, one ___, two ___, three ___, four ___

c. Do the kids often leave the water running?

never ___, sometimes ___, usually ___, always ___

d. About how many minutes?

less than one ___, one ___, two ___, three ___,
four ___, five or more ___

36. a. When family members brush their teeth, is this usually done with the faucet running?

never ___, sometimes ___, usually ___, always ___

b. About how many minutes?

less than one ___, one ___, two ___, three ___,
four ___, five or more ___

37. a. Does the husband shave with the water running?

never ___, sometimes ___, usually ___, always ___

b. About how many minutes?

less than one ___, one ___, two ___, three ___,
four ___, five or more ___

38. Where do family members shampoo their hair? (write in no. persons)

shower _____ lavatory _____ other _____ (where?)

bathtub _____ kitchen sink _____

III. Purchase of Durable Goods

39. a. We have talked about various kinds of water-using fixtures and equipment in your home. Were any of these fixtures or pieces of equipment purchased during the past year? Yes ____ No ____

b. When were they purchased? _____

40. Do you plan to purchase additional water-using fixtures or equipment during this next year? When ?

1971			40) 1972	
39.a) yes	39.b) month		yes	month
___	_____	Bathtub	___	_____
___	_____	Shower	___	_____
___	_____	Stool	___	_____
___	_____	Washer (autom)	___	_____
___	_____	Washer (wringer)	___	_____
___	_____	Dishwasher	___	_____
___	_____	Food disposer	___	_____
___	_____	Water heater	___	_____
___	_____	Water softener	___	_____
___	_____	Wading Pool	___	_____
___	_____	Swimming Pool	___	_____
___	_____	Lawn Sprinkler	___	_____
___	_____	Other	___	_____
___	_____		___	_____
___	_____		___	_____

IV. Water Use Outside the Dwelling

41. a. How many cars do you have?

none ___, one ___, two ___, three ___, four or more ___

b. Are they washed at home?

yes ___ no ___

c. If yes, how often were they washed during the past year?

more than once a week ___, once a week ___,
two or three times a month ___, once a month or less ___

d. Are they washed more often in some months than others?

Ja F Ma Ap My Jun Jul Aug S O N D

e. How are they usually washed?

bucket ___, hose ___, other _____

f. How many buckets of water are usually needed?

one ___, two ___, three ___, four ___, five ___,
six or more ___

or

g. How long (in min.) does the hose usually run?

1-2 ___, 3-4 ___, 5-6 ___, 7-8 ___, 9-10 ___,
11 or more ___

42. a. Was the lawn sprinkled during this past spring and summer?

yes ___ no ___

b. During which months was sprinkling done?

Ap My Jun Jul Aug S O

c. How do you think this compares with sprinkling you did last year?

more ___, about the same ___, less ___

43. a. How many times each week was the lawn sprinkled?

less than once ___, one ___, two ___, three or four ___,
almost every day ___

b. What time of day do you usually sprinkle?

6-9 am ___, 9-12am ___, 12-3 p.m. ___, 3-6 pm ___,
6-9 pm ___, 9-12pm ___, 12-6 am ___

44. About how many hours did the sprinkler operate each time?

less than one ___, one ___, two ___, three ___,
four ___, five ___, six or more ___

45. What kind of lawn sprinkling equipment do you have?

46. How much do you think it costs to sprinkle the lawn each time?

47. Were you trying to develop any new lawn area, trees, or shrubs during this past year?

yes ___ no ___

48. a. Did you have a flower garden?

yes ___ no ___

b. If yes, about how often did you water it each week?

less than one ___, one ___, two ___, three or four ___,
almost every day ___

c. During which months was it watered?

Ap My Jun Jul Au S O

49. a. Did you have a vegetable garden?

yes ___ no ___

b. If yes, about how often did you water it each week?

less than one ___, one ___, two ___, three or four ___,
almost every day

c. During which months was it watered?

Ap My Jun Jul Au S O

50. a. Do you have a wading pool?

yes ___ no ___

b. If yes, how large is it?

length _____, width _____, depth _____, cu. ft. _____

or

c. Size in gallons

under 25 ___, 25-50 ___, 50-100 ___, 100-200 ___,
200-300 ___, 300-400 ___, 400-500 ___, over 500 ___

51. How many times was it (wading pool) filled during the past year?

none ___, less than 10 ___, 10-19 ___, 20-29 ___,
30-39 ___, 40-49 ___, 50-59 ___, 60-69 ___,
70-79 ___, 80 and over ___

52. a. Do you have a swimming pool? yes ___ no ___

b. If yes, how large is it?

length _____, width _____, depth _____, cu. ft. _____

or

c. Size in gallons

under 25,000	_____	250,000	_____
25,000	_____	300,000	_____
50,000	_____	350,000	_____
100,000	_____	over 350,000	_____
150,000	_____		

53. How many times was it (swimming pool) filled during the past year?

none ___, one ___, two ___, three ___, four ___,
five or more ___ (no. ____)

V. Factor Affecting Variation in Water Consumption

54. a. Was there any time during this past year when you noticed leakage from water fixtures? yes ___ no ___

b. If yes, was this from faucets? ___ toilets? ___ both? ___

c. What months did this occur?

Faucet Ja F Ma Ap My Jun Jul Au S O N D

Toilet Ja F Ma Ap My Jun Jul Au S O N D

d. How long before the leak was repaired?

	Faucet	Toilet
less than 1 day	_____	_____
1-7 days (week)	_____	_____
1-2 weeks	_____	_____
2-4 weeks	_____	_____
more than 1 month	_____	_____

55. a. During this past year, was the water pressure low at any time?

yes _____ no _____

b. If yes, in which months did this occur?

Ja F Mar Ap My Jun Jul Au S O N D

c. During which hours of the day?

6-9 am ___, 9-12 am ___, 12-3 pm ___, 3-6 pm ___,
6-9 pm ___, 9-12 pm ___, 12-6 am ___

56. During this past year, did you have many overnight guests?

yes _____ no _____

If yes, which months? How many persons? No. of nights for each?

Months	No. persons	No. nights	Months	No. persons	No. nights
Jan.			July		
Feb.			Aug.		
Mar.			Sept.		
Apr.			Oct.		
May			Nov.		
June			Dec.		

57. During this past year, were there any periods when family members were away from home overnight (on vacations, business, etc.)

yes ___ no ___

If yes, which months? How many persons? No. of nights for each?

Months	No. persons	No. nights	Months	No. persons	No. nights
Jan.			July		
Feb.			Aug.		
Mar.			Sept.		
Apr.			Oct.		
May			Nov.		
June			Dec.		

58. Did you make any special efforts this past year to conserve water?

yes ___ no ___

If yes, what did you do?

Which months?

Ja F Ma Ap My Jun Jul Au S O N D

VI. Information Regarding Occupation, Income, Education

59. What is the husband's occupation?

60. Is the wife employed? yes ___ no ___

If yes, what is her occupation?

61. How many days does the wife average being away from home each week?

	Employment	Community activities
none	_____	_____
one	_____	_____
two	_____	_____
three	_____	_____
four	_____	_____
five	_____	_____
six	_____	_____
seven	_____	_____

62. a. What was the last grade in school completed by the husband?

b. What was the last grade in school completed by the wife?

63. a. What is the age of the husband?

_____ under 20
_____ 20 - 29
_____ 30 - 39
_____ 40 - 49
_____ 50 - 59
_____ 60 - 69
_____ 70 and over

b. What is the age of the wife?

_____ under 20
_____ 20 - 29
_____ 30 - 39
_____ 40 - 49
_____ 50 - 59
_____ 60 - 69
_____ 70 and over

64. What was the total family income last year before tax deductions?

_____ $0. to $4,999
_____ $5,000 to $9,999
_____ $10,000 to $14,999
_____ $15,000 to $19,999
_____ $20,000 to $24,999
_____ $25,000 or more

No. _____ H _____ W _____

Date _____

VII. General Questions on Water

65. Have you ever experienced a water shortage or restriction on water use?

yes _____ no _____

If yes, what happened?

66. Where does your water supply come from?

67. Where might the water utility get additional water supplies if more was needed in this area?

68. Do you think the cost of water in this community is: (check one)

very expensive ___, fairly expensive ___, about right ___,
fairly inexpensive ___, very inexpensive ___

69. What is your average water bill?

70. a. Which of these items are you paying for when you pay your water bill?

_____ buying rights to water from other users
_____ pumping water out of the source and to places it is used
_____ purifying and conditioning water before it is used
_____ customer service (repairs, turning water on and off, etc.) reading meters, billing and records
_____ improving and expanding the water system facilities

b. Which, of the items you mentioned, costs the most?

71. How is your water supply conditioned before it comes to your house?

72. a. Do you know how much you pay for sewage treatment?

yes _____ no _____

If yes, how much?

b. Where could you get this information?

73. Do you think the cost of sewage treatment in this community is: (check one)

very expensive ___, fairly expensive ___, about right ___,
fairly inexpensive ___, very inexpensive ___

74. a. Which of these items are you paying for when you pay your sewage treatment bill?

_____ enlarging the treatment plant and sewer system to service more people and handle more water
_____ maintaining the sewer system
_____ treating sewage as it goes through the plant
_____ removing phosphates from sewage

b. Which, of the items you mentioned, contributes most to sewage treatment costs?

75. Rank these users of water in this community according to the relative amount of water they use: (1 uses the most water and 5 the least)

_____ agriculture
_____ industry
_____ firefighting
_____ households
_____ commercial

Are there any other important users of water?

76. How much water do you think an average family uses each day?

77. a. Rank these processes according to the relative amount of water used for each: (1 uses the most water and 4 the least,)

_____ washing dishes in an automatic dishwasher
_____ flushing the toilet
_____ washing laundry in an automatic washer
_____ mopping floors

b. Which of these processes uses the most water:

___ a bath in a tub; ___ a shower;

Why?

78. a. What do you think causes water shortages?

b. How do you think water shortages might be solved?

79. If you were a public official, faced with community water shortage, who had to choose a policy that would reduce water consumption, which of these would be the best way to get results:

_____ double the price of water
_____ shut off water each day after a certain number of gallons had been used
_____ shut off water during part of each day
_____ other?

No. _____ H _____ W _____

Date _____

TEST OF EPISTEMOLOGICAL AND INSTRUMENTAL BELIEFS

These are proverbs and statements about life. You will find you agree with some, and disagree with others.

For each of these sayings, circle the answer at the right which best expresses how you feel about it.

		Strongly Agree	Agree	?	Disagree	Strongly Disagree
1.	Flowers know where the sun is, and feel its warmth.	SA	A	?	D	SD
2.	Every human problem can be solved and every hunger satisfied and every promise can be fulfilled if God so wills.	SA	A	?	D	SD
3.	Man's existence is completely under the control of destiny.	SA	A	?	D	SD
4.	Things that seem mysterious and unpredictable now will one day be predicted by science.	SA	A	?	D	SD
5.	Few things have but a single cause; for most the "cause" is really a multitude of little things happening together.	SA	A	?	D	SD
6.	The highest wisdom is continual cheerfulness.	SA	A	?	D	SD
7.	He who never hopes can never despair.	SA	A	?	D	SD
8.	To fear the worst often cures the worst.	SA	A	?	D	SD
9.	One often expects misery in vain.	SA	A	?	D	SD
10.	Old houses, like old people, feel very tired at times.	SA	A	?	D	SD
11.	As God created the world, so He can change or end it as he pleases.	SA	A	?	D	SD

		Strongly Agree	Agree	?	Disagree	Strongly Disagree
12.	There is a divinity that shapes our ends, roughhew them as we will.	SA	A	?	D	SD
13.	The world moves in an orderly fashion.	SA	A	?	D	SD
14.	For any event there are an infinite number of results.	SA	A	?	D	SD
15.	To fear the worst is to go through life with an unnecessary burden.	SA	A	?	D	SD
16.	One's fondest hopes rarely come true.	SA	A	?	D	SD
17.	Life often presents us with a choice of evils rather than of good.	SA	A	?	D	SD
18.	It is madness to be expecting evil before it comes.	SA	A	?	D	SD
19.	The unlighted match feels its own heat when lighted.	SA	A	?	D	SD
20.	God is powerless in the face of natural laws and to ask Him for help is to shout at the wind.	SA	A	?	D	SD
21.	Nothing comes to pass but what fate wills.	SA	A	?	D	SD
22.	People try to find order in the world when in fact there is none.	SA	A	?	D	SD
23.	The causes of any event are so intertwined that it is difficult to know how important each may be.	SA	A	?	D	SD
24.	It is worth a thousand dollars a year to have the habit of looking on the bright side of things.	SA	A	?	D	SD
25.	He that lives on hope will die starving.	SA	A	?	D	SD

		Strongly Agree	Agree	?	Disagree	Strongly Disagree
26.	Forewarned is forearmed.	SA	A	?	D	SD
27.	Nothing is so wretched or foolish as to anticipate misfortunes.	SA	A	?	D	SD
28.	Happiness comes from living day to day.	SA	A	?	D	SD
29.	When ancient opinions and rules of life are taken away, the loss to people cannot possibly be estimated.	SA	A	?	D	SD
30.	One of the most important things in life is to be absolutely sure of what you want.	SA	A	?	D	SD
31.	Uncertainty and expectation are the joys of life.	SA	A	?	D	SD
32.	For every action there's a limited number of outcomes; it's smart to consider them all beforehand.	SA	A	?	D	SD
33.	It's important to decide upon one thing and stick to it.	SA	A	?	D	SD
34.	Nothing is less in our power than the heart, and far from commanding it we are wiser to obey it.	SA	A	?	D	SD
35.	Our grand business is not to see what lies dimly at a distance, but to do what lies clearly at hand.	SA	A	?	D	SD
36.	The tried and true ways are the best.	SA	A	?	D	SD
37.	It is easy to classify most things as either good or bad.	SA	A	?	D	SD
38.	To know what may happen tomorrow is one of the dullest things in life.	SA	A	?	D	SD

		Strongly Agree	Agree	?	Disagree	Strongly Disagree
39.	You can only confuse yourself by thinking of all that might happen.	SA	A	?	D	SD
40.	Each important thing that happens to man can be traced to a single cause.	SA	A	?	D	SD
41.	Happiness comes from impulse, rather than reason.	SA	A	?	D	SD
42.	The pleasures of one today are worth those of two tomorrows.	SA	A	?	D	SD
43.	To live by custom is a foolish thing.	SA	A	?	D	SD
44.	It's best not to get too excited about anything.	SA	A	?	D	SD
45.	Certainty alone brings peace of mind.	SA	A	?	D	SD
46.	In deciding whether or not to do something it's wise to make as long a list as you can of all the outcomes.	SA	A	?	D	SD
47.	To try to do many things is to do none of them well.	SA	A	?	D	SD
48.	Our first impulses are good; thought usually weakens them.	SA	A	?	D	SD

Brim, Orville, G., Jr., David C. Glass, David E. Lanvin, and Norman Goodman. Personality and Decision Processes. Stanford, Calif.: Stanford University Press, 1962.

APPENDIX B

Criteria for Judging Water Awareness and Knowledge

Criteria for Scoring Performance of Activities Which Involve Water Use

Procedure for Developing Score for Water Conserving Behavior

CRITERIA FOR JUDGING WATER AWARENESS
AND KNOWLEDGE

(Evaluation of responses to Part VII--"Gen. Questions on Water")

3 = High awareness
2 = Some awareness
1 = Little or no awareness

66. 3= Wells
    2= Pumping station
    1= Don't know or gives other source such as Bd. of Water & Light, river, etc.)

67. 3= More wells, or Grand River (or river)
    2= Great Lakes
    1= Other answer or don't know

69. 3= Knows $ amount
    2= Knows $ amount approximately
    1= Don't know

70. 3= Does not check item marked "O"; checks all 4 items
(a) marked "X".
    2= Does not check item marked "O"; checks 2 or 3 items marked "X".
    1= Checks item marked "O", and/or checks less than 2 items marked "X".

O	buying rights to water from other users
X	pumping water out of the source and to places it is used
X	purifying and conditioning water before it is used
X	customer service (repairs, turning water on and off, etc.) reading meters, billing and records
X	improving and expanding the water system facilities

70. 3= Checks item marked "1st"
(b) 2= Checks either item marked "2nd" or item marked "3rd"
1= Checks item marked "4th," or item marked "O" or don't know

O	buying rights to water from other users
2nd	pumping water out of the source and to places it is used
3rd	purifying and conditioning water before it is used
1st	customer service (repairs, turning water on and off, etc.) reading meters, billing and records
4th	improving and expanding the water system facilities

71. 3= States at least 2 of the following processes (softening, purification and/or chlorination, fluoridation, filtration; may also mention iron removal, or sedimentation)
2= Mentions one process or says "chemicals put in," etc.
1= Other answer or don't know

72. (a and b together)
3= States 75% of water, or $ amount, or that it is on bill
2= States it is % of water, but gives inaccurate %; or call Bd. of Water & Light or City Hall
1= Other answer or don't know

74. 3= Does not check item marked "O" (unless indicates
(a) phosphate removal will be done soon);checks all 3 items marked "X"
2= Does not check item marked "O" (unless indicates phosphate removal will be done soon);checks 2 items marked "X"
1= Checks item marked "O" as occurring now, and/or checks less than 2 items marked "X"

X	enlarging the treatment plant and sewer system to service more people and handle more water
X	maintaining the sewer system
X	treating sewage as it goes through the plant
O	removing phosphates from sewage

74. 3= Checks item marked "1st"
(b) 2= Checks item marked "2nd"
1= Checks item marked "3rd," or item marked "O", or don't know

2nd	enlarging the treatment plant and sewer system to service more people and handle more water
3rd	maintaining the sewer system
1st	treating sewage as it goes through the plant removing phosphates from sewage
0	removing phosphates from sewage

75. 3= List 1 & 2 as the top two, in either order
(a) 2= List 1, 2, & 3 as the top three, in any order
1= Either 4 or 5 in top two, or 1 or 2 in the bottom two, or don't know

5	agriculture
1	industry
4	firefighting
2	households
3	commercial

75. Are there any other imp. users of water?
(b) 3= States govt. & public uses or suggests 2 or more govt. uses such as govt. offices, parks and recreation, street cleaning, etc.
2= Gives one specific isolated use as skating rinks, pools, water in parks, cleaning streets, etc.
1= Other answer or don't know

76. 3= Any figure between 150-300 gal.
2= Any figure between 100-150 gal. or between 300-400 gal.
1= Less than 100 gal., or over 400 gal., or don't know

77. 3= Lists all items in correct order
(a) 2= Lists dishwasher 1st and washer 2nd, or dishwasher 3rd and flushing toilet 2nd
1= List in any order, such as 1st (washer) in third place or lower, 2nd (dishwasher) in fourth, 3rd (flushing toilet) 1st, or 4th (mopping floors) any place above fourth

2nd	washing dishes in an automatic dishwasher
3rd	flushing the toilet
1st	washing laundry in an automatic washer
4th	mopping floors

77. Rate only on reasons why.
(b) 3= States clear cause-and-effect relationship: for shower-length of time it's run, for tub-depth filled
2= Gives some indication of cause-and-effect relationship
1= No evidence of cause-and-effect relationship

78. (a)
3= People use more, overuse or waste; may also mention population increase, and natural factors such as rainfall, sources of water in area
2= Only natural factors mentioned, such as rainfall, geography, not enough water sources, etc.
1= Other reasons, or don't know

78. (b)
3= Answers suggesting, generally or specifically, reduction in waste, changes in amount of water used or ways it is used, changes in life style; may also mention ways to do this such as education or restrictions
2= Increase supply of water in problem area, such as bringing water, seed clouds, desalt ocean, etc.
1= Other answer or don't know

CRITERIA FOR SCORING PERFORMANCE OF ACTIVITIES WHICH INVOLVE WATER USE

Score each activity on level of performance: 0--Not applicable
1--Lower use
2--Moderate use
3--Higher use

Activities	Lower Use	Moderate Use	Higher Use
Laundering (no. loads or tubs)	5 or less	6 to 10	11 or more
(No. extra cycles)	Occasionally or never	Half the time	Frequently or always
Hand laundering (frequency/week)	Once	Two to three times	Four or more times
Automatic dishwasher (No. loads/day)	1 or less	2	3 to 5
(No. extra cycles)	Occasionally or never	Half the time	Frequently or always
Hand dishwashing (frequency/day)	Once	Twice	Three or more times
Hand dishwashing method	Wash & rinse in dishpan or stoppered sink	Wash in dishpan or stoppered bowl; rinse under faucet	Wash and rinse under faucet
Washing foods (frequency/day)	Less than one or none	One	Two or more
Grinding garbage (frequency/day)	One or less	2 or 3	Four or more
Bathing, total tub and shower incl. baby baths (frequency/week)	Not over 15	16 to 30	31 or more
Tub depth	1/4 or less full	1/2 full	Over 1/2 full
Shower time (minutes)	Five or less	6 to 10	11 or more
Hands-washing No. members washing under running faucet	None	1 or 2	Three or four
Kids leave faucet running (frequency)	None or sometimes 1 min. or less	Sometimes & 2 or more min.	Usually, always

CRITERIA FOR SCORING PERFORMANCE OF ACTIVITIES WHICH INVOLVE WATER USE

Activities	Lower Use	Moderate Use	Higher Use
Teeth-brushing with water running (frequency)	Never or sometimes & one minute	Sometimes & two or more minutes	Usually or always
Shaving with water running (frequency)	Never	Sometimes	Usually or always
Car washing (frequency/month)	Once	Two or three times	Four or more times
Amount of water used in car washing	Buckets: 1-3 &/or min. 6 or less	Buckets: 1-3 &/or min. 7-10	Buckets: 1 or more &/or min. 11 or more
Lawn sprinkling (frequency/week)	Once or less, or not at all	Twice	Three or more times
Time run: hours sprinkler is on each time	Two hours or less	Three or four hours	Five or more hours
Flower garden sprinkling (frequency/week)	Once or less	Twice	Three or more times
Vegetable garden sprinkling (frequency/week)	Once or less	Twice	Three or more times
Wading pool (no. times filled/season)	29 or less	30-59 times	60 or more times
Swimming pool (no. times filled/season)	None	One or two	Three or more times

PROCEDURE FOR DEVELOPING SCORE FOR
WATER-CONSERVING BEHAVIOR

A. For answers to question No. 58 in interview schedule:

No = 2 points

Yes = 4 points

Add 1 point for each specific practice mentioned.

B. Add 1 point for each additional conserving practice mentioned, which was offered as an unsolicited response during the interview.

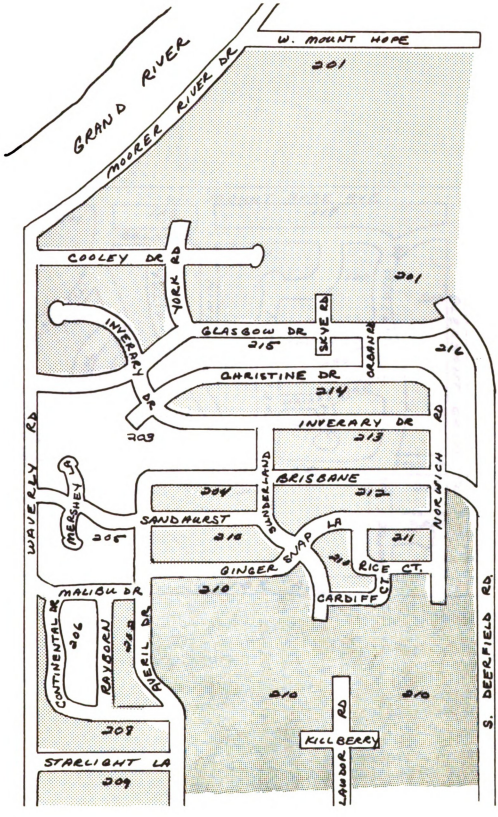
C. If leaks occurred during the year (question no. 54 on interview schedule):

Add 1 point if leaks (in faucet or toilet) were repaired within one week (if more than one leak, 1 point for each).

Subtract 1 point if leaks were not repaired within one week (if more than one leak, 1 point for each).

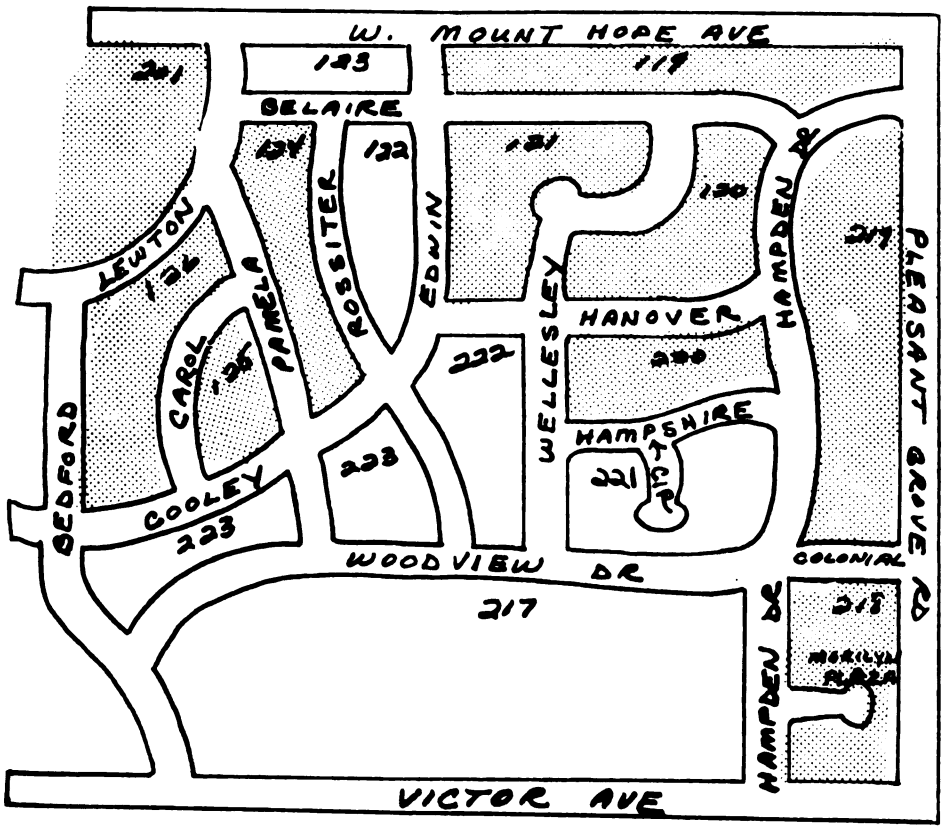
APPENDIX C

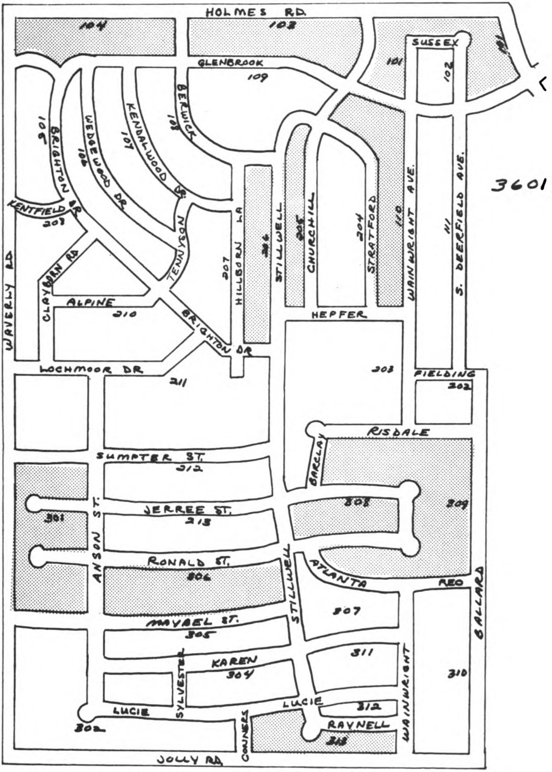
Maps of Census Tracts Included in Study


GRAND RIVER
MOORER RIVER DR
W. MOUNT HOPE
201
COOLEY DR
YORK RD
INVERARY DR
GLASGOW DR
SKYE EN
OLGA RD
216
CHRISTINE DR
214
INVERARY DR
213
WAVERLY RD
MERSHEY CT
209
BUNDELAND
BRISBANE
212
204
SANDHURST
210
GINGER
MALIBU DR
CONTINENTAL DR
206
RAYBORN
PRIEL DR
208
STARLIGHT LA
207
CLAP LA
211
RICE CT.
CARDIFF CT.
NORWICH
S. DEERFIELD RD
KILLBERRY RD
LAUDER

17

17


W. MOUNT HOPE AVE
123
BELAIRE
122
EDWIN
ROSSITER
PAMELA
LEWTON
CAROL
BEDFORD
COOLEY
223
222
WELLESLEY
HANOVER
HAMPSHIRE
221
WOOD VIEW DR
217
HAMPDEN DR
COLONIAL
PLEASANT GROVE RD
VICTOR AVE


HOLMES RD.
GLENBROOK
SUSSEX
BRIGHTON DR
WEDGEWOOD DR
KENDALWOOD DR.
BERWICK
KENTFIELD DR
TENNYSON
HILLBORN LA
STILLWELL
CHURCHILL
STRATFORD
WAINWRIGHT AVE.
S. DEERFIELD AVE.
WAVERLY RD
CLAYBORN RD
ALPINE
HEPFER
LOCHMOOR DR
FIELDING
RISDALE
BARCLAY
SUMPTER ST.
JERREE ST.
RONALD ST.
ANSON ST.
ATLANTA
REO
BALLARD
MAYBEL ST.
KAREN
SYLVESTER
LUCIE
RAYNELL
WAINWRIGHT
CONNERS
JOLLY RD.

3601