A Methodology for Determining Ability to Pay

For Use in the
Implementation of the
Economically Distressed Areas
Water Assistance Program

for
The Texas Water Development Board
Contract #90-483-761

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by

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Mr. G.E. (Sonny) Kretzschmar
Executive Administrator
Texas Water Development Board
1700 N. Congress Avenue
Austin, Texas 78711-3231

Dear Mr. Kretzschmar:

I am pleased to submit the final report "A Methodology for Determining Ability to Pay" in completion of my contractual requirements to the Water Development Board in connection with the implementation of Senate Bill 2.

It has been a pleasure working with you and your staff during the course of this project. I hope the work proves as useful as I believe it will be in helping define the parameters of this new financial assistance program for economically distressed areas of Texas.

If I can be of further assistance, please call.

Respectfully,

Milton L. Holloway, Ph.D.
Chief Executive Officer

Enclosures (4)

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EXECUTIVE SUMMARY

Problem Statement

Substandard water and waste water services in certain economically distressed areas of Texas have received widespread attention in recent years. The 71st Texas Legislature addressed the problem by passing Senate Bill 2 (SB 2) which sets up a state supported financial assistance program to provide grants and loans to service providers of eligible water and waste water projects, to be administered by the Texas Water Development Board. The statute requires that the amount of financial assistance provided by this program be based on "ability to pay" on the part of the residents in project areas to be served. The study reported in the pages of this report recommends a methodology for implementing this ability to pay based program.

Approach

The approach taken in this study is to first explore the methods currently in use by other agencies of government that base programs on a concept of ability to pay. Second, data are organized and statistical methods then defined and applied to develop empirically based estimates of ability to pay.

1. Learn from Past Experience

A review of existing federal and state financial assistance programs was completed in order to learn from past experiences and diverse methodological approaches. This review included six ability to pay based financial assistance programs administered by several federal and state agencies. The programs reviewed included (1) the U.S. Department of Agriculture (USDA) Food Stamp Program, (2) the U.S. Department of Housing and Urban Development's (HUD) Rental Assistance Program, (3) the Texas Department of Human Services (DHS) Assistance Programs, (4) the Farmers Home Administration's (FHA) Water and Waste Water Disposal Grant Program, (5) the U.S. Army Corp of Engineers' (COE) Flood Control Program, and (6) the U.S. Environmental Protection Agency's (EPA) Financial Assistance Program.

While the above referenced programs all have the common "thread" of financial assistance based on a concept of ability to pay, the similarity stops there. Some programs are designed to deliver assistance directly to individuals and therefore, the criteria of ability to pay are defined accordingly at the individual consumer level (e.g. food stamps and DHS service programs). The other programs are designed to operate primarily through the supplier of the

service and the ability to pay concept is applied at a community level (e.g. FHA's Water and Waste Water Grant Program and Corp of Engineers' Flood Control Program). In some cases the programs are designed to operate "on demand" (e.g. food stamps) while others require specific administrative approval when management discretion is exercised. In one case (EPA's Financial Assistance Program) ability to pay is a means of excluding communities from assistance rather than the reverse.

The ability to pay concept used in each of the programs reviewed is based principally on income and various measures of community or family resources, where the rationale is that the capacity of an individual or community to pay for a current product or service is best (for practical reasons) represented by the flow of monetary income augmented by other available resources. In some instances an income-based ability to pay calculation is made as a criterion to determine eligibility and in other instances the calculation, subject to various exclusions, is made to determine the amount of assistance to be granted. The definition of income varies considerably among the programs, but is for the most part, restricted to cash receipts by the family.

2. Follow SB 2 Directives and Make Use of Statistical Methods

Senate Bill 2 gives guidance to the problem of defining ability to pay, as well as to the practical means of determining an ability to pay dollar value to assign to a particular project. First, SB2 is explicit in defining who is eligible. Eligibility is determined by county under either an income and unemployment test or by virtue of being adjacent to the international border. Second, ability to pay is to be determined empirically by reference to expenditures actually made for comparable water and waste water services by families of similar income who are similarly situated.

After reviewing the language of SB 2 and studying the approaches of other agencies, three factors were determined to be important in arriving at a workable definition of ability to pay. First, the definition should recognize that the means of implementing financial assistance will be through the suppliers -- not directly to individuals. Second, ability to pay determinations ought to be conditional on family income, as well as a measure of family wealth, household size and the prices that families are required to pay for water and waste water services. Third, the administrative burden of the WDB and out-of-pocket costs to applicants for information gathering should be considered.

Definition of Ability to Pay and Implementation of the Program

The recommended methodology and procedures for implementation of the program are as follows:

1. **Ability to Pay** for water or waste water of a particular economically distressed community means the number of households in the community times the average monthly dollar amount per household that is typically spent on water or waste water services by a household of the same average (1) annual household income, (2) number of persons in the household, (3) market value of the resident's dwelling and (4) price of water or waste water. Annual household income means income from wages and salaries, self-employment income, interest, dividends, rents, social security income and public assistance income.

2. The **means of determining** the amount typically spent on water or waste water services in relation to (1) through (4) above is through a statistically based estimate from the experience of a random sample of households living in the eligible counties.

3. The **applicant** (a supplier of water and waste water services) will be responsible for gathering **varifiable** information from the community to be served, including average household income, housing value, number of persons per household and the average price of water for a typical water consumption level (e.g. 100 gallons per capita per day) to be specified by the WDB.

4. The **WDB will calculate** an ability to pay amount for water or waste water for the community to be served based on the data supplied by the applicant and the formula described in (2) above, which is fully detailed in Chapter 3 of this report.

5. The **WDB will update** the statistical analysis here reported as the set of eligible counties changes, and possibly upon the availability of sample information from the 1990 Census now being taken by the U.S. Bureau of the Census.

Recommendation Concerning Future Legislation

The purposes of financial assistance programs are sometimes subverted because of unanticipated consequences or because certain unexpected side effects become major problems. The Economically Distressed Areas Water Assistance Program is likely to produce at least two such side effects.

The language of SB 2 implies that the financial assistance program is to be used to alleviate **existing** problems through financial assistance to service suppliers. The prevention of future problems will be handled through newly created subdivision regulation authority of the eligible counties. It is obvious, however, that SB 2 has **no control** over market forces, and therefore land and home owners in the project community and in the vicinity of the communities served by the program will likely receive a windfall through property value enhancement. And, new colonia-type development may spread across the county line to the adjacent, ineligible county, where upon the adjacent county may soon become an eligible county since income levels will be pushed downward and unemployment rates will rise.

The other side effect is that the availability of state financial support is almost certain to change the expenditure patterns and program emphasis of the political subdivisions that receive support. It is uncertain what outcomes to anticipate, but one would expect that a political subdivision would spend more on non-capital services and less on capital intensive projects as a result of the program. And, one would also expect that the entity might spend more on roads (for example) since less is required for water and waste water. A larger danger is that the state will simply wind up supplanting federal assistance that would otherwise come. To some extent the state will be cross subsidizing other programs.

The problem with the program is that it amounts to a reward to existing home owners and land owners for creating a problem which only came about because of the avoidance of capital expenditures for central water and waste water systems. Such avoidance was a means of providing low cost housing. Once the value of the new (subsidized) water and waste water system becomes capitalized into the value of land and housing, the current owners will capture the windfall when properties are sold (the "windfall capitalization problem") and the problem will shift elsewhere (the "spreading problem"), unless the state also subsidizes the surrounding development in order to keep development cost competitive with areas outside the county. Otherwise the same patterns will tend to develop in the counties adjacent to the currently eligible counties.

One remedy to the "spreading problem" is to expand the new subdivision authority created for eligible counties in SB 2 to counties adjacent to eligible counties. A solution to the "windfall capitalization problem" would be to allow the state to impose a one-time sales tax on the first sale of property following the completion of a water and waste water project subsidized with the financial assistance

program. While it may be constitutionally impossible to give county (or other sub-state) governments discriminatory taxing authority, it seems unlikely that the state government would be unable to subsidize with one hand and tax away a resulting windfall with the other.

A final note regarding the importance of the newly created subdivision regulatory authority may be in order. If this authority is not adequate to prevent the development of new colonia-type subdivisions nearby the current ones, then the effectiveness of the entire program is in jeopardy. Existing home owners and landowners will simply capture the windfall in existing property value enhancement created by the program and the scene will be repeated "down the road". The resulting subsidy requirement to "chase" the developments will require increased bonding authority for the WDB, seemingly without end.

CHAPTER 1. INTRODUCTION AND PROBLEM STATEMENT

Social and economic conditions, principally along the Texas international border with Mexico, have lead to the development of rural subdivisions with very poor water and wastewater conditions. The water and wastewater conditions of these "economically distressed areas" have become unacceptable for a number of reasons, and consequently the State Legislature designed a remedy to the growing problem in the form of Senate Bill 2 which was passed during the 71st legislature.

Senate Bill 2 (SB 2) creates a means of improving the water and wastewater services for existing developments while attempting to control the proliferation of the problem as the population of this socio-economic group rapidly expands. The responsibility for administering the program is assigned to the Water Development Board in association with the ongoing regional financial assistance programs established in earlier periods. SB 2 defines a conceptual approach to the task of deciding how to implement a financial aid program based on ability to pay for water and wastewater services on the part of the residents of economically distressed areas. The expected mechanism is the use of grants and loans from the WDB to providers of water and wastewater services from an economically distressed areas account in the State Treasury to be funded by more than $100 million in state government bonds. The WDB therefore needs to define a methodology that determines the amount of state assistance to be provided based on the ability of conmmunity residents to pay for water and wastewater services. SB 2 goes further in stipulating that ability to pay be based on " a comparison of what other families of similar income who are similarly situated pay for comparable services."

The Board now has the task of interpreting SB 2 and designing a methodology for implementing the program. This project is intended to develop procedures for determining the ability of customers of water and wastewater providers to pay for water and wastewater services, and to help integrate ability to pay considerations into the Board's financial assistance program.

The work outlined in this report is a recommended approach to the problem of defining ability to pay and integrating the measurement thereof into the Board's financial assistance programs. The second chapter deals with the development of a conceptual definition of ability to pay and begins with a review of the definitions and purposes of several other government programs that are based on a concept of ability to pay. The third chapter deals with the determination of ability to pay based on empirical observations of what comparable people are in fact paying

for comparable services. The fourth chapter deals with some procedural problems of implementing ability to pay criteria into the Board's financial assistance programs. The fifth chapter contains an example of how the methodology would be applied to an existing development area outside of Brownsville, known as Cameron Park.

CHAPTER 2. DEFINITION OF ABILITY TO PAY

The layman's understanding of ability to pay certainly involves the notion that there are limits to the portion of one's income that one could be reasonably expected to spend on a necessary good. Such a limit is based on a vague notion of needs and social justice, and therefore difficult to translate into some workable rule. SB 2 bounds the problem, however, by requiring that the rule be based on actual expenditures of people in similar conditions to those to be served by a project. This mandate eliminates the temptation to define a necessary quantity of water and wastewater service. The first task therefore, is the development of a definition of ability to pay so that this empirical test can be implemented.

A definition of ability to pay needs to resolve whether the expenditure for water and wastewater is relative to income, income and wealth or some other indicator of capacity to pay, and whether the average, the maximum or the minimum observed actual payment is to be the measure of ability to pay. The definition should also provide a geographical and socio-economic specification that interprets the meaning of SB 2 when it requires that ability to pay be based on actual payments of people similarly situated.

A. Review of Other Ability to Pay Programs

Several existing government programs are based on a concept of ability to pay. A review of the concepts, purposes and definitions of these programs is provided here as background and guidance to the formulation of a definition of ability to pay for the Economically Distressed Areas Water and Wastewater Program. The programs here reviewed include (1) the U.S. Department of Agriculture's Food Stamp Program, (2) the U.S. Department of Housing and Urban Development's Rental Assistance Program, (3) the Texas Department of Human Services Assistance Programs, (4) the Farmer's Home Administration's Water and Wastewater Disposal Grant program, (5) U.S. Army Corp of Engineers' Flood Control Program, and (6) the U.S. Environmental Protection Agency's Financial Assistance Program. Also included is a review of the factors that would normally be considered by private banking institutions in consideration of financing for water and wastewater projects. The following paragraphs summarize the most important findings from the review.

Department of Agriculture Food Stamp Program

The food stamp program was designed to provide low-income households the necessary means to purchase nutritious food through regular market channels. The value of the monthly food stamp allotment is based on three factors: food costs, income, and family size. The basic guide is that households should not have to spend more than thirty percent of their income to purchase a nutritionally adequate diet.

The federal government provides the total cost of the food stamps issued to participating households; the states share with the federal government the cost of administering the program.

The U.S. Department of Agriculture establishes eligibility criteria for the program. With some exceptions, an applicant must provide proof of citizenship, residence, social security numbers, and evidence of employment or participation in employment services. An eligible household's resources must be less than $2000 ($3000 if a member is age 60 or over); the following are exempt resources: one home and surrounding property, income producing property, income producing vehicle, vehicles necessary for employment to the extent that the value does not exceed $4500, and personal effects such as clothing, household goods, etc.

The food stamp program is one of a number of Federal programs which use poverty income guidelines issued by the Department of Health and Human Services. Applicants for the food stamp program must also meet household income criteria which includes both a gross income test and a net income test.

Income is defined as total annual cash receipts before taxes from all sources, including: money wages and salaries before any deductions; net receipts from nonfarm or farm self-employment; regular payments from social security, railroad retirement, unemployment compensation, veterans' payments, public assistance and training stipends; alimony, child support, and military family allotments; private pensions, government employee pensions, and regular insurance or annuity payments; college scholarships, grants, and fellowships; and dividends, interest, net rental income, net royalties, periodic receipts from estates or trusts, and net gambling or lottery winnings.

Excluded from the definition of income are the following types of money received: capital gains; any assets drawn down as withdrawals from a bank, the sale of property, a house, or a car; and tax refunds, gifts, loans, lump-sum inheritances. Also excluded are noncash benefits, such as the employer-paid portion of health insurance or

other employee fringe benefits, food or housing received in lieu of wages and such Federal noncash benefit programs as Medicare, Medicaid, food stamps, school lunches, and housing assistance.

The calculations used in determining food stamp eligibility begin with the sum of household members' income from which certain deductions and adjustments are made to produce Net Food Stamp Income. The amount of food stamps provided to the household is based on the maximum coupon allotment less 30% of the household Net Food Stamp Income. This 30% of income represents the household's **ability to pay.**

The food stamp allotments are revised annually to reflect changes in the cost of food. The allotments are based on the cost of a thrifty food plan, a low cost, nutritionally adequate model food plan. The thrifty food plan, is based on the quantity of foods in 15 different food groups that families with different-age children might be expected to use to meet the recommended dietary allowances.

Environmental Protection Agency (EPA) Financial Assistance Program

Unlike the other programs reviewed, the EPA does not require applicants to the construction grants program to meet specific eligibility criteria. Rather, the EPA requires applicants to demonstrate their financial and management capability to construct, operate, and maintain a wastewater treatment system. A written certification by applicants must show that they have analyzed the costs and financial impacts of the proposed facilities.

Successful applicants were funded by the EPA at the level of 75% of project cost from 1972 to 1984; from FY 1984-FY 1990 the funding level was 55%.

Prior to construction, the applicant must determine whether the community and its residents have the financial and institutional capability to pay for and manage the system. In demonstrating that it has the required capability, the applicant must answer five questions among which is the question about the annual costs per household. Projects are considered high cost when the total annual cost per household exceeds $250. Also, when the total annual cost per household as a percentage of median income is computed, the following percentages portray high cost projects:

1.0% if median income is less than $10,000
1.5% if median income is between $10,000-17,000
1.75% if median income is more than $17,000

The screening system provided by EPA alerts reviewers to the size of community; this may be seen as a possible cause of a high cost system. In general, most high cost problems occur in smaller towns which have fewer resources, are less densely populated and consequently are unable to take advantage of economies of scale associated with larger wastewater systems.

Each loan applicant and its subscriber communities receiving wastewater treatment services must adopt a User Charge System in accordance with TWDB Rules and the CWA. The adopted user charge system must assure that each recipient of waste treatment services will pay its proportionate share of the operation, maintenance, and replacement (O,M,&R) costs of any wastewater treatment services provided by the applicant.

Any user charge system establishing a lower rate for low income residential users must meet all other existing user charge system requirements including proportionality, public notice, and hearing. The lower rate must be defined as a uniform percentage of the user charge rate charged other residential users; also, the amount of any cost reductions must be proportionately absorbed by all other residential users. As a result of establishing a low income residential class, the total revenues for proper operation and maintenance of the facilities must not be reduced.

The EPA definition of low income residential user is any residence with a household income below the Federal poverty level or any residence designated as low income under State law or regulation. States may establish their own definition of a low income residential user class.

In summary, the EPA construction grants program was designed to insure that community residents **have the ability to pay** the ongoing costs of a wastewater system before a subsidy is provided, not as a means of determining the need for low income groups to be helped. In recognition of the fact that a loan applicant may have several subscriber communities, of which one or more may include residential users not meeting the community ability to pay criteria, the EPA now allows a lower rate to be charged to the low income users. Special requirements, particularly public notice and hearing, must be met in order to include reduced rates for low income residential users in the user charge system.

Farmers Home Administration (FmHA) Water and Waste Disposal Grants

Of the six government assistance programs reviewed, this program has the most features in common with the Water

Development Board's new program. In fact, some funding for water projects in Texas economically distressed areas has been provided by this program.

Eligible applicants are political subdivisions or organizations organized on a not-for-profit basis, serving rural residents (the area must have a population of no more than 10,000 residents) who are unable to obtain financing for the proposed project elsewhere (i.e. through commercial credit at reasonable rates and terms, or from their own resources). Household income levels determine funding eligibility as well as the size of the maximum grant.

A project is not eligible for funding if the service area is above the poverty line and more than 100% of the statewide nonmetropolitan Median Household Income.

The purpose of the grants is to reduce user costs to a reasonable level for farmers, ranchers and rural residents, in the most financially needy communities. Reasonable user rate is defined as that which is not less than existing prevailing rates in communities having similar economic conditions being served by an established system constructed at similar costs per user. The initial user rates should produce enough revenue to provide for all costs of the facility (i.e. debt service, reserve, operation and maintenance).

Three separate methods of analysis are used in determining the funding level:

A) The funding cannot exceed 75% or 55% of cost depending on household income.

The "ability to pay" concept used in the first type is based strictly on a general categorization of income levels: (1) below the poverty line, and (2) above the poverty line, but still below the state median income of rural residents. "Ability to pay" percentages are then multiplied times the project cost to determine a maximum funding level.

B) The second method results in the level of funding needed to cover the difference between annual **debt service** and a theoretical approximation of the users' ability to pay.

For a service area with income below the poverty line, a factor of 0.5% is applied to Median Household Income (MHI); for a service area with income above the poverty line and below the statewide nonmetropolitan MHI, a factor of 1.0% is applied to MHI.

The ability to pay concept used is based on two income levels (previously determined, to show program eligibility),

each multiplied by a factor which reflects a percentage of income applicable to utility service expenditure[1].

C) If a grant based on (B) does not provide a "reasonable average user cost", this third method may be used to increase the funding level to an amount greater than (B), but not more than (A). Although limited in applicability, this method uses the average annual user cost of three similar systems to determine the average user cost for the applicant. This comparison may not reduce the average annual cost to the applicant to "less than existing prevailing costs in communities served by an established system, having similar economic conditions". This determination of user cost is translated into the FmHA grant by a simple formula.

U.S. Army Corp of Engineers Flood Control Program

The "Flood Control Cost-Sharing Requirements" establish an "ability to pay" test, whereby some projects will be cost shared by the Non-Federal interest[2] at a lower level than would otherwise apply. The regulations describe a sequence of calculations which determines the percentage of a project's cost paid by the Federal government, and the percentage paid by the non-Federal share. The maximum percentage a local sponsor of a project will pay is 50% while the minimum is 25%.

The "ability to pay" test is based on the following principles:
(1) Since the standard non-Federal cost share is substantially less than the full cost of a project, the "ability to pay" test causes reductions in the non-Federal share only in a limited number of cases of severe economic hardship;
(2) The test should depend not only on the economic circumstances within a project area, but also on the conditions of the state(s) in which a project is located. The state represents a potential source of assistance to the project;
(3) There are benefits of a project (such as a reduced cost for flood insurance, or even direct income as a result of the construction of a dam, for example), a portion of which

[1] More precisely, the debt service portion of utility expense. The calculation applies to water or wastewater, not both. The .5% and 1.0% factors were determined some years ago, and are applied nationwide.

[2] Language referring to "Federal Share", "non-Federal Share" and "Standard Share" is consistent with the Federal regulations. The latter term refers to the non-Federal share that would apply to a project before any ability to pay consideration.

should be used by the community to pay for the non-Federal share;
(4) Project sponsors may be permitted to defer a percentage of the non-Federal share, since project benefits are received over time;
(5) The non-Federal interest may waive the application of the ability to pay test. If the project sponsor does so, the non-Federal interest is considered to have the ability to pay the standard cost share.

Also of interest are the following items mentioned under "general policy" in the regulations:
(1) any reductions in the level of non-Federal cost sharing as a result of the ability to pay test will be applied to construction costs only. Operations maintenance and rehabilitation responsibilities are unaffected by the ability to pay test;
(2) the ability to pay test is conducted independently of a project sponsor's ability to finance its ultimate share of proposed project costs. The ability to finance is addressed in a statement of financial capability, and is much more narrowly defined than the ability to pay test, which considers the resource base of the community as a whole; and
(3) the ability to pay test shall not be used to affect project scope, or to change budgetary priorities among projects competing for scarce Federal funds.

Step one is a benefits test which establishes a potential reduction in the non-federal share depending on the extent to which local benefits relative to costs are less than normal. The results of the benefits test provide greater Federal assistance to projects with low ratios of benefits to costs and lesser assistance to projects with high benefits relative to costs. This result is consistent with the principle that benefits represent a community resource that will be available to pay a portion of the non-Federal share.

Step two, the "income test" provides a measure of the current economic resources of the project area and the State(s) in which the project is located. This measure determines whether a project qualifies for a full reduction in cost sharing to the Minimum Federal Share or for some fraction of the reduction in cost sharing.

A formula-based set of calculations is made and the potential local cost share may or may not be reduced. Such a formula solution is an ability to pay test, incorporating both the income test and the benefits test.

Texas Department of Human Services (DHS) Assistance Programs

The poverty assistance programs administered by the Texas Department of Human Services are federal programs, some of which require State matching funds. The programs reviewed include Nutrition Assistance Services, Aid for Families with Dependent Children (AFDC), Medicaid, and Home Energy Assistance Program.

Nutrition Assistance Services

A group of eight federal programs designed to protect the health and well-being of children, the elderly, low-income households, and victims of disasters in Texas by providing nutrition assistance, training, and education make up the nutrition assistance programs. The programs are 100% federally funded (with one exception, the Temporary Emergency Food Assistance Program (TEFAP), which requires 50% matching funds for state administration of the program). For example, the *National School Lunch Program* is available to all students attending schools where the lunch program is operating. Lunch is served free to students who are determined by local school authorities to have household income levels at or below 130 percent of the level of federal poverty income guidelines for Texas, adjusted for household size; if household income is 185% of the poverty level, a reduced price is available.

In fiscal year 1989, the schools were reimbursed at a rate of 14 cents general cash assistance for all lunches, plus an additional 92.25 cents special cash assistance for each reduced price lunch and 132.25 cents for each free lunch. The maximum reduced price charged for lunch is 40 cents.

Food Distribution Programs include the *Temporary Emergency Food Assistance Program* where nutritious commodities are distributed to eligible households (household income is less than 130% of the poverty level or 165% if age 60 or over) or households who receive AFDC, Food Stamps, Medicaid, or SSI.

Aid to Families with Dependent Children (AFDC)

The purpose of the AFDC program is to provide financial and medical assistance to needy dependent children and the parents or relatives with whom they live. In order to be eligible, the AFDC recipient must include a child deprived of the support or care of a legal parent, because of the parent's death, absence from the home, or physical or mental incapacity. Payments are for monthly income maintenance and child care, or, for families with children in emergency situations, to prevent destitution. AFDC recipients must be

reviewed and approved every six months with at least one face-to-face interview annually. The Department of Human Services determines the maximum grant amount for each household size, based on the total of state and federal matching funds. In order to be eligible, an applicant's household income (after deductions are made for work-related and child-care expenses) may not exceed the budgetary needs level defined by the Legislature, for the appropriate household size. The individual grant amount is based on the difference between the net household income and recognizable needs.

Eligible applicants cannot have more than $1000 in resources; however, the following resources are exempt: home and surrounding property, burial plots, up to $1500 cash value of a prepaid funeral plan, personal possessions, one vehicle to the extent of $1500 equity. Additional eligibility requirements include residency (in Texas), citizenship (U.S. or an alien lawfully admitted for permanent residence), age (in general, the child must be under 18 years old), social security number (obtained or applied for), work registration (unless exempt because attending school, caring for child or disabled household member, etc.), and relationship and domicile (the child must live in the home with a qualified relative).

Medicaid

Medicaid is a federal-state program that provides medical care for needy persons who are over age 65, blind, disabled, members of families with dependent children, qualified children and pregnant women, and qualified Medicare beneficiaries.

Federal standards require states to provide Medicaid to all persons receiving benefits from the following programs: AFDC and Supplemental Security Income (a public assistance program for the blind, aged and disabled, administered by the Social Security Administration). Also, some states, including Texas, have extended coverage to persons called "medically indigent": unable to pay large medical expenses but able to provide for their daily needs. Often, these are persons whose monthly income falls within the income limits specified for eligibility because of the payment of ongoing medical expenses.

Home Energy Assistance Program

Payments are made directly to an eligible low-income household, or, on behalf of the household, to an energy supplier to assist in meeting the cost of home energy. Eligible households are those with income which does not

exceed the greater of 150 percent of the poverty level or 60 percent of the State median income, or households with recipients of AFDC, SSI, Food Stamps or certain income-tested veterans' benefits.

Housing and Urban Development Rental Assistance Programs

The major active, assisted housing programs funded by the Department of Housing and Urban Development (HUD) are the Section 8 certificate and voucher programs, and the Public Housing program. This review focuses on the Section 8 program. The eligibility of families and persons wishing to participate in housing programs is determined by income limits established by the HUD Secretary. The following discussion first focuses on the methodology used in calculating income limits and the definitions of income, and then on the method of determining the amount of assistance provided. In general, the concept of ability to pay is based on 30% of income: if 30% of a family's income is insufficient to obtain decent, safe and sanitary rental housing, a subsidy may be provided to meet the difference.

An eligible program applicant is an authorized Public Housing Agency (any State, county, municipality or other governmental entity or public body which is authorized to engage in the development or operation of housing for low-income families). The local HUD Field Office Manager makes final decisions as to which Public Housing Agencies will be funded. Housing assistance payments are made to participating property owners (on behalf of eligible tenants) generally for 12 months and may be renewed for up to 180 months.

The income limits used by HUD to establish eligibility are calculated by family size for each metropolitan area and nonmetropolitan county in the United States and its territories. They are based on the Department's estimates of median family income, with adjustments for areas which have unusually high or low income to housing cost relationships. The first category, "very low-income families", is defined as families whose incomes do not exceed 50 percent of the median family income for the area. The second category , "lower income families", is defined as families whose incomes do not exceed 80 percent of the median family income for the area, and is used primarily as the basis for exceptions to the first category.

Median family income estimates are based on decennial Census data updated with Bureau of the Census P-60 income data and Department of Commerce County Business Patterns employment and earnings data. In order to minimize year-to-year fluctuations, income limits are maintained at the previous year's levels for areas where they would decrease

if based solely on the most current data. Also, annual increases are capped at ten percent.

HUD analyzes the existing Fair Market Rate of units appropriate for a family of four relative to income levels in determining the necessity of adjustments for areas with unusually high or low housing-cost-to-income relationships.

For purposes of determining beneficiary eligibility, annual income is defined as the anticipated income from all sources received by the family head and spouse, and by each additional family member (excluding children under the age of eighteen years). Income includes: wages and salaries (before payroll deductions); tips, commissions; net income from operation of a business or profession; interest, dividends, and other net income from real or personal property; payments from social security, annuities, retirement funds, or pensions; unemployment and disability compensation; welfare assistance; and alimony and child support. Adjusted income is calculated by deducting $480 for each dependent, and $400 for any elderly family.

In the Section 8 program the family must select a housing unit that meets HUD housing quality standards and is within the rental price guidelines. The family's *tenant payment* is calculated as the highest of: 30 percent of monthly adjusted income, or 10 percent of monthly income. If a family's initial lease was effective before August 1, 1982, the effective percentage is not 30 percent, but ranges from 26 to 30 percent. In the special case where a family receives welfare assistance, a portion of which is designated to meet the family's housing costs, the monthly portion designated for housing becomes the family's tenant payment. The tenant payment is the family's obligation to the property owner; the difference between this amount and the contract rent is paid by the Public Housing Agency to the property owner.

The Role of Income Among the Six Government Programs

The most important common denominator of determinants of ability to pay among the six programs reviewed here is income. The definition of income among the programs varies, however; especially when exclusions are taken into account. Table 1 summarizes the income definitions and exlusions of the six programs.

TABLE 1. INCOME DEFINITIONS FOR SIX GOVERNMENT PROGRAMS

Program/Standard for Eligibility	Primary Definition of Income	Major Exclusions Allowed
Food Stamp Program		
Poverty Level Income	Total Cash Receipts to family	Capital Gains Assets Drawn Down e.g. Sale of Home Noncash Benefits Loans, Gifts, Inheritances
DHS Assistance Programs		
Poverty Level Income (School Lunch Program, HEAP)	Total Cash Receipts to Family	(See under Food Stamps)
HUD Rental Assistance		
Limits Based on Median Family Income	Census Bureau, 7 types: Wage or Salary Income Nonfarm Self-Employment Inc. Farm Self-Employment Inc. Interest, Dividends, Net Rentals Social Security Income Public Assistance Income All other Income	Money from Sale of Property In-Kind Income: Food Stamps Withdrawals of Bank Deposits Money Borrowed Tax Refunds Gifts, Inheritances, Lump-Sum Receipts
FmHA Water and Waste Disposal Grants		
80% of State Median Households Inc. or Poverty Level Income (see Food Stamp Program)	Census Bureau (see Income Types under HUD) for Household Members Age 15 or Over	(See under HUD)
Army Corp Flood Control Program		
U.S. Average per Capita Income	Bureau of Economic Analysis: Earnings Personal Interest Income Rental Income Dividends Transfer Payments	Social Security Income (Note: Includes Transfer Payments)
EPA Wastewater Assistance Grants		
Poverty Level Income	Personal Interest Income Total Cash Receipts to Family	(See under Food Stamps)

Private Banking Institutions

As an alternative to the issuance of public debt and assistance from various state and federal agencies for water and waste water projects, a supplier of such services has the alternative of financing through borrowing from private banks or savings and loan institutions. Private lending institutions make their own judgments about the ability to pay in deciding whether to make loans for projects. Such determination, however, is akin to the EPA criteria discussed earlier in that a private banking institution wants evidence of ability to pay as a means of determining the cash flow basis for loan repayment and if found deficient, the loan will not be made. The bank wants to determine that the project is fiscally sound before extending credit, rather than finding that there is limited ability to pay and a subsidy is needed.

Chief among the information requirements for a bank loan is the investment cost of the project, operation and maintenance costs over the life of the project, and revenue expectations. These are the basic data for a pro forma cash flow analysis required by the bank to be furnished by the loan applicant. For purposes of the current study, the relevant question is that of measures and uses of ability to pay on the part of the customers of the water or waste water supplier. The bank is interested in (1) projected number of hookups to the system, (2) the upfront fixed hook up fee that will be collected, and (3) projected use rates (water sales) over the life of the project. Included in the pro forma analysis is the collection rate; i.e., the ratio of payments to billings for services rendered. The bank will want convincing evidence of revenue flow to support the project before a loan is extended. The interest rate on the loan will reflect the degree of risk the bank believes is associated with the project and the overall viability of the supplier.

As a general matter, the bank wants to see a "times coverage" factor sufficient to convince the bank that the project is fiscally sound before a loan is extended. Times coverage is the ratio of net income after O&M expenses and taxes, to debt service requirements. A times coverage factor of 1.2 or greater is typically required by bonding houses in the process of backing public bonds. Private banks will need to have similar evidence to consider a loan favorably.

B. Recommended Definition of Ability to Pay

Several factors need to be considered in the adoption of a workable definition of ability to pay for purposes of implementing SB 2. First, the definition ought to recognize that the method of implementation of the program is through the suppliers of water and wastewater services - financial assistance will not be provided directly to individual households but the benefits thereof will be extended to them by suppliers who receive Board financial assistance. Such a mechanism is implicit in SB 2 and in the existing Board programs. Therefore, the definition of ability to pay should be designed to use community level data since SB 2 places the initiative for assistance with potential suppliers to the various (economically distressed) communities; the definition of ability to pay will be implemented at the community level, not at an individual or household level.

Second, the conceptual idea of ability to pay for water and wastewater carries with it the notion that some portion of money available for current expenditure should be declared available for the purchase of water and wastewater services. Since current expenditures of individuals (and communities) are made out of current income, borrowing or dissaving, the definition of ability to pay needs to consider both income and wealth positions of the communities to be served by the program.

Third, the practical matters of administrative burden on the Board and out-of-pocket cost of information gathering by the applicant need to be considered in the adoption of a definition and implementation of an ability to pay based program. This includes the consideration of the availability of current information from standard sources and the cost of primary data collection. Data from a random sample of households living in the eligible counties derived from U.S. Bureau of the Census public use sample, community data collected by applicants and rate structure information from the would-be suppliers will be sufficient for the task.

The above three considerations have been taken into account, along with information from the study of the problems and experiences of other programs, the examination of the availability of data and the cost of data collection. The following definition of ability to pay is recommended:

Ability to Pay for water or waste water services of a particular economically distressed community means the number of households times the average monthly dollar amount per household that is typically spent on water or waste water services by the household of the same average (1) annual household income, (2) number of persons per household, (3) market value of the resident's dwelling and

(4) price of water or waste water. Annual household income means income from wages and salaries, self-employment income, interest, dividends, rents, social security income and public assistance income. The other factors are self explanatory, although the procedures for determining them are not. Such procedures will be discussed in Chapter 4.

The calculation of ability to pay in a particular case will be completed by the Water Development Board using the mathmatical formula and statistical estimates of parameters for the formula, detailed in Chapter 3. An applicant will gather certain community data and a cost estimate for serving a community with water or waste water and submit a request for assistance to the WDB as specified in Chapter 4. The difference between ability to pay and cost of service under the current rate structure of the applicant will be used by the WDB, along with other consideratories, to determine the size and structure of financial assistance to be provided under the program. An example is discussed in Chapter 5.

CHAPTER 3. ESTIMATION OF ABILITY TO PAY

SB 2 requires that ability to pay be based on the purchases of comparable services by people in similar circumstances, meaning among other things, that the determination of ability to pay must be empirically based rather than being strictly theoretical or arbitrary. The comparability requirement calls for some interpretations before the concept can be made operational. To become operational, choices of technique and data sources must be made. Finally, judgements have to be made concerning the reliability of analytical results of data and mathematical models. This chapter deals with these topics and summarizes the empirical findings of the estimates of ability to pay.

A. SB 2 Requirements

The requirement that ability to pay be based on " a comparison of what other families of similar income who are similarly situated pay for comparable service" dictates that a market based empirical method be employed. The statute also implies that in carrying out such an analysis, the rate structure under which the existing purchases are made by such comparables be considered in defining how services will be priced to economically distressed residents. The further implication of SB 2 is that the WDB will use the existing procedures of its water assistance programs to implement the program; i.e., the Board will pay part or all of the difference between the economically distressed communities' ability to pay and the cost of service through the provision of grants and loans to qualifying suppliers.

B. Interpretations of SB 2: Definitions

SB 2 is not specific about the details of the means of determining ability to pay or the exact procedures for its implementation; considerable latitude is given the Board in making such decisions. The statute provides general policy and concepts. For purposes of carrying out the analysis of ability to pay the approach was to define key variables and to rely on scientific procedures of hypothesis testing to develop a mathematical model of the relationship between the purchases of water and waste water, income and other variables for recommendation to the Board. Concerning recommendations for procedures to implement the program, the Board staff is much more knowledgable than Southwest Econometrics, Inc. about the strengths and weaknesses of various approaches. Therefore, we have only addressed the conceptual approach to implementation (discussed in the next chapter) leaving the practical considerations aside. Specifically, the definitions used for the analysis of ability to pay are:

Comparable Families--the U.S.Census and utility data upon which we have relied use a "household" definition which means that some units may contain unrelated individuals; for our purposes, households are the unit of observation and considered adequate for purposes of SB 2 when it uses the term "family". Data for all of the counties now eligible for the program (30 in all) were used in the analysis and therefore, **"similarly situated"** is satisfied geographically and the analytical process itself determines whether counties should be grouped into more homogeneous groupings.

Income--SB 2 speaks of comparable families of comparable income and implies similar socio-economic status; it does not define income nor specify which if any other measures of economic condition should be considered. Income is defined here as used by the U.S. Census for purposes of developing the analytical model for estimating the ability to pay.

Other Variables--The joint use of the terms "income and "similarly situated" imply that other indicators of economic status should be considered in the definition of ability to pay. Therefore, we have examined the use of a measure of **wealth** that may be most appropriate to the problem, namely the **market value** of the owned **residence.** The market value of the owned residence is recommended to represent wealth position so that "comparable" means the same income and wealth class. It is also implicit in notion of comparable that the size of the consuming unit (family) be considered. Therefore, the model developed below uses **household** as another variable needed for comparability. The definition used is number of persons per household as defined by the U.S. Bureau of the Census. The other, and most significant variable needed for comparability is the price of water or waste water services. The **water price** used in the analysis is the weighted average monthly price of water purchased by households in the sample. **Waste water service prices** are defined as the average monthly bill for waste water paid for by households in the sample.

C. Methodology for Estimating Ability to Pay

The methodology for estimating ability to pay for water and wastewater services on the part of residents of economically distressed communities was developed as a three-part procedure. First, traditional economic theory of consumer behavior was consulted in order to specify a model for the current purpose. Second, standard statistical procedures were employed to provide information about the reliability of estimated model parameters. Third, the availability of data was a practical constraint on the analysis.

The Model of Ability to Pay

Economic theory of consumer behavior tells us that rational economic choices by consumers who are free to choose means that consumers will allocate their current income between expenditures and savings, and that expenditures will be allocated among the goods available to them in a way that tends to maximize their satisfaction from consumption. It may of coarse be quite rational for consumers to spend more than their current income at times through dissaving from barrowing. The general model of a consumers water consumption might be formulated as follows:

$$Q=f(Pw/P1....Pn,I) \quad (1)$$

where: Q = the quantity of water consumed
Pw = the price of water
P1...Pn = prices of all other goods
I = income

As a practical matter the estimation of such a model is next to impossible and might be formulated without consideration of all prices but rather only prices for major groups of commodities. In fact, empirically estimated models of water demand have typically ignored all but the price of water, income and household size under various model formulations. The model recommended in this study is expressed as the quantity of water consumed as a function of average price, household income, number of persons per household and housing value. That is;

$$Q = f\ (AP,\ HI,\ NP,\ HV) \quad (2)$$

where: Q =annual quantity of water consumed
AP=annual average price of water
HI=annual household income
NP=number of persons per household
HV=market value of owned residence

The second part of the model explains monthly waste water expenditures as a function of monthly water consumption

$$MWWC = g(q) \quad (3)$$

where: MWWC = monthly waste water cost the ith month
q = monthly quantity of water consumed

In order to make the model as simple as possible, the possibility of expressing the model as simply the share of household income spent on water and wastewater as a function

of household size and value of the owned residence and the price of water was also tested; i.e.

$$YCW/I = g(NP, HV, PW) \quad (4)$$

where:

YCW=yearly cost of water
I=household income
NP=number of persons per household
HV=market value of the house
PW=price of water

The equation form (2) turned out to have the best statistical properties. Regardless of the specific form of the model specified, an empirically estimated relationship between the quantity of water consumed, the price of water, income, family size, and wealth (housing value) will provide the information needed for estimating ability to pay by residents of an economically distressed area. Once the relationship is estimated, one can determine an expected annual expenditure for water, given information about family size, income, wealth (housing value) and price. Since waste water services are usually provided at a price that is related to water consumption, monthly waste water costs can be estimated as a function of water consumption.

Data Sources

One economic translation of ability to pay is that we should be able to read the various prices a consumer is willing to pay for various quantities of water off of a consumer's demand function. We would therefore like to be able to estimate a functional equivalent of a demand function that includes family size, housing value, income level and the price of water per unit of time. The data required to be able to estimate such functions and the need to restrict the sample data to conditions comparable to that of economically distressed areas, dictates that micro level data be used. In fact, the estimation of such functions by statistical methods for this problem dictates that census and other secondary data be developed since primary data collection is not practical within the time and budget limitations imposed in this study. Such a data base is available from the 1980 U.S. Census, 5% Public Use Sample which includes housing value by class of housing, housing classified by sewered or non-sewered water and waste water service, household income, persons per household, number of bathrooms (among other housing statistics), and yearly cost of water.

The Census 5% Public Use Sample provides complete survey answers by individuals for 5% of the households answering the survey. The 5% sample information is available for groups of counties and/or subcounty areas

where the aggregate population is equal to or greater than 100,000 people. The county groupings included in the data used for analysis are groups 31 through 38, 43, 8, 9 and 53 shown in **Figure 1**. The answers to questions concerning number of persons in the household, household income, annual cost of water and whether the household is connected to public water and waste water make up the Census contribution to the data base. The details of the data preparation and a copy of the questionnaire section used by the Census are contained in Appendix A and C, respectively.

The yearly cost of water reported in the Census was disaggregated into water and waste water, and the resulting water cost was disaggregated into an annual average price and an annual quantity of water consumed. This disaggregation was accomplished by distributing the variable cost of water and waste water over the months of the year based on utility data, and then subtracting the monthly cost of waste water from the monthly cost of water and waste water. Then the remaining water cost was disaggregated by imposing a monthly distribution of water consumption (derived from the utility data) and using the rate structure to calculate the monthly average price and quantity, from which a weighted average price and annual total consumption was calculated (see Appendix A for a full description of data base construction).

The other principal data source is from information provided by the major water utilities operating in the qualifying counties. Information was received on rate structures and billing data for selected low income sections of the utilities' service area. This information allowed us to determine whether the dollars spent on water and waste water has been stable since the Census data was collected in 1980, and to be able to calculate the quantity of water consumed, average and marginal price and the annual expenditure on waste water services, from the Census reported annual cost of water.

A third set of data was used in the analysis for determining the extent to which water and waste water consumption patterns are stable over time. These sources are the U.S. Labor Department's Annual Consumer Survey which provides data on consumer expenditures (including water and wastewater) and income by income class for selected MSAs in the country and the National Income Accounts for the U.S. which provides national estimates of water and waste water expenditures. Houston and Dallas-Ft.Worth are included in the Consumer survey data, which provides a regional check on the validity of the Census data and the results of our analysis.

Specifically, four water utilities serving the major population centers along the border were selected and asked

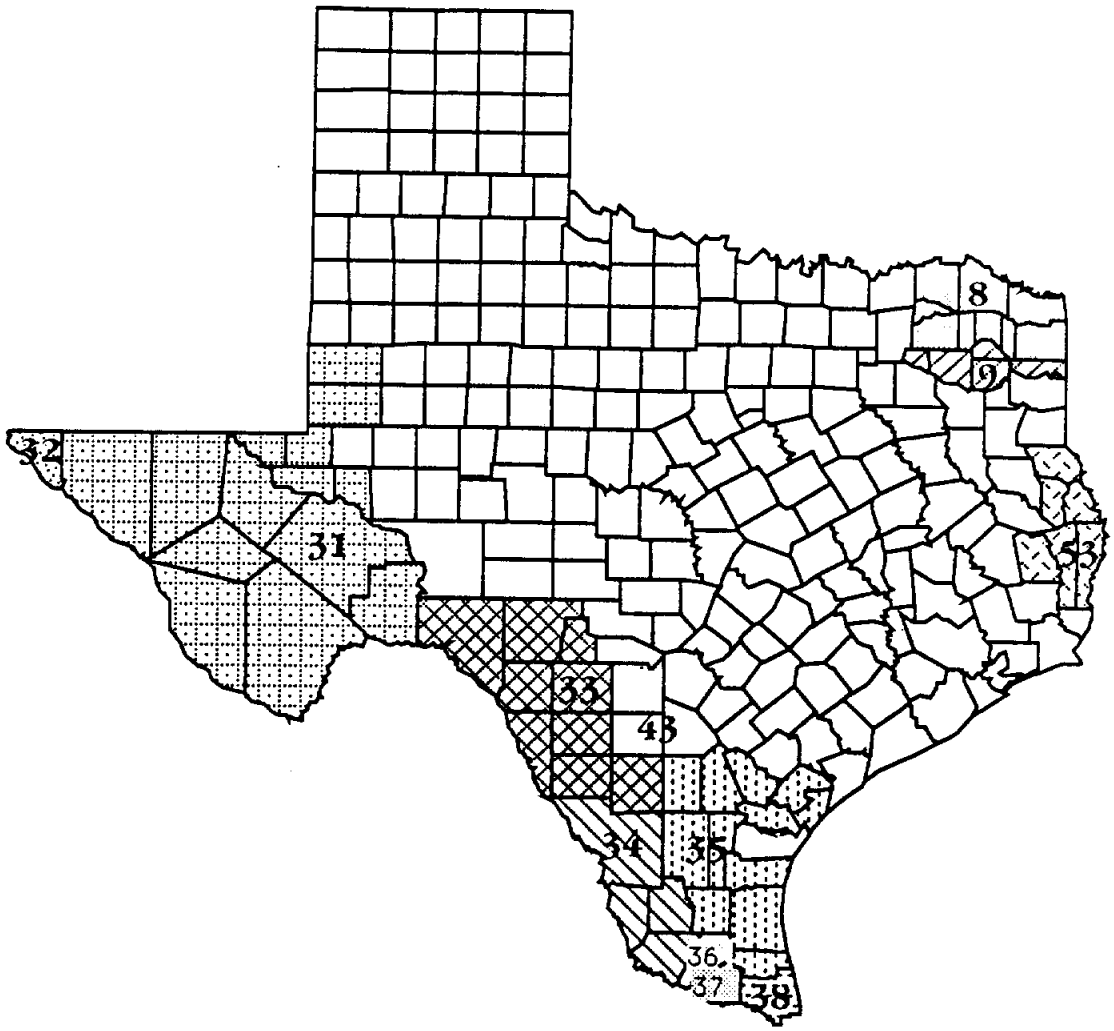


FIGURE 1. CENSUS GROUPS OF COUNTIES INCLUDED IN THE ABILITY TO PAY STUDY

to provide monthly billing data for twelve months in 1979 and 1989, and a summary of their rate structure that applied to these two periods. The utility was asked to send billing data for a selected zone or district within their service area consisting primarily of single family dwellings and which constitutes the low income end of the economic spectrum. El Paso, Sharyland WSC (serving the Mission area), Laredo and Brownsville supplied such data.

Empirical Estimation Procedures

Regression analysis was used to estimate parameters of the relationship between the alternate dependent variable (Q) and (YCW/I) and the various hypothesized explanatory variables, namely number of persons per household, housing values, household income and the price of water. The analytical package employed was the widely used micro/macro computer analysis package known as **SAS**.

D. Results of Statistical Analysis

The means of the share of income spent on water and waste water for each of the county groups in the border area in comparison with that for Dallas/Fort Worth and Houston are shown in **Table 2**.

The border region's share of income spent on water and waste water falls generally in the range of 0.848% to 1.491% depending on location, price, family size, housing value and income. Overall, the share of income spent is more like that for Dallas-Fort Worth than for Houston, although individual household variation ranges from 0.50% to 6.0% in the Border area.

As a general matter the statistical analysis of the 1980 Census data shows that the quantity of water consumed is dependent on (1) price, (2) household income, (3) housing value (wealth), and (4) the number of persons per household. The quantity of water consumed and the expenditures for water and waste water are significantly different among eight geographical areas defined by county groupings or parts of counties identified in the 5% Public Use Sample (Table 2). As a general matter, however, it is clear that price matters since the higher consumption areas are the areas with the lowest average price and vice versa.

The equation form with the strongest overall statistical results and best behavioral qualities is the mixed log/log/linear form:

TABLE 2. COMPARISON OF SHARES OF INCOME SPENT ON WATER AND WASTE WATER SERVICES (1979)*

Area	Persons per Household (av. no.)	Income per Household (1979$)	Share of Income Spent on Water& Waste Water (%)	Quantity of Water Consumed (GPCD)	Weighted Average Price ($/CCF)
1. Border (Average)**	3.56	20,964	0.936	163	0.545
2. Census Area**					
Pecos	3.07	19,500	0.978	191	0.577
El Paso	3.52	22,868	0.860	252	0.375
Zavala	3.63	17,336	0.852	129	0.654
Webb	4.06	20,227	1.059	113	0.405
Urban Hidalgo	4.01	22,364	1.015	80	0.920
Rural Hidalgo	4.59	14,205	1.543	65	0.930
Cameron	3.82	21,101	0.697	79	0.827
Frio	2.96	17,519	0.946	170	0.544
Duval	3.35	21,399	1.018	141	0.404
3. Dallas/Ft. Worth	2.80	26,681	0.712	N/A	N/A
4. Houston	2.80	22,662	0.432	N/A	N/A

* Note: The summary data for the Border areas are averages for households reporting that they own their home and use both public water and waste water services.

** See Appendix Table B for complete listing of county areas included in each Census area.

Sources: Data for Border areas is from the 1980 Census, 5% Public Use Sample; Dallas/Ft. Worth and Houston data from the U.S. Department of Labor, Consumer Survey for 1979.

Equation form: LnQ = a + bLnHI + cLnHV + dAP + eLnNP (5)

where: a = intercept
b = parameter for household income
c = parameter for housing value
d = parameter for price
e = parameter for number of persons per household
LnHI = log of household income
LnHV = log of housing value
AP = weighted average price
LnNP = log of number of persons per household

Log/log and log/linear and linear equation forms were also tested and proved to fit the data reasonably well. In fact, the log/log form produces slightly superior statistical qualities but will not produce reasonable results at the extreme ends of the price range. The recommended equation for calculating ability to pay is listed below as Equation (6). The summary statistics and alternate equation forms can be found in Appendix D.

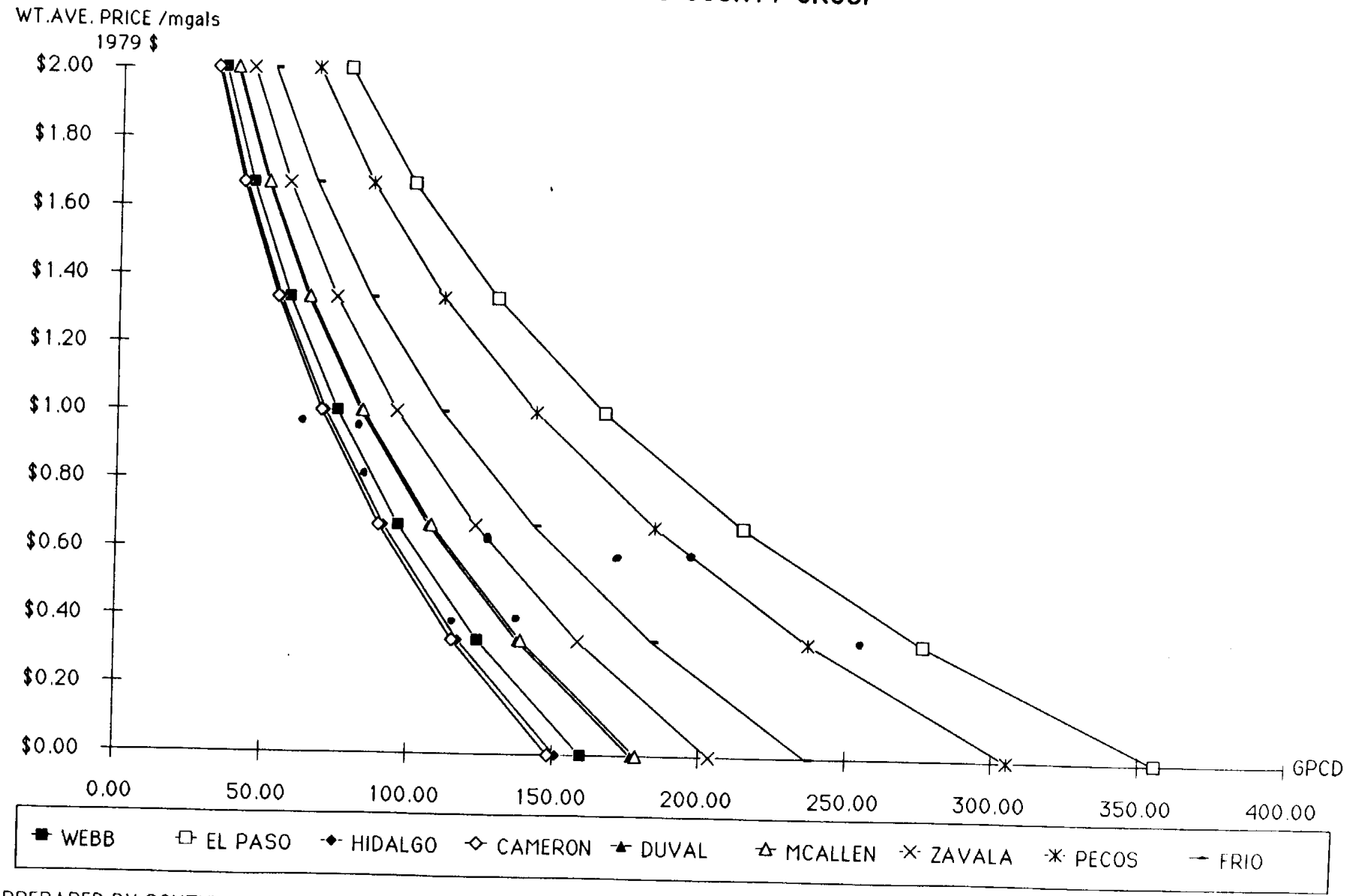
LnQ = a + 0.011122 LnHI + 0.086822 LnHV - 1.015991 AP + 0.138794 LnNP (6)

where: a = 4.537816 for county group Laredo
= 4.629708 for county group McAllen
= 4.702909 for county group Zavala
= 4.633962 for county group Hidalgo
= 4.971403 for county group Pecos
= 4.671791 for county group Frio
= 5.197409 for county group El Paso
= 4.410734 for county group Cameron

The equation for each county group is shown graphically in **Figure 2**, as are the 1979 average quantities of water consumed per person per day. El Paso has the highest use rate and the lowest price of water. Cameron has the lowest consumption and near the highest price for the average of the county groups.

Given equation (6) and values for average household income, housing value and persons per household, and a rate structure we can solve for the monthly quantity of water consumed, and thus the monthly cost of water for any community in the qualifying counties by first identifying in which county group the community is located. That is, by use of equation (6) an applicant for financial services could derive the annual ability to pay for water for an average household in the community in question. Once the per household water consumed estimate has been made, a monthly waste water cost is calculated as a function of the

FIGURE 2
WATER CONSUMPTION VERSUS PRICE
BY CENSUS COUNTY GROUP



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quantity of water used. The waste water costs per average month by range of water consumption per average month for each of the eight county groups are shown in **Table 3**. By multiplying the average household water and waste water estimate by the number of households, the annual expected revenue flow (ability to pay) from the community can be determined. Given the cost of delivering water and the ability to pay, one can then determine an amount of a monthly subsidy equivalent required from the WDB financial assistance program in order to cover the cost of service[3].

E. Test of Stability over Time

Since the primary data source used to estimate the functional relationships summarized in the previous section was the 1980 Census, there is a need to determine whether the relationships are stable over time. We need to know if the 1980 based estimates can be used with confidence in 1990 and over the next few years.

In order to answer the stability question, several information sources were used. First, the four utilities that provided data were asked to gather information for 1979 (for comparability with the Census data) and 1989 for determining whether changes have occurred to date. Second, shares of income spent for water and waste water in Dallas-Fort Worth, and Houston were calculated from the Consumer Survey for the years 1980 and 1987 (the latest year available). Third, the U.S. National Income Accounts were used to calculate the share of income spent for water and waste water by U.S. consumers for selected years since 1970.

Table 4 summarizes three measures of share of income spent on water and waste water services in Dallas, Houston and the U.S., for several years since 1980. The current nationwide average is 0.52% of personal disposable income, up from 0.43% in 1980. Houston area residents pay a slightly higher than national average share of income with 1987 levels at 0.66%. Dallas residents pay considerable higher than national average shares with the 1987 share standing at 0.93%. In all three cases there is a slight rise in share from 1980 to 1987, amounting to about 0.1%.

Table 5 summarizes the shares of income spent on water and waste water for the four low income subareas of selected utilities along the Texas/Mexico border. Also shown are the

[3] Note: Equation 6 is in terms of 1979$ so that the ability to pay calculations based on the equation will also be in terms of 1979$. For use during 1989 one will need to multiply by the consumer price index ratio with 1979 as the base. The ratio is currently 1.56; i.e. consumer prices have risen by 56% since 1979.

TABLE 3. MONTHLY WASTE WATER COSTS BY CENSUS COUNTY GROUP

County Group	Water Consumption Per Person Per Day (GPCD)		
	50 - 99	100 - 150	150 or greater
		(1979 $/month)	
Pecos (Gr 31)	3.00	3.00	3.00
El Paso* (Gr 32)	2.72	3.30	3.87
Zavala (Gr 33)	1.50	1.50	1.50
Webb* (Gr 34)	7.39	11.28	15.17
Duval* (Gr 35)	6.38	9.59	12.81
Urban Hidalgo* (Gr 36)	8.54	9.70	10.87
Rural Hidalgo* (Gr 37)	8.79	10.12	11.46
Cameron* (Gr 38)	7.51	11.41	15.31
Frio* (Gr 43)	4.40	5.30	6.20

* Evaluated at the mid point in each of the first two ranges and at 175 gpcd for the 150 or greater range. GPCD means gallons per capita per day.

TABLE 4	U.S. TRENDS IN SHARES OF INCOME SPENT ON WATER AND WASTE WATER SERVICES			
Dallas-Fort Worth	1980-1981	1982-1983	1984-1985	1986-1987
Income after Taxes (IAT)	$22,329	$30,248	$29,610	$28,028
Average annual Expenditures(AAE)	$21,943	$28,289	$29,981	$28,561
Water and other Public Services(WOPS)	$190	$219	$231	$261
Ratio of WOPS to AAE	0.87%	0.77%	0.77%	0.91%
Ratio of WOPS to IAT	0.85%	0.72%	0.78%	0.93%
Ratio of AAE to IAT	98.27%	93.52%	101.25%	101.90%
Houston	1980-1981	1982-1983	1984-1985	1986-1987
Income after Taxes	$18,595	$22,748	$22,467	$31,901
Average annual Expenditures	$19,545	$20,256	$23,407	$28,798
Water and other Public Services	$98	$128	$162	$211
Ratio of WOPS to AAE	0.50%	0.63%	0.69%	0.73%
Ratio of WOPS to IAT	0.53%	0.56%	0.72%	0.66%
Ratio of AAE to IAT	105.11%	89.05%	104.18%	90.27%
United States	1970	1975	1980	1982
Disposable Personal Income(DPI)	$715.6	$1,142.8	$1,918.0	$2,261.4
Personal Expenditures(PE)	$640.0	$1,012.8	$1,732.6	$2,050.7
Water and Other Sanitary Services(WOSS)	$3.1	$5.3	$9.3	$11.8
Ratio of PE to DPI	89.44%	88.62%	90.33%	90.68%
Ratio of WOSS to PE	0.48%	0.52%	0.54%	0.58%
Ratio of WOSS to DPI	0.43%	0.46%	0.48%	0.52%

Sources: Statistical Abstract of the United States, 1989.
The National Income and Product Accounts of the United States, 1929-1982.
Consumer Expenditure Surveys, 1980-1987.

TABLE 5

SHARE OF INCOME SPENT ON MUNICIPAL WATER IN THREE REPRESENTATIVE COMPARISON AREAS, TEXAS BORDER AREA: 1979 AND 1989.

Area	WATER USE (GALLONS PER CAPITA)		YEARLY COST OF WATER PER HOUSEHOLD (1979 DOLLARS)		YEARLY COST OF WASTE WATER PER HOUSEHOLD (1979 DOLLARS)		HOUSEHOLD INCOME (1979 DOLLARS)		SHARE OF INCOME SPENT ON WATER		SHARE OF INCOME SPENT ON WASTE WATER	
	1979	1989	1979	1989	1979	1989	1979	1989	1979	1989	1979	1989
EL PASO (ZONE 4)	111	115	$85	$87	$47	$74	$14,582	$13,462	0.55%	0.65%	0.32%	0.55%
SHARYLAND WSC (SOUTH MISSION)	102	114	$263	$213	$54	$50	$12,558	$12,199	2.10%	1.74%	0.43%	0.41%
LAREDO (ALL)	129	128	$88	$83	$95	$91	$15,957	$14,020	0.55%	0.59%	0.59%	0.65%
BROWNSVILLE (WEST AND EAST)	83	85	$78	$109	$88	$89	$15,703	$13,199	0.49%	0.83%	0.56%	0.68%

Area	SHARE OF INCOME SPENT ON WATER		SHARE OF INCOME SPENT ON WASTE WATER		AVERAGE HOUSING VALUE (1000$)		PERSONS PER HOUSEHOLD		AVERAGE PRICE OF WATER ($/1000GAL) (1979 DOLLARS)	
	1979	1989	1979	1989	1979	1989	1979	1989	1979	1989
EL PASO (ZONE 4)	0.55%	0.65%	0.32%	0.55%	$29,994		4.06	3.99	$0.517	$0.520
SHARYLAND WSC (SOUTH MISSION)	2.10%	1.74%	0.43%	0.41%	$22,414		4.16	3.86	$1.707	$1.321
LAREDO (ALL)	0.55%	0.59%	0.59%	0.65%	$37,405		3.83	3.58	$0.486	$0.497
BROWNSVILLE (WEST AND EAST)	0.49%	0.83%	0.56%	0.68%	$33,598		3.74	3.40	$0.91	$1.030

Sources: Texas Municipal Reports, National Decisions Systems, Area Utilities.

gallons per capita per day of water use, household incomes and number of persons per household. The per capita use data suggests that water consumption is stable to slightly rising over the period. Trends in national data (Table 4) also confirm that water consumption (withdrawals) is stable to slightly rising. According to the U.S. Geological Survey[4] withdrawals for residential and commercial use have risen from 166 gpcd in 1970, to 168 in 1975, 183 in 1980 and 189 in 1985.

The shares of income spent on water and waste water by residents in the four low income areas have risen since 1979, as is true for Dallas, Houston and the nation. The share has risen by 0.33% in El Paso, Zone 4 since 1979; 0.10% in Laredo; and 0.46% in the Brownsville low income area. The increase in share of income spent on water and waste water in the four low income areas has risen more than is true for the nation or Dallas and Houston principally because real incomes have declined. Table 5 shows that the real (1979$) dollars spent has been stable but the shares have been rising.

The matter of expenditures for water and waste water per household in the four areas is instructive (Table 5). After adjusting for inflation, the real cost of water is stable to declining at the consumption levels of the four low income areas studied. This is true even though the rate structures applicable to the small areas identified in Table 5 have been changing. The rate structures for 1979 and 1989 for the four comparison areas are shown in **Table 6.**

Given the complexity of the various rate structures shown in Table 6, it is not easy to generalize, but the price for the first increment of consumption, usually 3,000 gallons per month, has not increased as much as inflation in either El Paso or Mission (Sharyland). The blocks of consumption at the margin of 12,000 to 15,000 gallons have increased faster than inflation in El Paso, but slower than inflation in Mission. Overall, the average real price for water for the four low income areas studied has stayed about constant in El Paso and Laredo, has decreased in Mission and has increased modestly in Brownsville.

The most important observation from examination of the four selected areas set forth in Table 5 is that the number of persons per household, household incomes and housing values are quite similar among the areas and relatively

[4] U.S. Geological Survey, Estimated Use of Water in the United States in 1985, Circular 1005, and previous quinqeunnial issues. Note: the term "consumption" used throughout this report means the quantity of water billed to the customer by the utility and should not be confused with the term "consumption use" as used in the water conservation literature.

stable over the ten year period. The share of income spent on water and waste water reflects a difference in per capita consumption levels, persons per household and the price of water. In large part, however, the varying shares of income spent on water is a direct reflection of the price of water charged by the utility serving the area. Expenditures on waste water are tied directly to water use and the price of waste water. This fact (the dominance of per capita consumption and price) is borne out in the regression analysis summarized in the previous section. The most important determinant of the money spent on water and waste water is the price, followed by the geographical region in which the consumer is located. This means that a criterium of ability to pay based on "what is currently being paid by households in similar circumstances" will be considerably influenced by the cost of service of the utility now supplying comparison communities.

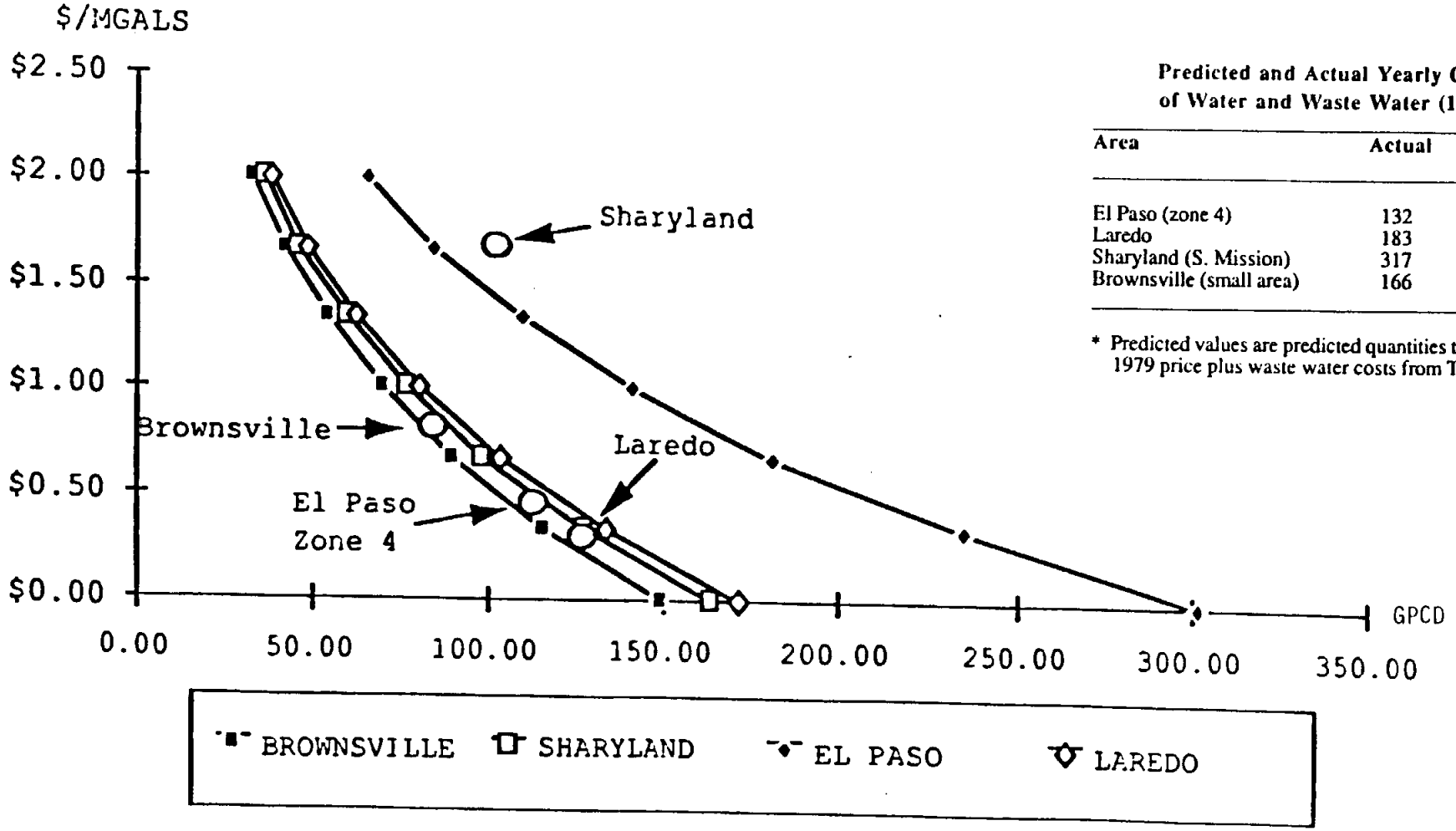
The model estimated in the previous section (Equation 6) when evaluated at the average values of persons per household, income, housing values and average prices shown in Table 5, produces an estimate of water consumption. The equations and observed values for each of the four low income areas are shown in **Figure 3**. The model produces quite accurate results for the Laredo and Brownsville areas while somewhat overpredicting water consumption in El Paso and underpredicting in Sharyland. The predicted and actual yearly cost of water and waste water for the four small areas are also shown in Figure 3 and illustrate the reasonableness the model for ability to pay proposes. Overall, the model should produce quite reasonable ability to pay results for a wide range of communities throughout the Border area.

TABLE 6. WATER RATE STRUCTURES FOR FOUR COMMUNITIES IN 1979 AND 1989

Year	El Paso		Sharyland WCS		Laredo		Brownsville	
1979 Average Monthly Consumption	12988		12830		15049		9442	
Rate Structure	min (2992 gal) next 7480 gal else	3.00 0.41 0.49	min (3,000 gal) next 3,000 gal next 4,000 gal next 5,000 gal next 10,000 gal next 25,000 gal next 50,000 gal	7.00 1.00 0.90 0.80 0.90 1.00 1.25	min (4,000 gal) next 46,000 gal	2.35 0.45/mgal+0.55		min 2.60 0.60/mgal
1989 Average Monthly Consumption	13994		13392		13917		8790	
Rate Structure	min (2992 gal) next 7480 gal next 7480 gal next 7480 gal	4.17 0.61 0.80 0.93	min (3,000 gal) next 3,000 gal next 44,000 gal next 50,000 gal	3.75 1.50 1.25 1.50	min (3,000 gal) next 6,000 gal next 40,000 gal next 50,000 gal	3.75 0.07 0.64 0.56		min 5.93 0.84/mgal

FIGURE 3

SMALL AREA WATER DEMAND QUANTITY VERSUS PRICE



Predicted and Actual Yearly Cost of Water and Waste Water (1979)*

Area	Actual	Predicted
El Paso (zone 4)	132	208
Laredo	183	214
Sharyland (S. Mission)	317	237
Brownsville (small area)	166	183

* Predicted values are predicted quantities times actual 1979 price plus waste water costs from Table 3.

CHAPTER 4. IMPLEMENTATION OF ABILITY TO PAY PROCEDURES

Implementation of ability to pay criteria requires that community level information be gathered by the applicant, including the development of an engineering design plan. Implementation also requires integration of the criteria into the rules of the WDB.

A. Burden of the Applicant

The statistical results of the analysis of the 1980 Census data and the resulting regression model provide a straightforward means of implementing a financial assistance program based on ability to pay. Equation (6) allows us to calculate an ability to pay estimate for water services, given information about the new community to be served. Specifically, the applicant for financial assistance (a utility) will submit estimates of average household conditions in the community including (1) household income, (2) housing value, (3) number of persons per household and (4) the average annual price of water on his (the utility's) system for the norm of 100 gallons per capita per day. The average price will be calculated by using the utilities' rate structure and the average of 100 gpcd distributed over the year according to the following distribution:

Monthly Distribution of Water Consumption (%)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
5.5	5.5	6.5	7.5	10.5	11.5	12.5	10.5	7.5	7.5	7.5	7.5

The suggested procedure for obtaining information on the community to be served by the applicant is to use personal interview techniques in a random sample of households in the community, supplemented by tax appraisal district data on housing values. The personal interviews will need to be door-to-door since telephones may not be present in many cases. The interview will be very simple since questions will be needed only for (1) number of persons per household, (2) household income and (3) market value of the house. The weighted average price of water will be calculated by the applicant based on a range of normal water consumption levels (e.g. 100 gpcd) and the utilities' own rate structure. The tax appraisal district will constitute a second source of property value estimates, and the WDB may require some appraisal work. The questions on household income will need to be structured so that the definition of income is correctly documented to include wages and salaries, rental income, interest and dividends, profits and state and federal transfer payments (Census definition).

CHAPTER 5. CAMERON PARK 1: AN EXAMPLE

A residential housing development on the northeast fringe of Brownsville was selected as an example for application of the ability to pay methodology developed in this study. The data for water and waste water costs and current and projected population and housing units for Cameron Park 1 were taken from Texas Water Development Board, "A Reconnaissance Level Study of Water Supply and Wastewater Disposal Needs of the Colonias of the Lower Rio Grande Valley", January 1987 (referred to hereafter as TCB study). Cameron Park 1 contained 500 housing units in 1986 and had an estimated population of 2250, or 4.5 persons per household. The 1986 housing density was 5.9 units per acre. The projected growth of the development is a population of 4176 and 928 housing units by 2010 or an increasing density to 10.9 units per acre by 2010 with the same 4.5 persons per household. One of the utilities that currently supplies water to the Cameron Park 1 area is Military Highway WSC (MHWSC).

Although water service is currently available for a few residences, it is assumed that an entire water supply system would need to be put in place to serve the community. For purposes of this example it is assumed that MHWSC has no excess capacity and will have to add plant and transmission lines to serve the the existing community. Assuming a typical capital cost of $2,500 per housing unit for densities in the range of 5.9 units per acre, the water supply investment cost is estimated to be $1,250,000.

Cameron Park 1 does not have waste water service. The TCB study referenced above puts the unit capital cost of serving Cameron county colonias at $5,311 per housing unit. The total capital cost of serving the existing 500 units with waste water services would be $2,655,500.

In summary, the capital investment cost of providing water and waste water service to the existing housing units is approximately $3,905,500.

According to the TCB study the projected operating cost for waste water service to Colonias in Cameron county would be on the order of $19/month. Assuming an operating cost of $1.00 per 1000 gallons for the water supply system, the monthly operating cost for water would amount to approximately $13.50 per month per unit for water [(100 gpcd x 4.5 x 365/1000 x $1.00)/12]. The estimated capital and operating cost estimates for Cameron Park 1 are $33.66 for water and $61.40 for waste water.

The monthly cost expected to be incurred by MHWSC is $95.06 per unit (Table 7). Therefore, the total annual cost

TABLE 7. MONTHLY COST OF SERVICE AND ABILITY TO PAY IN CAMERON PARK (1989$)

ITEM	WATER CAPITAL*	WATER OPERATING	TOTAL WATER	WASTE WATER CAPITAL*	WASTE WATER OPERATING	TOTAL WASTE WATER	TOTAL WATER & WASTE WATER
Cost of Service	19.97	13.69	33.66	42.40	19.00	61.40	95.06
Ability to Pay			10.30**			11.72**	22.02**
Short Fall			23.36			49.68	73.04
						NPV $9,078 per unit*	
						NPV $4.539 million for total project*	

* Assuming 9% interest and 30 year amortization

** Based on the independent variable values for NP, HV, HI and APw listed in text above and Equation 6 for water and Table 3 for waste water ability to pay estimates.

of serving Cameron Park with waste water and water supply service will be $570,360.

The other information needed for the analysis is the set of independent variables for solving equation (6) in order to calculate ability to pay. The rough estimates are as follows:

Variable	Value
NP	4.5
HV (1979 $)	$7,230
HI (1979 $)	$5,513
APw (1979 $)/1000 gal	$1.106
(1979 $)/CCF	$0.827

The number of persons per household (NP) is taken from the TCB study; the housing value (HV) is from the Cameron county appraisal district; household income is from survey results of a local group which estimated 1989 income at $8,600 per household (converting to 1979, the household income is $5,513). Solving equation (6) we get a 1979$ ability to pay estimate of $6.60 per month for water, and, using Table 3 for Census region "Cameron" for the 50 to 99 gpcd use range, we obtain a waste water ability to pay of $7.51 per month. Taken together the water and waste water ability to pay is $14.11 per month in 1979$ or $22.01 in 1989$ which is $264.14 annually per household. The difference between ability to pay revenue and costs are shown in Table 7 (last column) and the net present value of the difference is $4.539 million.

This particular example shows that the subsidy needed to make the project feasible for the utility exceedes the capital cost of the project ($4.539 compared to $3.905 million), meaning that some of the subsidy might have to be translated into cost sharing on operating cost. As a general matter, however, it is expected that the required subsidy will be less than the total investment cost of the project.

APPENDICES

APPENDIX A: DATA SOURCES AND CONVERSIONS

DATA SOURCES AND CONVERSIONS

This appendix will cover the sources of the data used in this study, the selection of variables and the data transformations used to produce certain variables.

SOURCES OF DATA

A household water demand model designed to predict water demand for households at the micro level was developed as a means of measuring ability of economically distressed communities to pay for water and waste water services. For estimation purposes household level data was required. The primary data source used to estimate the coefficients in this model was the 1980 Census. Specifically, the Census 5% Public Use Sample was selected because it is the best Census sample available that includes measures on water usage. It is also the largest sample available from the Census.

Several utilities were contacted in order to have actual water billing data by household against which to check both the reasonableness of estimations and the stability of water use patterns over time. This look at stability examines both the changes in water use patterns over time and the soundness of using 1980 Census data to model water use in 1989. Of the numerous utilities contacted, several proved cooperative in providing SEI with billing data by household, from which the actual billing experiences was determined. The utilities were requested to select areas that were comparable to economically distressed areas for this study's purposes. Additionally, this data was examined to determine how water consumption varied by month. Household level data was obtained from the Brownsville municipal utility (PUB), the Sharyland Water Supply Corporation (serving rural Hidalgo county) and the El Paso municipal utility. Laredo and El Paso provided summary statistics for their entire cities. In order to obtain current measures of the independent demographic variables in our model for the small areas Cameron Park, El Paso Zone 4, and several other areas were examined. National Decision Systems of Encinitas, California provided estimates of housing values, household income, and household size for 1989.

In order to calculate consumption and average price data from the Census yearly cost of water measure rate structure information was needed. Such rate structures were obtained from the utilities mentioned above and Municipal Advisory Council reports.

For comparative purposes, we collected data for water expenditures in Houston and Dallas (the only Texas cities

reported) from the Consumer Expenditures Survey of the Bureau of Labor Statistics.

DATA TRANSFORMATIONS

Defining the Data Set

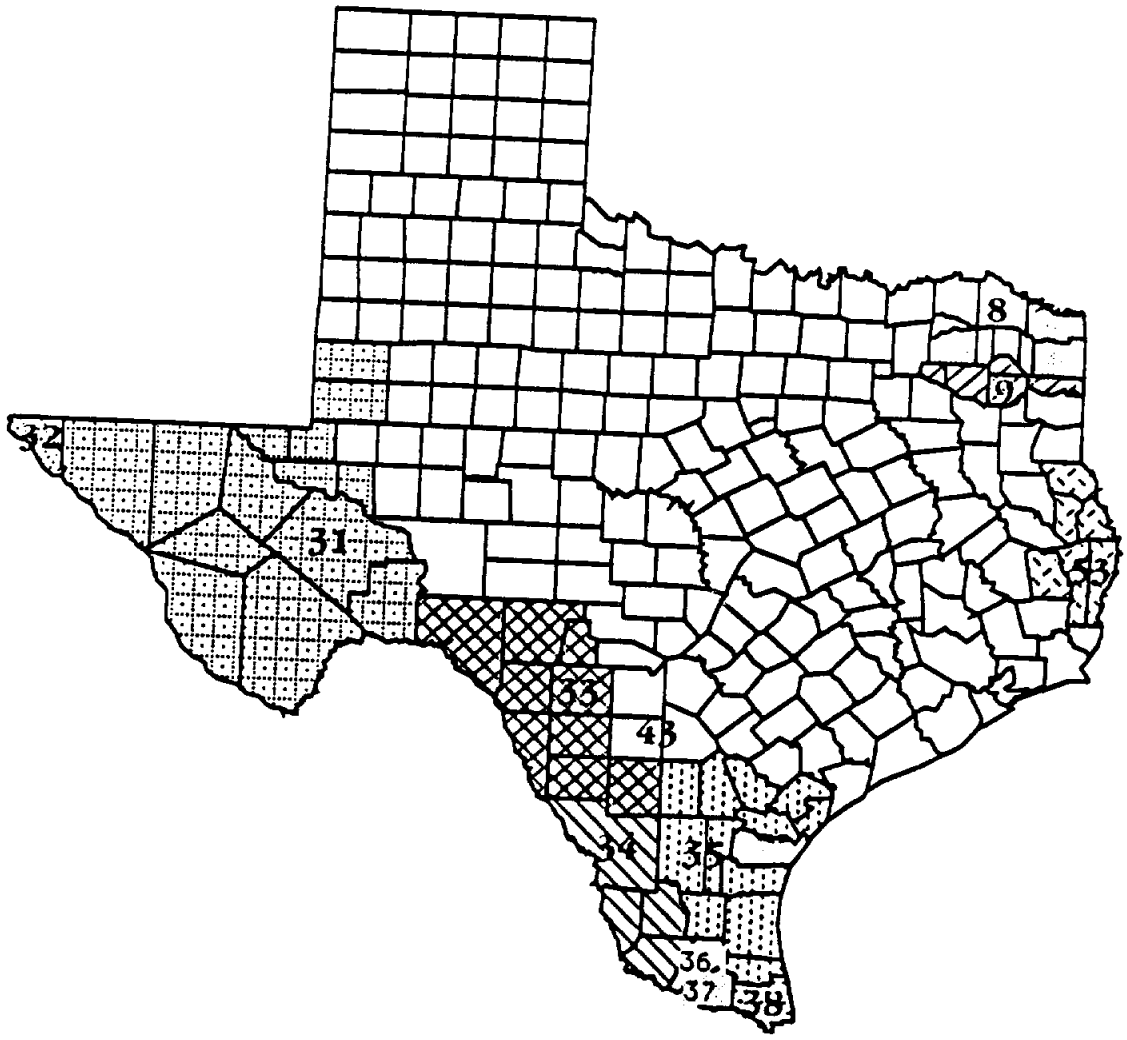
As a first step in data analysis all household observations that reported no yearly cost of water were eliminated. In an attempt to construct a data set that meets the spirit of comparability we limited our sample to those households reporting that they lived in single family owner occupied housing units with public water and wastewater service. As explained in the text, our task is to estimate how much water and waste water service the inhabitants of economically distressed areas would consume if it were available based on what families in similar circumstances actually consume. Outliers were also eliminated where there was an incongruity between housing values and household incomes in a two step process. First, we assigned the entire data set to a poverty class level of either 1, 2, 3, or 4. These categories were established as multiples of the poverty level. Thus, those respondents at or below the poverty level by Census definitions were assigned a poverty category of 1. Those respondents whose household size (number of persons) and income level placed them above the Census definition of the poverty level but below twice the poverty level we assigned a value of 2. A similar process assigned the category 3. All households whose income and household size placed them above three times the poverty level we assigned the categorical value of 4. The second step in the process was to determine the 5th and 95th percentile household value for each poverty class in each county group. All observations outside these bounds were eliminated. Thus, any household in the lowest income category but residing in an house valued at the upper end was removed from the data set. We further eliminated all households in the highest housing value class ($200,000 and up). A printout of the percentile breaks by county group and income class is attached **(Exhibit A1)**.

The final data set for the 12 Census county groups from which we made our estimations then contained approximately 10,000 observations. Census 5% samples are drawn from areas no smaller than 100,000 people, forcing the aggregation of smaller counties into county groups- see the **attached map.** A further restriction that we imposed on the data was that the Census respondents must report a yearly cost of water of at least the local minimum annual fees for water and wastewater in order to remain in the data set. To establish this minimum annual fee we applied the rate structure for a consumer served by the dominant utility in a county group.

EXHIBIT A1

PERCENTILE BREAKS: HOUSING VALUES (INDEXED VALUES) BY POVERTY CLASS

OBS	COUNTY	POVERTY	NUMBER	AVERAGE	SD	PR15	PR25	PR10	PR25	PR50	PR75	PR90	PR95	PR99
1	Red River	1	159	3.8365	3.78851	1	1	1.0	1.0	2.0	5	10.0	13.0	16
2	Red River	2	264	4.8485	3.57853	1	1	1.0	2.0	4.0	7	10.0	11.0	15
3	Red River	3	232	6.1595	3.89866	1	1	2.0	3.0	5.0	9	11.0	13.0	16
4	Red River	4	562	9.5036	4.66651	1	2	3.0	6.0	10.0	13	16.0	17.0	21
5	Marion	1	61	3.1311	2.88372	1	1	1.0	1.0	2.0	4	7.0	9.0	15
6	Marion	2	72	5.3333	3.38181	1	1	2.0	2.0	5.0	9	10.0	11.0	13
7	Marion	3	69	7.9420	4.11912	1	1	2.0	5.0	9.0	11	12.0	15.0	19
8	Marion	4	171	9.4503	4.55446	1	2	3.0	6.0	9.0	13	15.0	17.0	20
9	Pecos	1	98	3.9796	4.30051	1	1	1.0	1.0	2.0	5	11.0	15.0	19
10	Pecos	2	142	4.5986	3.72467	1	1	1.0	2.0	3.0	7	10.0	11.0	16
11	Pecos	3	108	5.9167	4.30849	1	1	1.0	2.0	5.0	9	11.0	13.0	18
12	Pecos	4	302	8.9470	4.82214	1	1	2.0	5.0	9.0	12	16.0	18.0	19
13	El Paso	1	277	7.7617	4.20502	1	1	2.0	5.0	8.0	10	13.0	15.0	20
14	El Paso	2	638	8.5439	3.53459	1	3	4.0	6.0	9.0	10	12.0	15.0	18
15	El Paso	3	702	9.8590	3.74414	2	4	5.0	8.0	10.0	12	15.0	16.0	20
16	El Paso	4	1443	12.8718	4.59265	2	5	7.0	10.0	12.0	16	19.0	21.0	23
17	Zavala	1	117	4.1368	3.42885	1	1	1.0	1.0	3.0	6	9.0	11.0	14
18	Zavala	2	182	5.8846	4.06343	1	1	1.0	2.0	5.0	9	12.0	13.0	17
19	Zavala	3	97	7.8866	4.34184	1	1	2.0	4.0	8.0	10	14.0	16.0	18
20	Zavala	4	147	10.8163	4.98219	1	2	3.0	8.0	11.0	14	17.0	19.0	22
21	Webb	1	158	4.4810	3.69838	1	1	1.0	1.0	3.0	7	9.0	12.0	15
22	Webb	2	188	6.4309	4.43256	1	1	1.0	2.0	6.0	9	12.0	13.0	20
23	Webb	3	114	8.8070	4.65229	1	1	2.0	5.0	9.0	12	14.0	16.0	19
24	Webb	4	171	12.5029	5.43991	1	2	4.0	9.0	13.0	16	20.0	21.0	23
25	Duval	1	205	3.3463	3.32283	1	1	1.0	1.0	2.0	5	9.0	10.0	14
26	Duval	2	277	5.0217	4.10808	1	1	1.0	2.0	4.0	8	11.0	12.0	18
27	Duval	3	230	7.1304	4.52460	1	1	1.5	3.0	7.0	10	13.0	15.0	19
28	Duval	4	535	10.9271	5.25424	1	2	3.0	7.0	11.0	15	18.0	20.0	22
29	Urban Hidalgo	1	144	5.4306	4.22721	1	1	1.0	2.0	5.0	9	10.0	12.0	21
30	Urban Hidalgo	2	204	6.1029	4.26975	1	1	1.0	2.0	5.0	9	12.0	14.0	18
31	Urban Hidalgo	3	172	8.2326	4.06720	1	1	2.0	5.0	9.0	11	13.0	15.0	18
32	Urban Hidalgo	4	320	12.2219	4.87629	1	4	6.0	9.0	12.0	15	19.0	21.0	23
33	Rural Hidalgo	1	125	3.6000	2.97028	1	1	1.0	1.0	3.0	5	7.0	9.0	13
34	Rural Hidalgo	2	92	5.2609	3.64306	1	1	2.0	2.0	4.0	8	11.0	12.0	15
35	Rural Hidalgo	3	42	7.0476	4.72643	1	1	2.0	3.0	6.5	10	13.0	15.0	23
36	Rural Hidalgo	4	54	9.4630	5.68584	1	1	2.0	5.0	9.0	13	19.0	19.0	21
37	Cameron	1	185	4.8432	4.01387	1	1	1.0	2.0	3.0	7	10.0	12.0	19
38	Cameron	2	242	5.5248	4.04967	1	1	1.0	2.0	5.0	8	10.0	13.0	20
39	Cameron	3	168	7.6905	4.56221	1	1	2.0	4.0	8.0	11	13.0	15.0	21
40	Cameron	4	321	11.9283	5.44040	1	2	4.0	9.0	12.0	16	20.0	21.0	22
41	Frio	1	86	4.4535	4.11784	1	1	1.0	1.0	2.0	7	10.0	12.0	17
42	Frio	2	121	5.8264	4.21046	1	1	1.0	2.0	5.0	9	11.0	13.0	17
43	Frio	3	126	7.7698	4.65130	1	1	2.0	3.0	9.0	11	13.0	16.0	18
44	Frio	4	200	10.8450	4.88470	1	2	4.5	7.0	11.0	14	17.0	19.5	22
45	Newton	1	34	3.5294	3.31421	1	1	1.0	1.0	2.0	5	7.0	13.0	13
46	Newton	2	40	4.8250	4.08178	1	1	1.0	2.0	3.5	6	10.5	13.0	20
47	Newton	3	36	7.4444	4.25236	1	1	2.0	4.0	7.0	10	13.0	16.0	19
48	Newton	4	60	10.7500	5.24526	1	1	3.0	8.5	11.0	14	17.5	21.5	23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For example, in El Paso the minimum monthly fee for the combination of water and wastewater service in 1979 was $4.75. In order for an observation in the 5% sample of El Paso county to be included in our analysis the annual yearly cost of water reported by a respondent in El Paso county had to be at least $57 (4.75 x 12). We applied rate structures to nine of the county groups' yearly cost of water data to assemble a data set for estimating water demand. Following the application of these restrictions, the data set was reduced to approximately 4,500 observations to be used for estimation purposes. We made the choice of the "dominant" utility by selecting the utility in the county group that served the most consumers, an obvious decision in most of the county groups. The El Paso Water Works' 1979 year end customer count of 100,598 with a county population of 479,899 (and 137,100 households) makes it the obvious dominant utility. The selection of a utility rate structure is similarly straightforward in most circumstances- see Table A1.

TABLE A1

Utility Data Used By County Group

Census County Group Number (&Name)	Eligible County/ Counties	Utility's Rates Used
31 Pecos	Pecos	Ft. Stockton
31 Pecos	Brewster	Ft. Stockton
31 Pecos	Presidio	Ft. Stockton
31 Pecos	Jeff Davis	Ft. Stockton
31 Pecos	Hudspeth	Ft. Stockton
31 Pecos	Reeves	Ft. Stockton
31 Pecos	Terrell	Ft. Stockton
31 Pecos	Winkler	Ft. Stockton
32 El Paso	El Paso	El Paso
33 Zavala	Zavala	Crystal City
33 Zavala	Val Verde	Crystal City
33 Zavala	Kinney	Crystal City
33 Zavala	Maverick	Crystal City
33 Zavala	Dimmit	Crystal City
34 Webb	Zapata	Laredo
34 Webb	Jim Hogg	Laredo
34 Webb	Starr	Laredo
34 Webb	Webb	Laredo
35 Duval	Duval	Laredo
35 Duval	Willacy	Laredo
35 Duval	Jim Wells	Laredo
36 Urban Hidalgo	Urban Hidalgo	McAllen
37 Rural Hidalgo	Rural Hidalgo	McAllen
38 Cameron	Cameron	Brownsville
43 Frio	Frio	Pearsall

Our selection of the McAllen rates for rural Hidalgo county was based on several factors. Much of rural Hidalgo

county is served by utilities that do not provide wastewater service. Since our data set is limited to those observations where the consumers have water and waste water service it would be inappropriate to apply a rate structure that does not include sewer service. Among those utility service areas with waste water service, the price of water varies greatly. For example, the city of Hidalgo has extremely inexpensive ground (well) water in an area that principally uses surface (expensive) water. Our use of Laredo's water rates for the Duval county group is also based on judgements about comparability. Laredo has relatively expensive waste water service and relatively low cost water. Since much of the Duval county group area uses ground (inexpensive) water in a predominantly rural area (precluding inexpensive waste water service), this contiguous county group's rate structure appears to be a good match.

The Source and Estimation of Calculated Variables

Use of utility rates extends beyond just restricting the data set. Consumption and average prices variables in the demand model are calculated from the yearly cost of water variable that is directly reported. Other directly reported variables include housing value, household income and number of persons in the household. We estimated the consumption and average price variables in the computer program, (provided under seperate cover) which is summarized as follows. Having answered whether the Census variable "YCWater"- yearly cost of water- includes water and waste water charges in the affirmative above, we first removed wastewater charges from the yearly cost of water variable. Waste water charges vary by utility over a broad range of possiblities including the following:

- ø flat monthly fee (e.g., $1.50 per month as in Zavala County),
- ø a variable amount based on some months' water consumption (e.g., a flat fee is established for an address based on February water consumption in El Paso),
- ø a minimum monthly fee plus a unit price based on water consumption (sometimes bounded on the upper end),
- ø a straight unit price based on consumption.

Because of the range of waste water pricing schemes and the range of waste water charges, water demand was estimated and the remainder between water and YCWater is assumed to be approximately the waste water charge. There is extreme variance between monthly fees in the data, from $1.50/month to fees in excess of $10/month.

To estimate annual water consumption, water consumption by month was first calculated and then the average price of water per month followed making use of the selected rate structure. This is important since the average price varies by consumption which varies greatly over the course of the year (since consumption is not distributed as a straight line over the course of a year, consumers pay different marginal price levels in different months... thus $240 buys different amounts of water if it is translated as 12 months of $20 rather than as $10 in some winter months and $30 in some summer months). To apportion water consumption over the months of the year we first subtracted the fixed monthly fees from the yearly cost of water reported by a respondent. This takes the following form:

YCWater - (minimum fee * 12) = excess

where excess is that consumption above what is included in the minimum charge.

The distribution of water consumption by month in the utility provided data was then examined. We took that distribution and applied it to the excess calculated above. Adding that amount back to the monthly minimum gives us the monthly expenditure. For example, the February proportion of the annual water bill is, on average, 5.606%. With a $240 yearly cost of water and a $2 monthly minimum the February expenditure would be calculated as follows:

240 - (2 * 12) = 216

216 * .05606 = 12.11 + 2 =14.11= Feb. expenditure

Of course, this leaves out the waste water charges from this example. Assuming these numbers come from a county group with a fee structure that has a fixed monthly waste water charge of $1.50, the calculation becomes:

240 - (3.5 * 12) = 198

198 * .05606 = 11.10+3.5 =14.60 = Feb. expenditure

Suppose further that the price structure includes 1,000 gallons in the minimum fee and charges $0.90 for each of the next 8 thousand gallon units with subsequent consumption priced at $0.80 per thousand gallons. To determine how this price structure translates into consumption in gallons the price steps need to be established. Written in the If..then.. syntax of computer programming these steps appear as follows:

If 3.5 <Feb expenditure < 10.70
then Feb consumption = 1 + (Feb expenditure-3.5)/0.9

the $10.70 figure is calculated as the 3.5 minimum plus the next 8 thousand gallons in the first price step times $0.90 per thousand. The consumption is the first thousand gallons included in the minimum fee plus the rest of the expenditure divided by the unit price.

Similarly, the second price step is incorporated as:

If Feb. expenditure > 10.70 then Feb. consumption = 9 + (Feb. expenditure - 10.70)/0.8

So, for our $240 annual cost of water example, the February consumption figure would be 9 + (14.60 - 10.70)/.8, or 13.875 thousand gallons. The total annual quantity is derived by simply adding the monthly quantities calculated as above. The only distinction between this example and the way the computer program works is that our model calculates water not in thousand gallon increments but in CCF (hundred cubic feet). The selection of this unit of measure has no bearing on the outcome of the model (there are 748.05 gallons per CCF), it is simply a matter of using the unit of measure in use by some of the utilities.

Another estimated independent variable in our model is the weighted average price. This price is calculated from the consumption figure by dividing consumption by expenditure. First it is calculated by month by establishing ranges similar to the consumption ranges above. Once the average price for a month is derived, the weighted annual average price for a consumer is determined by taking the sum of the products of each months consumption and average price and dividing that quantity by the total annual quantity. Expressed mathematically,

$$\text{Wt.ed Ave.P} = \frac{[(\text{JanCns} * \text{JanAveP}) + (\text{FebCns} * \text{FebAveP}) \ldots]}{\text{Total Annual Quantity}}$$

The functional form of the equation utilized in the regression analysis was introduced with an example worked through in the body of the report. The results of running our analysis on the data set described in this appendix are presented in Appendix D. The first page of Appendix D shows the means, the ranges, etc. for the set of variables used, derived or referenced in this work. These ranges and means are based on the entire data set for the study area as a whole. The last pages of Appendix D present a reduced set

of the same information on a county group by county group basis. The second and third pages of Appendix D present a correlation coefficient matrix of the variable set. This should enable the reader to explore relationships in the data in at least a cursory way. The pages that follow the correlation coefficient matrix pages present regression results for four functional forms considered: linear, log/log, log/linear and modified log/log (log/log/linear).

The selection of the fourth equation form was based not only on its stability over ranges normally considered, but also on its suitablility for theorized reasons. A model of this format will have a quantity axis intercept, i.e., there is satiation, where even if water is free there is some maximum amount consumers will use. Furthermore, a model of this functional form is asymptotic to the price axis. This can be interpreted as meaning that due to humans' dependence on water to sustain life, there will be some consumption no matter what the price. This functional form is inspired by Griffin and Chang's community level water demand modeling work at Texas A&M. The dummy variables used in all the functional forms are included to pick up any variation not explicitly modeled (for example, weather variations among the county groups). A functional form by functional form application of the model to each of the county groups modeled is provided under separate cover with the SAS code written to estimate these results.

APPENDIX B: COUNTY GROUPINGS IN THE 5% PUBLIC USE SAMPLE OF THE 1980 CENSUS POPULATION

APPENDIX B

LISTING OF COUNTIES IN THE STUDY

Counties Eligible Under Senate Bill #2:

El Paso	Hudspeth	Jeff Davis
Presidio	Reeves	Pecos
Brewster	Terrel	Winkler
Val Verde	Kinney	Maverick
Zavala	Dimmit	Webb
Frio	LaSalle	Duval
Jim Wells	Zapata	Jim Hogg
Brooks	Starr	Hidalgo
Cameron	Willacy	Red River
Marion	Sabine	Newton

5% Public Use Census Sample County Groups Used in Analysis:

Census County Group 32:
El Paso

Census County Group 31:

Hudspeth	Jeff Davis	Presidio
Culberson	Loving	Winkler
Andrews	Gaines	Ward
Crane	Brewster	Pecos
Terrel		

Census County Group 33:

Val Verde	Edwards	Real
Uvalde	Kinney	Maverick
Zavala	Dimmit	La Salle

Census County Group 34:

Webb	Zapata	Jim Hogg
Starr		

Census County Group 36:
West Hidalgo County

Census County Group 37:
East Hidalgo County

Census County Group 38:
Cameron

Census County Group 35:

Wallacy	Kenedy	Brooks
Kleberg	Jim Wells	Duval
McMillen	Live Oak	San Patricio
Aransas	Refugio	Goliad
Bee		

Census County Group 43:

Atascosa	Medina	Bandera	Kerr
Kendal	Gillespie	Frio	

APPENDIX C: CENSUS QUESTIONNAIRE

Appendix E.—Facsimiles of Respondent Instructions and Questionnaire Pages

Page 2

ALSO ANSWER THE HOUSING QUESTIONS ON PAGE 3

Here are the QUESTIONS ↓	These are the columns for ANSWERS → *Please fill one column for each person listed in Question 1.*	PERSON in column 1	PERSON in column 2
		Last name First name Middle initial	Last name First name Middle initial
2. How is this person related to the person in column 1? *Fill one circle.* *If "Other relative" of person in column 1, give exact relationship, such as mother-in-law, niece, grandson, etc.*		*START in this column with the household member (or one of the members) in whose name the home is owned or rented. If there is no such person, start in this column with any adult household member.*	If relative of person in column 1 Husband/wife; Son/daughter; Brother/sister; Father/mother; Other relative If not related to person in column 1 Roomer, boarder; Partner, roommate; Paid employee; Other nonrelative
3. Sex *Fill one circle.*		Male ■ Female	Male ■ Female
4. Is this person — *Fill one circle.*		White; Black or Negro; Japanese; Chinese; Filipino; Korean; Vietnamese; Indian (Amer.) *Print tribe* ←; Asian Indian; Hawaiian; Guamanian; Samoan; Eskimo; Aleut; Other — *Specify*	White; Black or Negro; Japanese; Chinese; Filipino; Korean; Vietnamese; Indian (Amer.) *Print tribe* ←; Asian Indian; Hawaiian; Guamanian; Samoan; Eskimo; Aleut; Other — *Specify*
5. Age, and month and year of birth *a. Print age at last birthday.* *b. Print month and fill one circle.* *c. Print year in the spaces, and fill one circle below each number.*		a. Age at last birthday b. Month of birth c. Year of birth 1 ● 8 9 / 8 1 2 3 4 5 6 7 8 9 / 8 1 2 3 4 5 6 7 8 9 ■ Jan.—Mar; Apr.—June; July—Sept; Oct.—Dec	a. Age at last birthday b. Month of birth c. Year of birth 1 ● 8 9 / 8 1 2 3 4 5 6 7 8 9 / 8 1 2 3 4 5 6 7 8 9 ■ Jan.—Mar; Apr.—June; July—Sept; Oct.—Dec
6. Marital status *Fill one circle.*		Now married; Widowed; Divorced; Separated; Never married	Now married; Widowed; Divorced; Separated; Never married
7. Is this person of Spanish/Hispanic origin or descent? *Fill one circle.*		No (not Spanish/Hispanic); Yes, Mexican, Mexican-Amer., Chicano; Yes, Puerto Rican; Yes, Cuban; Yes, other Spanish/Hispanic ■	No (not Spanish/Hispanic); Yes, Mexican, Mexican-Amer., Chicano; Yes, Puerto Rican; Yes, Cuban; Yes, other Spanish/Hispanic ■
8. Since February 1, 1980, has this person attended regular school or college at any time? *Fill one circle. Count nursery school, kindergarten, elementary school, and schooling which leads to a high school diploma or college degree.*		No, has not attended since February 1; Yes, public school, public college; Yes, private, church-related; Yes, private, not church-related	No, has not attended since February 1; Yes, public school, public college; Yes, private, church-related; Yes, private, not church-related
9. What is the highest grade (or year) of regular school this person has ever attended? *Fill one circle.* *If now attending school, mark grade person is in. If high school was finished by equivalency test (GED), mark "12."*		Highest grade attended: Nursery school; Kindergarten Elementary through high school *(grade or year)* 1 2 3 4 5 6 7 8 9 10 11 12 College *(academic year)* ■ 1 2 3 4 5 6 7 8 or more Never attended school — *Skip question 10*	Highest grade attended: Nursery school; Kindergarten Elementary through high school *(grade or year)* 1 2 3 4 5 6 7 8 9 10 11 12 College *(academic year)* ■ 1 2 3 4 5 6 7 8 or more Never attended school — *Skip question 10*
10. Did this person finish the highest grade (or year) attended? *Fill one circle.*		Now attending this grade *(or year)*; Finished this grade *(or year)*; Did not finish this grade *(or year)*	Now attending this grade *(or year)*; Finished this grade *(or year)*; Did not finish this grade *(or year)*
		CENSUS USE ONLY A. I N	CENSUS USE ONLY A. I N

NOW PLEASE ANSWER QUESTIONS H1—H12 FOR YOUR HOUSEHOLD

If you listed more than 7 persons in Question 1, please see note on page 20.

PERSON in column 7

Last name

First name — Middle name

If relative of person in column 1:
- ○ Husband/wife
- ○ Son/daughter
- ○ Brother/sister
- ○ Father/mother
- ○ Other relative

If not related to person in column 1:
- ○ Roomer, boarder
- ○ Partner, roommate
- ○ Paid employee
- ○ Other nonrelative

- ○ Male ■ ○ Female

- ○ White
- ○ Black or Negro
- ○ Japanese
- ○ Chinese
- ○ Filipino
- ○ Korean
- ○ Vietnamese
- ○ Indian (Amer.) — Print tribe
- ○ Asian Indian
- ○ Hawaiian
- ○ Guamanian
- ○ Samoan
- ○ Eskimo
- ○ Aleut
- ○ Other — Specify

a. Age at last birthday

c. Year of birth: 1 9 ○ ○

b. Month of birth
- ○ Jan.—Mar.
- ○ Apr.—June
- ○ July—Sept.
- ○ Oct.—Dec.

- ○ Now married
- ○ Widowed
- ○ Divorced
- ○ Separated
- ○ Never married

- ○ No (not Spanish/Hispanic)
- ○ Yes, Mexican, Mexican-Amer., Chicano
- ○ Yes, Puerto Rican
- ○ Yes, Cuban
- ○ Yes, other Spanish/Hispanic

- ○ No, has not attended since February 1
- ○ Yes, public school, public college
- ○ Yes, private, church-related
- ○ Yes, private, not church-related

Highest grade attended:
- ○ Nursery school
- ○ Kindergarten

Elementary through high school *(grade or year)*: 1 2 3 4 5 6 7 8 9 10 11 12 ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○

College *(academic year)*: 1 2 3 4 5 6 7 8 or more ○ ○ ○ ○ ○ ○ ○ ○

- ○ Never attended school — *Skip question 10*
- ○ Now attending this grade *(or year)*
- ○ Finished this grade *(or year)*
- ○ Did not finish this grade *(or year)*

CENSUS USE ONLY — A. ○ I ○ N ○ ○

H1. Did you leave anyone out of Question 1 because you were not sure if the person should be listed — *for example, a new baby still in the hospital, a lodger who also has another home, or a person who stays here once in a while and has no other home?*
- ○ Yes — *On page 20 give name(s) and reason left out.*
- ○ No

H2. Did you list anyone in Question 1 who is away from home now — *for example, on a vacation or in a hospital?*
- ○ Yes — *On page 20 give name(s) and reason person is away.*
- ○ No

H3. Is anyone visiting here who is not already listed?
- ○ Yes — *On page 20 give name of each visitor for whom there is no one at the home address to report the person to a census taker.*
- ○ No

H4. How many living quarters, occupied and vacant, are at this address?
- ○ One
- ○ 2 apartments or living quarters
- ○ 3 apartments or living quarters
- ○ 4 apartments or living quarters
- ○ 5 apartments or living quarters
- ○ 6 apartments or living quarters
- ○ 7 apartments or living quarters
- ○ 8 apartments or living quarters
- ○ 9 apartments or living quarters
- ○ 10 or more apartments or living quarters
- ○ This is a mobile home or trailer

H5. Do you enter your living quarters —
- ○ Directly from the outside or through a common or public hall?
- ○ Through someone else's living quarters?

H6. Do you have complete plumbing facilities in your living quarters, that is, hot and cold piped water, a flush toilet, and a bathtub or shower?
- ○ Yes, for this household only
- ○ Yes, but also used by another household
- ○ No, have some but not all plumbing facilities
- ○ No plumbing facilities in living quarters

H7. How many rooms do you have in your living quarters? *Do not count bathrooms, porches, balconies, foyers, halls, or half-rooms.*
- ○ 1 room
- ○ 2 rooms
- ○ 3 rooms
- ○ 4 rooms
- ○ 5 rooms
- ○ 6 rooms
- ○ 7 rooms
- ○ 8 rooms
- ○ 9 or more rooms

H8. Are your living quarters —
- ○ Owned or being bought by you or by someone else in this household?
- ○ Rented for cash rent?
- ○ Occupied without payment of cash rent?

H9. Is this apartment (house) part of a condominium?
- ○ No
- ○ Yes, a condominium

H10. *If this is a one-family house* —

a. Is the house on a property of 10 or more acres?
- ○ Yes
- ○ No

b. Is any part of the property used as a commercial establishment or medical office?
- ○ Yes
- ○ No

H11. *If you live in a one-family house or a condominium unit which you own or are buying* —

What is the value of this property, that is, how much do you think this property (house and lot or condominium unit) would sell for if it were for sale?

Do not answer this question if this is —
- A mobile home or trailer
- A house on 10 or more acres
- A house with a commercial establishment or medical office on the property

- ○ Less than $10,000
- ○ $10,000 to $14,999
- ○ $15,000 to $17,499
- ○ $17,500 to $19,999
- ○ $20,000 to $22,499
- ○ $22,500 to $24,999
- ○ $25,000 to $27,499
- ○ $27,500 to $29,999
- ○ $30,000 to $34,999
- ○ $35,000 to $39,999
- ○ $40,000 to $44,999
- ○ $45,000 to $49,999
- ○ $50,000 to $54,999
- ○ $55,000 to $59,999
- ○ $60,000 to $64,999
- ○ $65,000 to $69,999
- ○ $70,000 to $74,999
- ○ $75,000 to $79,999
- ○ $80,000 to $89,999
- ○ $90,000 to $99,999
- ○ $100,000 to $124,999
- ○ $125,000 to $149,999
- ○ $150,000 to $199,999
- ○ $200,000 or more

H12. *If you pay rent for your living quarters* —

What is the monthly rent?

If rent is not paid by the month, see the instruction guide on how to figure a monthly rent.

- ○ Less than $50
- ○ $50 to $59
- ○ $60 to $69
- ○ $70 to $79
- ○ $80 to $89
- ○ $90 to $99
- ○ $100 to $109
- ○ $110 to $119
- ○ $120 to $129
- ○ $130 to $139
- ○ $140 to $149
- ○ $150 to $159
- ○ $160 to $169
- ○ $170 to $179
- ○ $180 to $189
- ○ $190 to $199
- ○ $200 to $224
- ○ $225 to $249
- ○ $250 to $274
- ○ $275 to $299
- ○ $300 to $349
- ○ $350 to $399
- ○ $400 to $499
- ○ $500 or more

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A4. Block number

A6. Serial number

B. Type of unit or quarters
- Occupied
  - ○ First form
  - ○ Continuation
- Vacant
  - ○ Regular
  - ○ Usual home elsewhere
- Group quarters
  - ○ First form
  - ○ Continuation

For vacant units

C1. Is this unit for —
- ○ Year-round use
- ○ Seasonal/Mig. — *Skip C2, C3, and D.*

C2. Vacancy status
- ○ For rent
- ○ For sale only
- ○ Rented or sold, not occupied
- ○ Held for occasional use
- ○ Other vacant

C3. Is this unit boarded up?
- ○ Yes
- ○ No

D. Months vacant
- ○ Less than 1 month
- ○ 1 up to 2 months
- ○ 2 up to 6 months
- ○ 6 up to 12 months
- ○ 1 year up to 2 years
- ○ 2 or more years

E. Indicators
1. ○ ○ Mail return
2. ○ ○ Pop./F

F. Total persons

Page 4

ALSO ANSWER THESE QUESTIONS

H13. Which best describes this building?
Include all apartments, flats, etc., even if vacant.

- A mobile home or trailer
- A one-family house detached from any other house
- A one-family house attached to one or more houses
- A building for 2 families
- A building for 3 or 4 families
- A building for 5 to 9 families
- A building for 10 to 19 families
- A building for 20 to 49 families
- A building for 50 or more families
- A boat, tent, van, etc.

H14a. How many stories (floors) are in this building?
Count an attic or basement as a story if it has any finished rooms for living purposes.

- 1 to 3 — *Skip to H15*
- 4 to 6
- 7 to 12
- 13 or more stories

b. Is there a passenger elevator in this building?

- Yes
- No

H15a. Is this building —

- On a city or suburban lot, or on a place of less than 1 acre? — *Skip to H16*
- On a place of 1 to 9 acres?
- On a place of 10 or more acres?

b. Last year, 1979, did sales of crops, livestock, and other farm products from this place amount to —

- Less than $50 (or None)
- $50 to $249
- $250 to $599
- $600 to $999
- $1,000 to $2,499
- $2,500 or more

H16. Do you get water from —

- A public system *(city water department, etc.)* or private company?
- An individual drilled well?
- An individual dug well?
- Some other source *(a spring, creek, river, cistern, etc.)*?

H17. Is this building connected to a public sewer?

- Yes, connected to public sewer
- No, connected to septic tank or cesspool
- No, use other means

H18. About when was this building originally built? *Mark when the building was first constructed, not when it was remodeled, added to, or converted.*

- 1979 or 1980
- 1975 to 1978
- 1970 to 1974
- 1960 to 1969
- 1950 to 1959
- 1940 to 1949
- 1939 or earlier

H19. When did the person listed in column 1 move into this house (or apartment)?

- 1979 or 1980
- 1975 to 1978
- 1970 to 1974
- 1960 to 1969
- 1950 to 1959
- 1949 or earlier
- Always lived here

H20. How are your living quarters heated?
Fill one circle for the kind of heat used most.

- Steam or hot water system
- Central warm-air furnace with ducts to the individual rooms *(Do not count electric heat pumps here.)*
- Electric heat pump
- Other built-in electric units *(permanently installed in wall, ceiling, or baseboard)*
- Floor, wall, or pipeless furnace
- Room heaters with flue or vent, burning gas, oil, or kerosene
- Room heaters without flue or vent, burning gas, oil, or kerosene *(not portable)*
- Fireplaces, stoves, or portable room heaters of any kind
- No heating equipment

H21a. Which fuel is used most for house heating?

- Gas: from underground pipes serving the neighborhood
- Gas: bottled, tank, or LP
- Electricity
- Fuel oil, kerosene, etc.
- Coal or coke
- Wood
- Other fuel
- No fuel used

b. Which fuel is used most for water heating?

- Gas: from underground pipes serving the neighborhood
- Gas: bottled, tank, or LP
- Electricity
- Fuel oil, kerosene, etc.
- Coal or coke
- Wood
- Other fuel
- No fuel used

c. Which fuel is used most for cooking?

- Gas: from underground pipes serving the neighborhood
- Gas: bottled, tank, or LP
- Electricity
- Fuel oil, kerosene, etc.
- Coal or coke
- Wood
- Other fuel
- No fuel used

H22. What are the costs of utilities and fuels for your living quarters?

a. Electricity
$ _____ .00 OR
Average monthly cost
- Included in rent or no charge
- Electricity not used

b. Gas
$ _____ .00 OR
Average monthly cost
- Included in rent or no charge
- Gas not used

c. Water
$ _____ .00 OR
Yearly cost
- Included in rent or no charge

d. Oil, coal, kerosene, wood, etc.
$ _____ .00 OR
Yearly cost
- Included in rent or no charge
- These fuels not used

H23. Do you have complete kitchen facilities? *Complete kitchen facilities are a sink with piped water, a range or cookstove, and a refrigerator.*

- Yes
- No

H24. How many bedrooms do you have?
Count rooms used mainly for sleeping even if used also for other purposes.

- No bedroom
- 1 bedroom
- 2 bedrooms
- 3 bedrooms
- 4 bedrooms
- 5 or more bedrooms

H25. How many bathrooms do you have?
A complete bathroom is a room with flush toilet, bathtub or shower, and wash basin with piped water.

A half bathroom has at least a flush toilet or bathtub or shower, but does not have all the facilities for a complete bathroom.

- No bathroom, or only a half bathroom
- 1 complete bathroom
- 1 complete bathroom, plus half bath(s)
- 2 or more complete bathrooms

H26. Do you have a telephone in your living quarters?

- Yes
- No

H27. Do you have air conditioning?

- Yes, a central air-conditioning system
- Yes, 1 individual room unit
- Yes, 2 or more individual room units
- No

H28. How many automobiles are kept at home for use by members of your household?

- None
- 1 automobile
- 2 automobiles
- 3 or more automobiles

H29. How many vans or trucks of one-ton capacity or less are kept at home for use by members of your household?

- None
- 1 van or truck
- 2 vans or trucks
- 3 or more vans or trucks

CENSUS USE

H22a.

H22b.

H22c.

H22d.

FOR YOUR HOUSEHOLD

Please answer H30—H32 if you live in a one-family house which you own or are buying, unless this is —

- A mobile home or trailer . . . . . }
- A house on 10 or more acres . . . . . } *If any of these, or if you rent your unit or this is a multi-family structure, skip H30 to H32 and turn to page 6.*
- A condominium unit . . . . . }
- A house with a commercial establishment or medical office on the property . . . . . }

H30. What were the real estate taxes on this property last year?

$ _____ .00 OR ○ None

H31. What is the annual premium for fire and hazard insurance on this property?

$ _____ .00 OR ○ None

H32a. Do you have a mortgage, deed of trust, contract to purchase, or similar debt on this property?

- ○ Yes, mortgage, deed of trust, or similar debt
- ○ Yes, contract to purchase
- ○ No — *Skip to page 6*

b. Do you have a second or junior mortgage on this property?

○ Yes ○ No

c. How much is your total regular monthly payment to the lender?
Also include payments on a contract to purchase and to lenders holding second or junior mortgages on this property.

$ _____ .00 OR ○ No regular payment required — *Skip to page 6*

d. Does your regular monthly payment (amount entered in H32c) include payments for real estate taxes on this property?

- ○ Yes, taxes included in payment
- ○ No, taxes paid separately or taxes not required

e. Does your regular monthly payment (amount entered in H32c) include payments for fire and hazard insurance on this property?

- ○ Yes, insurance included in payment
- ○ No, insurance paid separately or no insurance

Please turn to page 6

FOR CENSUS USE ONLY

	1	2	3	4	5	6	7
S.S. Yes	○	○	○	○	○	○	○
S.S. No	○	○	○	○	○	○	○
2.	00–34	00–34	00–34	00–34	00–34	00–34	00–34
4.	000–999	000–999	000–999	000–999	000–999	000–999	000–999

GQ.	H30.	H31.	H32c.
00–34	0000–9999	000–999	0000–9999

Page 6

ANSWER THESE QUESTIONS FOR

Name of Person 1 on page 2:
Last name | First name | Middle initial

11. In what State or foreign country was this person born?
Print the State where this person's mother was living when this person was born. Do not give the location of the hospital unless the mother's home and the hospital were in the same State.
Name of State or foreign country, or Puerto Rico, Guam, etc.

12. *If this person was born in a foreign country –*
a. Is this person a naturalized citizen of the United States?
○ Yes, a naturalized citizen
○ No, not a citizen
○ Born abroad of American parents
b. When did this person come to the United States to stay?
○ 1975 to 1980 ○ 1965 to 1969 ○ 1950 to 1959
○ 1970 to 1974 ○ 1960 to 1964 ○ Before 1950

13a. Does this person speak a language other than English at home?
○ Yes ○ No, only speaks English – *Skip to 14*
b. What is this language?
(For example – Chinese, Italian, Spanish, etc.)
c. How well does this person speak English?
○ Very well ○ Not well
○ Well ○ Not at all

14. What is this person's ancestry? *If uncertain about how to report ancestry, see instruction guide.*
(For example: Afro-Amer., English, French, German, Honduran, Hungarian, Irish, Italian, Jamaican, Korean, Lebanese, Mexican, Nigerian, Polish, Ukrainian, Venezuelan, etc.)

15a. Did this person live in this house five years ago (April 1, 1975)?
If in college or Armed Forces in April 1975, report place of residence there.
○ Born April 1975 or later – *Turn to next page for next person*
○ Yes, this house – *Skip to 16*
○ No, different house
b. Where did this person live five years ago (April 1, 1975)?
(1) State, foreign country, Puerto Rico, Guam, etc.:
(2) County:
(3) City, town, village, etc.:
(4) Inside the incorporated (legal) limits of that city, town, village, etc.?
○ Yes ○ No, in unincorporated area

16. When was this person born?
○ Born before April 1965 – *Please go on with questions 17-33*
○ Born April 1965 or later – *Turn to next page for next person*

17. In April 1975 *(five years ago)* was this person –
a. On active duty in the Armed Forces?
○ Yes ○ No
b. Attending college?
○ Yes ○ No
c. Working at a job or business?
○ Yes, full time ○ No
○ Yes, part time

18a. Is this person a veteran of active-duty military service in the Armed Forces of the United States?
If service was in National Guard or Reserves only, see instruction guide.
○ Yes ○ No – *Skip to 19*
b. Was active-duty military service during –
Fill a circle for each period in which this person served.
○ May 1975 or later
○ Vietnam era *(August 1964–April 1975)*
○ February 1955–July 1964
○ Korean conflict *(June 1950–January 1955)*
○ World War II *(September 1940–July 1947)*
○ World War I *(April 1917–November 1918)*
○ Any other time

19. Does this person have a physical, mental, or other health condition which has lasted for 6 or more months and which . . .

	Yes	No
a. Limits the kind or amount of work this person can do at a job?	○	○
b. Prevents this person from working at a job?	○	○
c. Limits or prevents this person from using public transportation?	○	○

20. *If this person is a female –*
How many babies has she ever had, not counting stillbirths?
Do not count her stepchildren or children she has adopted.

None	1	2	3	4	5	6	7	8	9	10	11	12 or more
○	○	○	○	○	○	○	○	○	○	○	○	○

21. *If this person has ever been married –*
a. Has this person been married more than once?
○ Once ○ More than once
b. Month and year of marriage? *(Month) (Year)*
Month and year of first marriage? *(Month) (Year)*
c. *If married more than once* – Did the first marriage end because of the death of the husband (or wife)?
○ Yes ○ No

22a. Did this person work at any time last week?
○ Yes – *Fill this circle if this person worked full time or part time. (Count part-time work such as delivering papers, or helping without pay in a family business or farm. Also count active duty in the Armed Forces.)*
○ No – *Fill this circle if this person did not work, or did only own housework, school work, or volunteer work.*
Skip to 25
b. How many hours did this person work last week (at all jobs)?
Subtract any time off, add overtime or extra hours worked.
Hours

23. At what location did this person work last week?
If this person worked at more than one location, print where he or she worked most last week.
If one location cannot be specified, see instruction guide.
a. Address *(Number and street)*
If street address is not known, enter the building name, shopping center, or other physical location description
b. Name of city, town, village, borough, etc.
c. Is the place of work inside the incorporated (legal) limits of that city, town, village, borough, etc.?
○ Yes ○ No, in unincorporated area
d. County
e. State f. ZIP Code

24a. Last week, how long did it usually take this person to get from home to work (one way)?
Minutes
b. How did this person usually get to work last week?
If this person used more than one method, give the one usually used for most of the distance.
○ Car ○ Taxicab
○ Truck ○ Motorcycle
○ Van ○ Bicycle
○ Bus or streetcar ○ Walked only
○ Railroad ○ Worked at home
○ Subway or elevated ○ Other – *Specify*
If car, truck, or van in 24b, go to 24c. Otherwise, skip to 28.

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Per. No.	11.	13b.	14.	15b.	23.	VL	24a.
1							
2							
3							
4							
5							
6							
7							
8							
9							

PERSON 1 ON PAGE 2

c. When going to work last week, did this person usually —
- ○ Drive alone — *Skip to 28*
- ○ Drive others only
- ○ Share driving
- ○ Ride as passenger only

d. How many people, including this person, usually rode to work in the car, truck, or van last week?
- ○ 2
- ○ 3
- ○ 4
- ○ 5
- ○ 6
- ○ 7 or more

After answering 24d, skip to 28.

25. Was this person temporarily absent or on layoff from a job or business last week?
- ○ Yes, on layoff
- ○ Yes, on vacation, temporary illness, labor dispute, etc.
- ○ No

26a. Has this person been looking for work during the last 4 weeks?
- ○ Yes
- ○ No — *Skip to 27*

b. Could this person have taken a job last week?
- ○ No, already has a job
- ○ No, temporarily ill
- ○ No, other reasons *(in school, etc.)*
- ○ Yes, could have taken a job

27. When did this person last work, even for a few days?
- ○ 1980
- ○ 1979
- ○ 1978
- ○ 1975 to 1977
- ○ 1970 to 1974
- ○ 1969 or earlier
- ○ Never worked

Skip to 31d

28 – 30. Current or most recent job activity

Describe clearly this person's chief job activity or business last week. If this person had more than one job, describe the one at which this person worked the most hours. If this person had no job or business last week, give information for last job or business since 1975.

29. Industry

a. For whom did this person work? *If now on active duty in the Armed Forces, print "AF" and skip to question 31.*

(Name of company, business, organization, or other employer)

b. What kind of business or industry was this?

Describe the activity at location where employed.

(For example: Hospital, newspaper publishing, mail order house, auto engine manufacturing, breakfast cereal manufacturing)

c. Is this mainly — *(Fill one circle)*
- ○ Manufacturing
- ○ Wholesale trade
- ○ Retail trade
- ○ Other — *(agriculture, construction, service, government, etc.)*

29. Occupation

a. What kind of work was this person doing?

(For example: Registered nurse, personnel manager, supervisor of order department, gasoline engine assembler, grinder operator)

b. What were this person's most important activities or duties?

(For example: Patient care, directing hiring policies, supervising order clerks, assembling engines, operating grinding mill)

30. Was this person — *(Fill one circle)*
- ○ Employee of private company, business, or individual, for wages, salary, or commissions
- ○ Federal government employee
- ○ State government employee
- ○ Local government employee *(city, county, etc.)*
- ○ Self-employed in own business, professional practice, or farm —
  - ○ Own business not incorporated
  - ○ Own business incorporated
- ○ Working without pay in family business or farm

CENSUS USE

21b.

22b.

28.

A B C D E F G H J K L M

AF ○ NW ○

29.

N P Q R S T U V W X Y Z

31a. Last year (1979), did this person work, even for a few days, at a paid job or in a business or farm?
- ○ Yes
- ○ No — *Skip to 31d*

b. How many weeks did this person work in 1979?

Count paid vacation, paid sick leave, and military service.

Weeks

c. During the weeks worked in 1979, how many hours did this person usually work each week?

Hours

d. Of the weeks not worked in 1979 (if any), how many weeks was this person looking for work or on layoff from a job?

Weeks

32. Income in 1979 —

Fill circles and print dollar amounts.

If net income was a loss, write "Loss" above the dollar amount.

If exact amount is not known, give best estimate. For income received jointly by household members, see instruction guide.

During 1979 did this person receive any income from the following sources?

If "Yes" to any of the sources below — How much did this person receive for the entire year?

a. Wages, salary, commissions, bonuses, or tips from all jobs . . . *Report amount before deductions for taxes, bonds, dues, or other items.*
- ○ Yes → $ .00 *(Annual amount – Dollars)*
- ○ No

b. Own nonfarm business, partnership, or professional practice . . . *Report net income after business expenses.*
- ○ Yes → $ .00 *(Annual amount – Dollars)*
- ○ No

c. Own farm. . . *Report net income after operating expenses. Include earnings as a tenant farmer or sharecropper.*
- ○ Yes → $ .00 *(Annual amount – Dollars)*
- ○ No

d. Interest, dividends, royalties, or net rental income . . . *Report even small amounts credited to an account.*
- ○ Yes → $ .00 *(Annual amount – Dollars)*
- ○ No

e. Social Security or Railroad Retirement . . .
- ○ Yes → $ .00 *(Annual amount – Dollars)*
- ○ No

f. Supplemental Security (SSI), Aid to Families with Dependent Children (AFDC), or other public assistance or public welfare payments . . .
- ○ Yes → $ .00 *(Annual amount – Dollars)*
- ○ No

g. Unemployment compensation, veterans' payments, pensions, alimony or child support, or any other sources of income received regularly . . . *Exclude lump-sum payments such as money from an inheritance or the sale of a home.*
- ○ Yes → $ .00 *(Annual amount – Dollars)*
- ○ No

33. What was this person's total income in 1979?

Add entries in questions 32a through g; subtract any losses.

$ .00 *(Annual amount – Dollars)*

If total amount was a loss, write "Loss" above amount.

OR ○ None

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31b 31c 31d

32a. 32b. 32c. 32d. 32e. 32f. 32g. 33.

➡ *Please turn to the next page and answer the questions for Person 2 on page 2*

APPENDIX D: EQUATION FORMS AND STATISTICAL RESULTS

RESULTS OF REGRESSION ANALYSIS ON BORDER COUNTY DATA SET

N Obs	Variable	N	Minimum	Maximum	Mean	Std Dev
4551	JANCNS	4400	0.1204908	64.4431081	16.2397737	9.7013520
	JANWAT	3954	2.1625100	29.8633600	11.4222986	4.8868836
	JANAVEP	4400	0.1357998	21.9748826	0.6025175	0.5057132
	JULCNS	4400	0.2831544	153.3094386	35.1026949	23.7236622
	JULWAT	3954	2.3819000	58.0979000	20.9138868	9.8783307
	JULAVEP	4400	0.1284209	9.5787352	0.5040557	0.2746395
	QUANT	4400	2.2242636	1184.73	284.3483312	182.5988003
	WTAVE	4400	0.1895907	14.4235806	0.5453798	0.3607134
	YCWATER	4551	45.0000000	492.0000000	196.1819380	80.7139289
	NEWHV	4551	5000.00	175000.00	37977.64	25318.69
	HINCOME	4551	75.0000000	75000.00	20964.85	15017.54
	NPERSONS	4551	1.0000000	18.0000000	3.5664689	1.9653953
	INCRATIO	4551	0.000933333	2.4000000	0.0212791	0.0692666
	LNEWHV	4551	8.5171932	12.0725413	10.3178148	0.7286448
	LHINC	4551	4.3174881	11.2252434	9.6534062	0.8716182
	LWTAVE	4400	-1.6628876	2.6688644	-0.7065240	0.4096545
	LNP	4551	0	2.8903718	1.1173373	0.5739506

Correlation

CORR	HINCOME	NEWHV	WTAVE	NPERSONS	MCALLEN
HINCOME	1.0000	0.6584	-0.0879	0.0933	0.0303
NEWHV	0.6584	1.0000	-0.1077	-0.1035	0.0370
WTAVE	-0.0879	-0.1077	1.0000	-0.0157	0.3242
NPERSONS	0.0933	-0.1035	-0.0157	1.0000	0.0673
MCALLEN	0.0303	0.0370	0.3242	0.0673	1.0000
ZAVALA	-0.0671	-0.0777	0.0850	0.0067	-0.0885
HIDALGO	-0.0770	-0.0998	0.1847	0.0887	-0.0541
PECOS	-0.0313	-0.1328	0.0290	-0.0879	-0.1049
FRIO	-0.0583	-0.0512	-0.0013	-0.0819	-0.0809
ELPASO	0.0909	0.2179	-0.3268	-0.0049	-0.2165
CAMERON	0.0045	-0.0060	0.2687	0.0408	-0.1074
DUVAL	0.0135	-0.0538	-0.1610	-0.0475	-0.1274
QUANT	0.1765	0.2285	-0.4354	0.1048	-0.2193
LHINC	0.8588	0.5645	-0.0956	0.1699	0.0224
LNEWHV	0.5985	0.8746	-0.1340	-0.1045	0.0376
LWTAVE	-0.0970	-0.1365	0.8241	0.0121	0.4628
LNP	0.1640	-0.0370	-0.0351	0.9407	0.0684
LQUANT	0.1733	0.2143	-0.6567	0.0957	-0.2365

CORR	ZAVALA	HIDALGO	PECOS	FRIO	ELPASO
HINCOME	-0.0671	-0.0770	-0.0313	-0.0583	0.0909
NEWHV	-0.0777	-0.0998	-0.1328	-0.0512	0.2179
WTAVE	0.0850	0.1847	0.0290	-0.0013	-0.3268
NPERSONS	0.0067	0.0887	-0.0879	-0.0819	-0.0049
MCALLEN	-0.0885	-0.0541	-0.1049	-0.0809	-0.2165
ZAVALA	1.0000	-0.0490	-0.0952	-0.0734	-0.1964
HIDALGO	-0.0490	1.0000	-0.0581	-0.0449	-0.1200
PECOS	-0.0952	-0.0581	1.0000	-0.0871	-0.2328
FRIO	-0.0734	-0.0449	-0.0871	1.0000	-0.1797
ELPASO	-0.1964	-0.1200	-0.2328	-0.1797	1.0000
CAMERON	-0.0974	-0.0595	-0.1155	-0.0891	-0.2383
DUVAL	-0.1156	-0.0706	-0.1370	-0.1058	-0.2828
QUANT	-0.0865	-0.1316	0.0027	-0.0545	0.5643
LHINC	-0.0662	-0.0878	-0.0240	-0.0549	0.1171
LNEWHV	-0.0892	-0.1150	-0.1489	-0.0555	0.2963
LWTAVE	0.1794	0.2620	0.1212	-0.1457	-0.4627
LNP	-0.0089	0.0680	-0.0868	-0.0841	0.0157
LQUANT	-0.0997	-0.1426	0.0316	-0.0682	0.5554

Correlation

CORR	CAMERON	DUVAL	QUANT	LHINC	LNEWHV
HINCOME	0.0045	0.0135	0.1765	0.8588	0.5985
NEWHV	-0.0060	-0.0538	0.2285	0.5645	0.8746
WTAVE	0.2687	-0.1610	-0.4354	-0.0956	-0.1340
NPERSONS	0.0408	-0.0475	0.1048	0.1699	-0.1045
MCALLEN	-0.1074	-0.1274	-0.2193	0.0224	0.0376
ZAVALA	-0.0974	-0.1156	-0.0865	-0.0662	-0.0892
HIDALGO	-0.0595	-0.0706	-0.1316	-0.0878	-0.1150
PECOS	-0.1155	-0.1370	0.0027	-0.0240	-0.1489
FRIO	-0.0891	-0.1058	-0.0545	-0.0549	-0.0555
ELPASO	-0.2383	-0.2828	0.5643	0.1171	0.2963
CAMERON	1.0000	-0.1403	-0.2585	0.0069	-0.0268
DUVAL	-0.1403	1.0000	-0.1214	-0.0030	-0.0903
QUANT	-0.2585	-0.1214	1.0000	0.1745	0.2532
LHINC	0.0069	-0.0030	0.1745	1.0000	0.5908
LNEWHV	-0.0268	-0.0903	0.2532	0.5908	1.0000
LWTAVE	0.3210	-0.2047	-0.5808	-0.1026	-0.1638
LNP	0.0348	-0.0437	0.1229	0.2586	-0.0340
LQUANT	-0.3305	-0.0599	0.9022	0.1803	0.2501

CORR	LWTAVE	LNP	LQUANT
HINCOME	-0.0970	0.1640	0.1733
NEWHV	-0.1365	-0.0370	0.2143
WTAVE	0.8241	-0.0351	-0.6567
NPERSONS	0.0121	0.9407	0.0957
MCALLEN	0.4628	0.0684	-0.2365
ZAVALA	0.1794	-0.0089	-0.0997
HIDALGO	0.2620	0.0680	-0.1426
PECOS	0.1212	-0.0868	0.0316
FRIO	-0.1457	-0.0841	-0.0682
ELPASO	-0.4627	0.0157	0.5554
CAMERON	0.3210	0.0348	-0.3305
DUVAL	-0.2047	-0.0437	-0.0599
QUANT	-0.5808	0.1229	0.9022
LHINC	-0.1026	0.2586	0.1803
LNEWHV	-0.1638	-0.0340	0.2501
LWTAVE	1.0000	-0.0075	-0.7567
LNP	-0.0075	1.0000	0.1163
LQUANT	-0.7567	0.1163	1.0000

Model: LINEAR
Dependent Variable: QUANT

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	12	65237308.153	5436442.3461	292.866	0.0000
Error	4387	81435565.710	18562.92813		
C Total	4399	146672873.86			

Root MSE	136.24584	R-square	0.4448
Dep Mean	284.34833	Adj R-sq	0.4433
C.V.	47.91512		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|
INTERCEP	1	183.561328	10.13926266	18.104	0.0001
HINCOME	1	0.000417	0.00018775	2.220	0.0265
NEWHV	1	0.000818	0.00011429	7.155	0.0001
WTAVE	1	-118.981459	6.87332902	-17.311	0.0001
NPERSONS	1	12.751330	1.09949908	11.597	0.0001
MCALLEN	1	-11.706411	10.95995152	-1.068	0.2855
ZAVALA	1	44.195416	10.94746666	4.037	0.0001
HIDALGO	1	-10.656558	14.80536917	-0.720	0.4717
PECOS	1	101.022764	10.25696933	9.849	0.0001
FRIO	1	55.282276	11.36608588	4.864	0.0001
ELPASO	1	201.653344	8.58215073	23.497	0.0001
CAMERON	1	-25.996588	10.40311851	-2.499	0.0125
DUVAL	1	14.661849	9.51041138	1.542	0.1232

Model: LOG/LOG
Dependent Variable: LQUANT

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	12	1735.21932	144.60161	1131.188	0.0000
Error	4387	560.79756	0.12783		
C Total	4399	2296.01688			

Root MSE	0.35754	R-square	0.7558
Dep Mean	5.42582	Adj R-sq	0.7551
C.V.	6.58953		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|
INTERCEP	1	2.860861	0.08509712	33.619	0.0001
LHINC	1	0.004126	0.00823717	0.501	0.6164
LNEWHV	1	0.075635	0.00997691	7.581	0.0001
LWTAVE	1	-1.627013	0.02136490	-76.154	0.0000
LNP	1	0.115564	0.01026907	11.254	0.0001
MCALLEN	1	0.885500	0.03229412	27.420	0.0001
ZAVALA	1	0.654829	0.02998390	21.839	0.0001
HIDALGO	1	0.892786	0.04150351	21.511	0.0001
PECOS	1	0.817135	0.02771595	29.482	0.0001
FRIO	1	-0.063966	0.02975134	-2.150	0.0316
ELPASO	1	0.574516	0.02268184	25.329	0.0001
CAMERON	1	0.391712	0.02903987	13.489	0.0001
DUVAL	1	0.045486	0.02497899	1.821	0.0687

Model: LOG/LINEAR
Dependent Variable: LQUANT

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	12	1405.49354	117.12446	576.992	0.0000
Error	4387	890.52333	0.20299		
C Total	4399	2296.01688			

Root MSE	0.45055	R-square	0.6121
Dep Mean	5.42582	Adj R-sq	0.6111
C.V.	8.30374		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|
INTERCEP	1	5.409719	0.03352911	161.344	0.0000
HINCOME	1	0.000001611	0.00000062	2.595	0.0095
NEWHV	1	0.000002488	0.00000038	6.584	0.0001
NPERSONS	1	0.041953	0.00363589	11.539	0.0001
WTAVE	1	-1.016946	0.02272913	-44.742	0.0000
MCALLEN	1	0.099058	0.03624301	2.733	0.0063
ZAVALA	1	0.170061	0.03620172	4.698	0.0001
HIDALGO	1	0.094005	0.04895926	1.920	0.0549
PECOS	1	0.441562	0.03391834	13.018	0.0001
FRIO	1	0.145021	0.03758604	3.858	0.0001
ELPASO	1	0.676245	0.02837996	23.828	0.0001
CAMERON	1	-0.123942	0.03440164	-3.603	0.0003
DUVAL	1	0.059331	0.03144958	1.887	0.0593

Model: MODIFIED LOG/LOG
Dependent Variable: LQUANT

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	12	1398.52559	116.54380	569.674	0.0000
Error	4387	897.49129	0.20458		
C Total	4399	2296.01688			

Root MSE	0.45230	R-square	0.6091
Dep Mean	5.42582	Adj R-sq	0.6080
C.V.	8.33617		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|
INTERCEP	1	4.537816	0.10832947	41.889	0.0000
LHINC	1	0.011122	0.01041945	1.067	0.2858
LNEWHV	1	0.086822	0.01262161	6.879	0.0001
WTAVE	1	-1.015991	0.02284451	-44.474	0.0000
LNP	1	0.138794	0.01298148	10.692	0.0001
MCALLEN	1	0.091892	0.03643949	2.522	0.0117
ZAVALA	1	0.165093	0.03634375	4.543	0.0001
HIDALGO	1	0.096146	0.04913476	1.957	0.0504
PECOS	1	0.433587	0.03408351	12.721	0.0001
FRIO	1	0.133975	0.03771921	3.552	0.0004
ELPASO	1	0.659593	0.02864298	23.028	0.0001
CAMERON	1	-0.127082	0.03456828	-3.676	0.0002
DUVAL	1	0.056426	0.03159884	1.786	0.0742

---------- COUNTYGR=Duval ----------

N Obs	Variable	N	Minimum	Maximum	Mean	Std Dev
628	WTAVE	628	0.3582593	0.5227767	0.4030785	0.0342112
	NPERSONS	628	1.0000000	14.0000000	3.3535032	1.8403255
	HINCOME	628	320.0000000	75000.00	21398.88	15866.76
	NEWHV	628	5000.00	175000.00	34349.12	25889.03
	YCWATER	628	84.0000000	480.0000000	217.7659236	89.7220997
	QUANT	628	64.4634627	554.6169730	230.0337582	111.0545508

---------- COUNTYGR=Urban Hidalgo ----------

N Obs	Variable	N	Minimum	Maximum	Mean	Std Dev
391	WTAVE	391	0.6649240	1.3922364	0.9198072	0.1688946
	NPERSONS	391	1.0000000	13.0000000	4.0076726	2.0562456
	HINCOME	391	530.0000000	75000.00	22363.54	16663.32
	NEWHV	391	5000.00	175000.00	40709.72	28392.42
	YCWATER	391	134.0000000	480.0000000	226.9514066	69.3365275
	QUANT	391	34.5337787	516.7842841	156.1294804	92.9347045

---------- COUNTYGR=Rural Hidalgo ----------

N Obs	Variable	N	Minimum	Maximum	Mean	Std Dev
128	WTAVE	128	0.6791416	1.2911388	0.9303016	0.1602426
	NPERSONS	128	1.0000000	14.0000000	4.5937500	2.7073464
	HINCOME	128	135.0000000	75000.00	14205.78	13703.14
	NEWHV	128	5000.00	112500.00	23037.11	17126.70
	YCWATER	128	140.0000000	420.0000000	219.1171875	60.6850163
	QUANT	128	41.8847950	423.2483658	145.5519704	80.3193827

---------- COUNTYGR=Cameron ----------

N Obs	Variable	N	Minimum	Maximum	Mean	Std Dev
465	WTAVE	465	0.4491254	14.4235806	0.8273027	0.8124907
	NPERSONS	465	1.0000000	11.0000000	3.8172043	2.0954910
	HINCOME	465	135.0000000	75000.00	21100.82	15619.49
	NEWHV	465	5000.00	175000.00	37258.06	28281.69
	YCWATER	465	53.0000000	450.0000000	178.9161290	78.0399948
	QUANT	465	2.2242636	592.4921492	147.0679769	98.9248112

VARIABLE MEANS BY COUNTY GROUP

COUNTYGR=Pecos

N Obs	Variable	N	Minimum	Maximum	Mean	Std Dev
446	WTAVE	446	0.4768691	0.9731268	0.5765134	0.0760536
	NPERSONS	446	1.0000000	11.0000000	3.0672646	1.6462296
	HINCOME	446	305.0000000	75000.00	19499.85	13194.51
	NEWHV	446	5000.00	95000.00	27642.94	18388.67
	YCWATER	446	85.0000000	485.0000000	190.6928251	75.8107478
	QUANT	446	50.3531305	941.5413309	285.8336270	168.9041097

COUNTYGR=El Paso

N Obs	Variable	N	Minimum	Maximum	Mean	Std Dev
1579	WTAVE	1428	0.3717219	0.3794739	0.3753368	0.0017468
	NPERSONS	1579	1.0000000	13.0000000	3.5224826	1.8194750
	HINCOME	1579	75.0000000	75000.00	22868.34	14399.85
	NEWHV	1579	5000.00	175000.00	45730.68	23543.26
	YCWATER	1579	60.0000000	492.0000000	196.5953135	74.2039050
	QUANT	1428	217.9850766	1184.73	432.9727260	170.7032353

COUNTYGR=Zavala

N Obs	Variable	N	Minimum	Maximum	Mean	Std Dev
327	WTAVE	327	0.4006186	1.3005967	0.6536381	0.1445155
	NPERSONS	327	1.0000000	18.0000000	3.6299694	2.2743072
	HINCOME	327	255.0000000	75000.00	17336.02	13800.61
	NEWHV	327	5000.00	175000.00	30726.30	22404.54
	YCWATER	327	45.0000000	480.0000000	147.6850153	71.7989387
	QUANT	327	20.7596552	1153.19	228.6248678	176.8339718

COUNTYGR=Webb

N Obs	Variable	N	Minimum	Maximum	Mean	Std Dev
310	WTAVE	310	0.3582593	0.5227767	0.4054481	0.0360994
	NPERSONS	310	1.0000000	12.0000000	4.0580645	2.1078946
	HINCOME	310	145.0000000	75000.00	20227.27	16807.06
	NEWHV	310	5000.00	175000.00	36895.16	27632.75
	YCWATER	310	84.0000000	480.0000000	214.2387097	91.6427624
	QUANT	310	64.4634627	554.6169730	225.6679090	113.4318730

---------- COUNTYGR=Duval ----------

N Obs	Variable	N	Minimum	Maximum	Mean	Std Dev
628	WTAVE	628	0.3582593	0.5227767	0.4030785	0.0342112
	NPERSONS	628	1.0000000	14.0000000	3.3535032	1.8403255
	HINCOME	628	320.0000000	75000.00	21398.88	15866.76
	NEWHV	628	5000.00	175000.00	34349.12	25889.03
	YCWATER	628	84.0000000	480.0000000	217.7659236	89.7220997
	QUANT	628	64.4634627	554.6169730	230.0337582	111.0545508

---------- COUNTYGR=Urban Hidalgo ----------

N Obs	Variable	N	Minimum	Maximum	Mean	Std Dev
391	WTAVE	391	0.6649240	1.3922364	0.9198072	0.1688946
	NPERSONS	391	1.0000000	13.0000000	4.0076726	2.0562456
	HINCOME	391	530.0000000	75000.00	22363.54	16663.32
	NEWHV	391	5000.00	175000.00	40709.72	28392.42
	YCWATER	391	134.0000000	480.0000000	226.9514066	69.3365275
	QUANT	391	34.5337787	516.7842841	156.1294804	92.9347045

---------- COUNTYGR=Rural Hidalgo ----------

N Obs	Variable	N	Minimum	Maximum	Mean	Std Dev
128	WTAVE	128	0.6791416	1.2911388	0.9303016	0.1602426
	NPERSONS	128	1.0000000	14.0000000	4.5937500	2.7073464
	HINCOME	128	135.0000000	75000.00	14205.78	13703.14
	NEWHV	128	5000.00	112500.00	23037.11	17126.70
	YCWATER	128	140.0000000	420.0000000	219.1171875	60.6850163
	QUANT	128	41.8847950	423.2483658	145.5519704	80.3193827

---------- COUNTYGR=Cameron ----------

N Obs	Variable	N	Minimum	Maximum	Mean	Std Dev
465	WTAVE	465	0.4491254	14.4235806	0.8273027	0.8124907
	NPERSONS	465	1.0000000	11.0000000	3.8172043	2.0954910
	HINCOME	465	135.0000000	75000.00	21100.82	15619.49
	NEWHV	465	5000.00	175000.00	37258.06	28281.69
	YCWATER	465	53.0000000	450.0000000	178.9161290	78.0399948
	QUANT	465	2.2242636	592.4921492	147.0679769	98.9248112