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Social and Economic Impacts of Water Transfers

A Case Study of the Edwards Aquifer

Water Policy

FINAL REPORT

Social and Economic Impacts of Water Transfers
A Case Study of the Edwards Aquifer

Prepared For

Medina County Groundwater Conservation District
1613 Avenue K, Suite 105
Hondo, Texas
(210) 741-3162

Prepared By

BBC Research & Consulting
3773 Cherry Creek North Drive, Suite 701
Denver, Colorado 80209
(303) 321-2547

G.E. Rothe Company
P.O. Box 688
Hondo, Texas 78861
(210) 426-5696

R.L. Masters Environmental Consulting
435 Isom Road, Suite 226
San Antonio, Texas 78269-0767
(210) 340-0343

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TABLE OF CONTENTS

TABLE OF CONTENTS

(Continued)

PART B. Impacts of Water Transfers in the Edwards Aquifer

TABLE OF CONTENTS

(Continued)

Executive Summary

How transfers of water impact local communities is a topic of growing interest in the western United States. This study develops a framework for analyzing such effects, and presents a case study of the social and economic impacts of potential water transfers in the Edwards Aquifer area of Texas.

BBC Research & Consulting (BBC), in association with G.E. Rothe Company, Inc. and R.L. Masters Environmental Consulting, performed this study. This study team commenced the study in November 1995 and completed it in July 1996.

This study was conducted for the Medina County Groundwater Conservation District (District). The District received partial funding for this study from the Texas Water Development Board (TWDB).

Study Approach

This research was conducted (and is presented) in two phases. In the first phase, the study team developed a general approach to identifying and quantifying social and economic impacts of transferring irrigation water to other uses. The second phase was a case study of the possible impacts of a potential water transfer of water supplies from Edwards irrigators in Medina and Uvalde Counties.

To develop the impact framework, and then apply the framework to estimate impacts of potential water transfers in the Edwards Aquifer, the study team:

- reviewed the literature on socioeconomic impacts of water transfers;
- researched impacts in other regions that have experienced water transfers;
- met with District and TWDB officials, Texas A&M University researchers, and others to gain their insights into assessing impacts of transfers and defining potential transfer scenarios for the Edwards Aquifer;
- compiled and critiqued existing social and economic impact models;
- developed a social and economic impact assessment framework;

- collected secondary economic, demographic, water use and other data for the area of origin for Edwards Aquifer transfers (Medina and Uvalde Counties); and

- collected information from farmers, business persons, government officials and others within the area of origin.

While study approach and preliminary findings were reviewed with the District and the TWDB at key junctures in our research, the findings and conclusions contained in this report are those of the study team.

Limitations

Certain limitations apply to the assessment of impacts of Edwards Aquifer transfers. By necessity, the study team had to make selections as to the type, structure, timing and magnitude of potential water transfers to be studied. Assumptions were made concerning applicable regulations governing future water use and water transfers. The study team made these decisions in consultation with the District and the TWDB.

There are several types of impacts that might be important in examining other proposed water transfers that are not a focus for this study. Transfers of water from Edwards irrigation to other uses could substantially benefit municipal and industrial water users or those affected by spring flows. Economic benefits to water users and avoided impacts for deferred water development projects are important considerations, but, as discussed in the body of the report, they are outside the scope of this study.

Key Assumptions Concerning Transfers of Edwards Supplies

In many applications of the water transfers impact framework, the researcher would know the timing, amount of water, origin and destination, price and means of conveyance related to a specific proposed transfer. However, potential water transfers from agricultural users of Edwards Aquifer groundwater to other uses are still very general in nature. Proposals are not specific as to location, amount of acreage, amount of water or timing. The price that would be paid for these supplies is not known. The legal framework for accomplishing such transfers is not necessarily in place. Currently, groundwater users in Texas may use amounts of water necessary for crop production but do not have quantified water rights. In sum, little is clearly established and much is uncertain about potential transfers of Edwards Aquifer supplies.

Nevertheless, the Medina County Groundwater Conservation District seeks information about what the impacts might be from possible transfers. To identify the range and magnitude of potential impacts, we made a number of assumptions concerning potential transfers:

- Medina and Uvalde Counties comprise the study area for this research.

- Only the water supplies, not the land, would be transferred under the scenarios assumed for this study.

- Groundwater pumping for domestic use, landscaping, small gardens, and livestock would still be permissible after transferring the irrigation supplies.

- Restrictions on groundwater use would be maintained with any future sales of the property. Restrictions would also pertain to any leases of the previously irrigated land.

- Water transfers might pertain to any irrigated agriculture using Edwards wells. While there are differences in hydrologeologic conditions between areas that could be important, this analysis makes no differentiation based on location of the Edwards Aquifer irrigation wells in Medina and Uvalde Counties.

- Irrigation based upon sources other than Edwards wells, such as Carrizo Sands wells, Leona wells and Medina Lake supplies, would not be affected.

- Conveyance facilities would not be constructed. We assumed that irrigation would be retired, pumping for that acreage would cease, and the water previously used would remain in the aquifer to be withdrawn elsewhere for other purposes or left in the aquifer to maintain spring flows and downstream flows.

- The impacts were examined based upon the assumption that the transfers would occur at the present time. Therefore, the impact analysis compares present baseline conditions with conditions as they would be at the present time if transfers occurred.[1] However, we also assume that there would be considerable advanced notice of any transfers so that farmers would not have irrigation cut off mid-season. Impacts would be greater if no advanced notice were given.

- Up to 100 percent of the Edwards irrigation supplies could be transferred. We also examined scenarios in which one-half of the supplies would be transferred.

- Because irrigators might be compensated for transferred supplies based upon the incremental value of irrigated land over nonirrigated crop land, we assumed that $1,000 per acre would be the price paid to each farmer to no longer irrigate (each farmer would still retain title to the land and could dryland farm). The study team also examined impacts that would occur if farmers received no compensation for the irrigation supplies.

Potential Impacts Examined in the Study

The analytical methods used in the impact assessment depend in part on the types of social and economic impacts to be studied. Both direct and secondary effects and impacts were identified and are the focus of our impact assessment for transfers of water supplies from Edwards irrigators in Medina and Uvalde Counties.

Direct Effects of Water Transfers

This step of the impact analysis considers the direct effects on Edwards irrigators under the water transfer scenarios.

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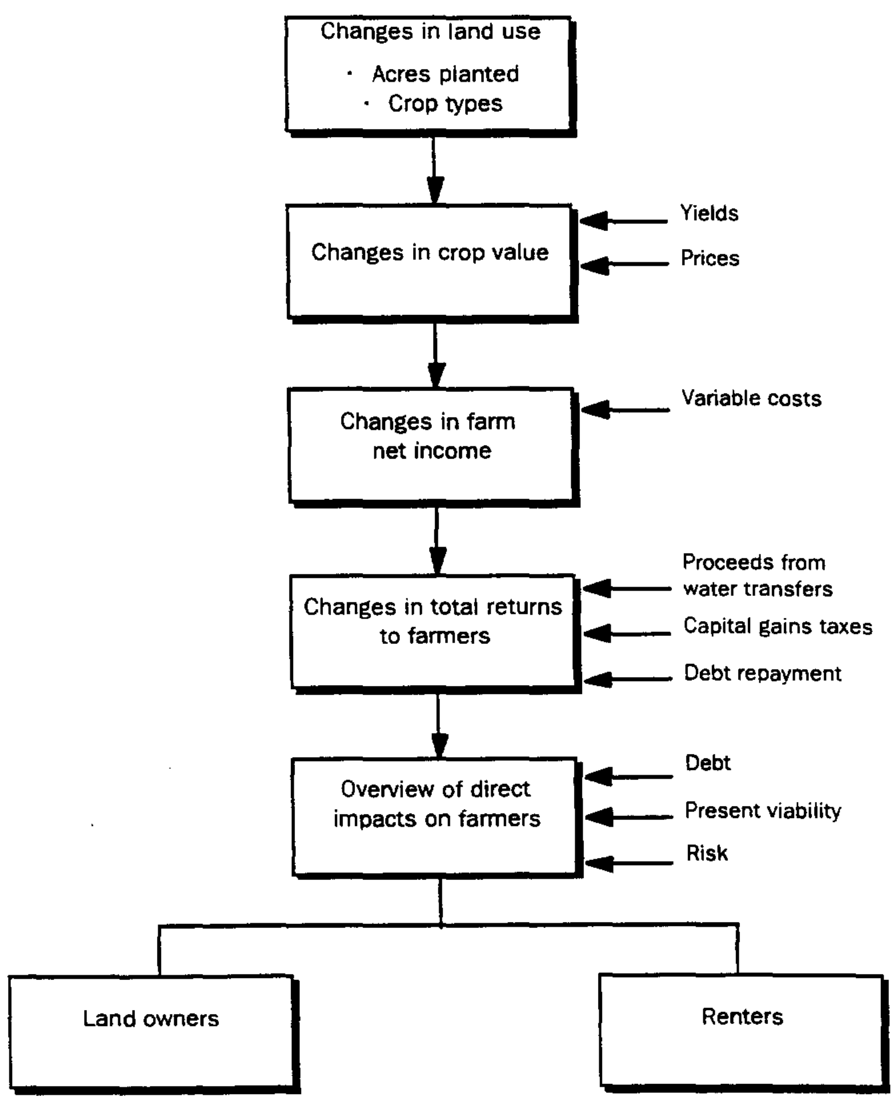
[1] In order to examine the impacts of water transfers, one must first understand the economic and demographic characteristics of the study area without the transfers. In impact analysis, these conditions are referred to as "baseline."

Exhibit ES-1 outlines the framework applied in examining direct impacts of the water transfers on Medina and Uvalde County farmers. As shown, we began by projecting changes in land use. Changes in the total number of planted acres and changes in the number of irrigated and dryland acres by crop type were estimated. Combining these projections with estimates of average yields and prices, the study team then estimated changes in gross crop values in the two counties. Changes in farm net income before fixed costs were projected based upon gross crop value less our estimates of variable costs. This produced estimates of farm operating income. Analysis of changes in total returns to farmers included income earned from the proceeds of the water sales. Tax effects were also examined.

EXHIBIT ES-1.
Overview of Analysis of Direct Impacts on Farmers



Source: BBC Research & Consulting

Changes in land use. Based upon analysis of the local agricultural economy and discussions with farmers, the study team projects that most crop land removed from irrigation would be converted to dryland farming. Assuming all of the Edwards irrigation in Medina and Uvalde Counties were transferred, it is estimated that 75,350 out of a total of 91,000 irrigated acres in the two counties would shift to dryland farming.

The crop distribution on acres converted from irrigation to dryland farming was assumed to mirror the present dryland crop distribution in each county. Based upon this assumption, the amount of study area acreage in dryland sorghum, wheat, oats, and hay and pasture would substantially increase under any of the transfer scenarios. Corn for food and vegetables would be largely eliminated except for the approximately 16,000 acres irrigated from Medina Lake and Carrizo and Leona wells.

Changes in crop value. Transfers of irrigation supplies would reduce the total value of crop production in the study area because dryland farming is lower yield and a greater proportion of the crop acres would be in lower value crops. Total annual study area crop output would decline from $52 million to $30 million if Edwards supplies were transferred.

Changes in farm net income. Annual net income from crops to irrigators and dryland farmers in Medina and Uvalde Counties combined, before fixed costs, is estimated to be $15 million under baseline conditions. If all Edwards irrigation supplies were transferred, annual net farm income before fixed costs would be $7 million per year, $8 million lower than under baseline conditions.

Changes in total returns to farmers. If farmers were compensated for transferring their irrigation supplies, the economic impact on these farmers would be much less dramatic than might be suggested by the changes in farm net income described immediately above.

Impacts on land owners under the "with compensation" scenarios. Under the transfer scenarios in which owners of irrigated land would receive compensation, sale of irrigation supplies would be voluntary and only take place if a land owner found it in his or her best interest to forego irrigation in exchange for the one-time cash payment of $1,000 per acre. By definition, all selling land owners would benefit. Those that would not benefit at the offered price would not sell.

Impacts on land owners under the "no compensation" scenarios. Farmers' circumstances would be substantially different if they were not compensated for transfer of irrigation supplies. Annual net income to Edwards irrigators would decline by $8 million per year if all supplies were transferred. An owner of 1,000 acres irrigated by Edwards wells would face a loss of land value of about $500 per acre, or $500,000. Farmers with substantial debt might not be able to maintain profitable operations and would need to restructure the debt, sell the farm or go bankrupt. For many, the remaining value of the land would be less than the outstanding mortgages on the land. Farmers with less outstanding debt might still be affected by reluctance of lenders to provide new loans. Because of the high variability of income in dryland farming, even financially secure farmers might go bankrupt during multi-year drought.

While it was not possible to develop precise estimates of the number of farmers that would lose their farms if their irrigation supplies were removed without compensation, a third or more of the present irrigators might be vulnerable to foreclosure. Our analyses suggest that other farmers would purchase the land of farmers that went bankrupt as a result of the water transfers, and they would continue farming the land on a dryland basis, somewhat mitigating the effect on the regional economy. Even so, such a transfer would permanently put many irrigators out of the farming business.

These impact estimates are based upon the assumption that farmers would know in advance that water supplies would be transferred. Impacts on farmers would be more severe if irrigation ceased mid-season.

Impacts on farmers leasing irrigated land. About one-quarter of all harvested crop acres in Uvalde County was leased in 1992 (including both dryland and irrigated acreage). In Medina County, only 13 percent of crop acreage was leased. Farmers leasing land would face potential losses of operating income, but would not receive any compensation for the irrigation supplies. Those unable to locate lands that could be leased (or purchased if the renter had sufficient capital) would no longer be able to farm. Farmers primarily farming leased land would be more severely impacted than farmers owning land under a scenario in which land owners would be compensated.

Secondary Effects of Water Transfers

Transfers of irrigation supplies could have major impacts on Medina and Uvalde County businesses, employees and residents that extend far beyond the farmers involved in the transfers.

How the study team projected secondary effects of the potential transfers. To estimate the potential secondary economic, demographic, fiscal and social impacts of water transfers on the local economy, the study team examined the relationships between crop production and a range of other economic activities in Medina County and Uvalde County. Key components of this research included review of crop budgets; interviews with a variety of businesses with ties to local agricultural activity; and analysis of the quantitative relationships among agriculture, farm related businesses and other economic activities using an input-output model of the local economy.

Economic impacts. Transfer of all of the Edwards Aquifer irrigation supplies from Medina and Uvalde Counties would have major impacts on the local economy, even if farmers were compensated for the transferred irrigation supplies.

Processors and shippers, primarily working with locally grown vegetables and corn for food, are important sources of local employment, particularly in Uvalde County. These businesses add substantially to the value of the crops and they are relatively large employers. Although employment levels vary considerably by season for many of these operations, interviews with processors and shippers indicate that full-time equivalent employment of these operations would encompass more than 700 local jobs. Our interviews with local crop processors and shippers suggested that the viability of most of these operations would be threatened if all the Edwards irrigation supplies were transferred. Due to the added cost of transporting crops to Medina and Uvalde Counties for further shipping and processing, as well as the greatly increased risk of spoilage, most local shippers and processors would relocate or shut down.

Reductions in farming, and impacts on activity of businesses providing farm inputs or processing farming outputs, would have ripple effects throughout the rest of the local economy, including support sectors such as trade and services. This "multiplier effect" was incorporated in the economic model used to develop impact projections. The following summarizes the impacts on Medina and Uvalde Counties if all of the Edwards irrigation supplies were transferred (and irrigators were compensated).

Impacts on output. Economic impacts can be measured in terms of diminished output, or in terms of declines in "value added." While impacts on output measure changes in the total sales of firms within the region, impacts on value added reflect changes in the productivity of the region — the contribution that local manufacturing, processing, marketing and services make to the value of products ultimately sold to consumers. This contribution is reflected in the earnings of local business owners, the wages and salaries of employees, and the taxes paid by local businesses.

Economic output from study area businesses would fall by about $125 million if all of the Edwards irrigation supplies were transferred (including impacts on crop production). This represents about 8 percent of total economic output from businesses in Medina and Uvalde Counties. Regional value added would decline by nearly $50 million per year. Exhibit ES-2 summarizes these results.

Impacts would be widely felt among different sectors of the local economy. Only one-sixth of the impacts would be in the crop production sector. Effects on crop processing and shipping would be much greater. About one-half of the reduction in economic activity would be in support sectors such as trade and services. Retail sales in the two counties might fall 6 percent as a result of the transfers.

EXHIBIT ES-2.
Potential Impacts of Water Transfers on Output and Value Added in Medina and Uvalde Counties*

Sector	Output/Sales ($ millions)	Value Added** ($ millions)	Projected Job Loss
Crop production	$22.0	$12.2	310
Crop processing/shipping	44.0	14.5	530
Other businesses	56.6	20.9	680
Total	$122.6	$47.6	1,520

* Assumes farmers are compensated for transferred irrigation supplies.
** Value added includes employee compensation, ownership earnings and business taxes.
Source: BBC Research & Consulting.

Impacts on employment. If all of the irrigation supplies were transferred, over 1,500 jobs would be lost in Medina and Uvalde Counties, about 7 percent of total jobs located in these two counties. Over one-fifth of the local manufacturing jobs would be lost, primarily due to closure of major food processors. About 13 percent of local agricultural jobs would be lost. The number of jobs in wholesale and retail trade would be reduced by 11 percent. Impacts on Medina and Uvalde County jobs are summarized in Exhibit ES-3.

EXHIBIT ES-3.
Potential Impacts of Water Transfers on Employment in Medina and Uvalde Counties*

Sector	Projected Job Loss	Percent of 1993 Jobs in Sector
Agriculture, forestry and fisheries	450	12.7%
Mining	0	0.0
Construction	30	1.7
Manufacturing	320	21.3
Transportation, communications, public utilities	30	4.1
Trade	470	11.1
Finance, insurance, real estate	30	3.6
Services	190	4.3
Government	0	0.0
Total	1,520	7.0%

* Assumes 100 percent transfer of Edwards irrigation supplies and compensation to farmers.
Source: BBC Research & Consulting.

Demographic impacts. In 1994 there were about 55,000 residents in the combined Medina County/Uvalde County study area. Based upon the estimates of job losses noted above, the combined population of Medina and Uvalde Counties could be reduced by up to 3,800 people (about 1,300 households) if all of the Edwards irrigation were transferred.

Fiscal impacts on local governments. Because of the funding mechanisms of local governmental units, fiscal impacts on the counties, municipalities and school districts would be less severe than impacts on the overall local economy:

- Combined, Medina and Uvalde Counties might lose about $150,000 to $300,000 per year in property and sales tax revenues as a result of the water transfers. Tax rates might need to increase by 2 to 4 percent to recover these lost revenues.
- The potential 6 percent decrease in study area retail sales could have a greater relative impact on local municipalities than on the counties.
- The Texas school district funding equalization system would offset fiscal impacts on local school districts.
- The study team's assessment of impacts on the local power cooperative suggests that impacts on rate payers would be minimal.

Social impacts. While the projected economic impacts would be felt throughout the local economy, the impacts would not fall evenly on all segments of the population.

Farm owners and operators. As discussed previously in this Executive Summary, water transfers would create some dislocation of farm owners and operators, even if irrigators were compensated for the transfers. Because of the differences between irrigation and dryland crop operations — particularly the lower yields, different crop types and high risks of dryland farming — not every former irrigator would want to continue in crop production. Because many irrigators in these two counties are older, water transfers might hasten farmers' retirement. Some local farm owners work off the farm, and sale of irrigation supplies might have little effect on their lifestyles. Farmers that primarily lease irrigated land would need to convert to dryland farming, find new employment, or relocate their operations outside the counties.

Even with certain dislocations among former irrigators, the economics of farming in the area suggest that most formerly irrigated land would convert to dryland production in the long-run. It might be that different farmers would be working the land, however.

Farm workers and employees in directly related occupations. Assuming irrigators were compensated for the transfers, impacts would fall hardest on farm workers and employees in directly related occupations. More than one-third of the jobs on crop farms would be eliminated. Most of the lost jobs would be held by Hispanics. Many of these potentially displaced workers have little formal education and limited English skills. It might be difficult for these employees to find other jobs in the area. San Antonio jobs might be difficult to obtain as well, and the long commuting distance limits this option for Uvalde County residents.

Impacts on the livestock industry. Because formerly irrigated land devoted to food would go into livestock feed, total production of feed would not be substantially impacted if Edwards irrigation supplies were transferred. There should be minimal negative economic impacts on livestock production.

Unemployment, crime, and other social impacts. The job losses projected under the 100 percent transfer scenarios could raise the local unemployment rate to about 14 percent. High unemployment could lead to greater social problems such as crime, substance abuse and greater instability of family structures. These factors could create perceptions of a local community in a state of decline. As other sources of economic growth created new jobs, or families left the area, the unemployment rate would fall back to recent levels (about 6 percent unemployment).

Impacts on religious institutions and community organizations. The social impacts discussed above would place stresses on community support systems including religious institutions, social service organizations, government agencies, and informal support mechanisms including extended families.

Impacts on long-term economic development prospects. Study team assumptions concerning the nature of the water transfers were such that water would still be available for new industrial, commercial and residential development in both counties. However, long-term economic development prospects in Medina County and Uvalde County might be affected by a lasting perception of a community in decline.

Impacts on sense of community. Transfers of Edwards irrigation supplies could well accelerate the rate at which Medina County becomes integrated into the San Antonio economy. This might have both positive and negative effects. Longer commuting times and a greater "San Antonio focus" might make it harder for families to maintain the types of rural lifestyles that many desire. The sense of community might suffer.

While Medina County is well within the commuting shed of San Antonio, to date, Uvalde County has not been well integrated into the San Antonio economy. Uvalde County may be too distant from San Antonio jobs for out-commuting to replace the economic stimulus now provided by irrigated crop farming and related industries. While Medina County could regain the lost jobs resulting from any transfers of irrigation supplies, it would be much more difficult for Uvalde County to rebound from these job losses. Therefore, the long-term social and economic impacts in Uvalde County could be much more pronounced than in Medina County.

Transition impacts. The impacts discussed here represent the long-run effects of water transfers, assuming formerly irrigated lands are successfully converted to dryland farming. Short-term impacts could be greater if a substantial amount of agricultural land goes out of production during the transition from irrigated to nonirrigated crops.

Key Observations Based on Findings

Substantial impacts on the local community would occur even if farmers were compensated for transferring their supplies. This research demonstrates that the local communities would be substantially impacted if all of the Edwards irrigation supplies were transferred:

- study area output would decrease by $123 million,
- over 1,500 jobs would be lost in the two counties, and
- study area population could decrease by up to 3,800 people.

Large impacts on the local economy would occur regardless of whether or not irrigators were compensated for their irrigation supplies. There are little differences in the study team's estimates of community-wide economic, demographic, fiscal and social impacts between the compensated and the uncompensated transfer scenarios. Similarly, paying irrigators $2,000 or more per acre (as opposed to the study's assumed $1,000 per acre compensation) for their irrigation supplies would not substantially lessen the total impacts on the two-county region.

For example, even though transfers without compensation would bankrupt many of the farmers losing the irrigation supplies, local banks could probably weather these losses (federal land banks hold most of the land mortgages; local banks primarily make equipment and operating loans). Shutting down the local crop processing and shipping operations would have an even greater impact on the local economy than bankruptcy of local irrigators.

Impacts on the two-county region would still be substantial if only 50 percent of the water supplies were transferred. This study also shows that impacts on the local communities would still be significant if only 50 percent of the water supplies were transferred. The following compares the impacts if 50 percent of the Edwards irrigation supplies were transferred:

- study area output would decrease by $67 million,
- 900 jobs would be lost in the two counties, and
- population could decrease by up to 2,200 people.

(These impact estimates assume farmers are compensated for their supplies and that vegetables are affected the same as other irrigated crops.)

Impacts would be far less if the highest value crops stayed in production. The study team also examined economic impacts assuming 50 percent of the water supplies were transferred, but that irrigation of vegetables would be unchanged (and irrigators were compensated). This would keep local vegetable processors and shippers in business, a major source of income and employment within the study area. To keep vegetables in production, the transfer scheme would need to allow irrigators the flexibility to shift remaining water supplies or crop production between farms or encourage an active market for leasing remaining irrigated land. Under this scenario:

- study area output would decrease by $23 million,
- over 300 jobs would be lost, and
- study area population could decrease by up to 800 people.

There would still be hardships for those workers displaced from farm work and other local jobs under this 50 percent scenario. Many of the farm workers, and perhaps other displaced workers, might not have the education and skills for new jobs created within the local economy. However, the smaller magnitude of these job losses would make it more likely that displaced workers could find new jobs in the local area. Also, the smaller magnitude would likely be less overwhelming for local support networks that could aid these workers and their families.

Conclusions

The framework for analyzing economic, demographic, fiscal and social impacts presented in the body of the report should provide useful guidance to those examining potential water transfers in Texas. Application of this framework to the Edwards case study shows that impacts from water transfers can extend far beyond the farmers directly involved in a water sale. Farm workers; owners and employees of farm-related businesses; and firms and workers in the local trade, services and other support sectors can be severely affected by water transfers. Local governments and social institutions can be impacted as well.

The quantification of impacts in Medina and Uvalde Counties documents that secondary impacts would exceed the total direct impacts on farmers transferring their supplies. Our research of water transfers in other regions finds that because these impacted workers and businesses are usually not directly involved in a water transaction, they are rarely compensated for these negative impacts. Analysis of transfers in other regions suggests some methods of mitigating these secondary impacts (see Section II), but more might be necessary to avoid damaging local communities.

SECTION I. Introduction

How transfers of water impact local communities is a growing topic of interest in the western United States. Whether the transfers represent physical conveyance of water from one basin to another or simply transfers of surface or groundwater rights within a basin, there may be social and economic impacts on local communities. This study develops a framework for considering such effects, and presents a case study of the social and economic impacts of potential water transfers in the Edwards Aquifer area of Texas.

This research was conducted in two phases. In the first phase, the study team developed a general approach to identifying and quantifying social and economic impacts of transferring irrigation water to other uses. Our objective was to create a framework or system that can be used to examine the impacts of a wide range of potential transfers throughout Texas, now or in the future. Part A describes this framework.

The second phase was a case study of the possible impacts of a potential water transfer. In the future, groundwater currently used in irrigated agriculture in the rural areas west of San Antonio could shift to San Antonio area urban users. The impact framework developed in Phase I was applied in projecting the social and economic impacts of these possible transfers on the area of origin. We present this case study in Part B.

Study Team

BBC Research & Consulting (BBC), in association with G.E. Rothe Company, Inc. and R.L. Masters Environmental Consulting, performed this study. The BBC study team commenced the study in November 1995 and completed it in June 1996.

Study Sponsors

This study was conducted for the Medina County Groundwater Conservation District (District). The District received partial funding for this study from the Texas Water Development Board (TWDB).

Objectives

As noted above, there were two principal objectives of this research.

1. Develop a framework for assessing social and economic impacts of different types of potential water transfers in Texas. The TWDB and others are interested in identifying tools that can be used to assess social and economic impacts of different types of water transfers that might be proposed for various regions throughout Texas. As potential transfers are identified, this impact assessment framework would be available to those wishing to examine any associated social and economic impacts.

2. As a case study, apply this framework to assess the impact of potential water transfers from rural to urban users within the Edwards Aquifer. The Edwards Aquifer is a water source for both irrigators and municipal users. Most of the irrigation use is in Medina and Uvalde Counties west of San Antonio. While no transfers have been specifically proposed, transfer of groundwater use from these rural areas to San Antonio urban users has been an element of several recently prepared regional water plans. This case study is designed to identify the social and economic impacts on local communities that might occur if these transfers took place.

Study Approach

To develop the impact framework, and then apply the framework to estimate impacts of potential water transfers in the Edwards Aquifer, the study team:

- reviewed the literature on socioeconomic impacts of water transfers;
- researched impacts in other regions that have experienced water transfers;
- met with District and TWDB officials, Texas A&M University researchers, and others to gain their insights into assessing impacts of transfers and defining potential transfer scenarios for the Edwards Aquifer;
- compiled and critiqued existing social and economic impact models;
- developed a social and economic impact assessment framework;
- collected secondary economic, demographic, water use and other data for the area of origin for Edwards Aquifer transfers (Medina and Uvalde Counties); and
- collected information from farmers, business persons, government officials and others within the area of origin.

While study approach and preliminary findings were reviewed with the District and the TWDB at key junctures in our research, the findings and conclusions contained in this report are those of the study team.

This study was conducted independently from the TWDB-funded study of the "dry-year option" approach to water transfers in the Edwards Aquifer. However, the BBC study team met with the Texas A&M professors conducting the dry-year option research to review methodology, assumptions and data sources for these two study efforts.

Limitations

The impact framework developed in this study is intended to apply to a broad spectrum of potential water transfers in Texas. However, it is not possible to foresee the unique conditions of every possible transfer, so the framework might not be entirely applicable to every future situation.

Certain limitations also apply to the assessment of impacts of Edwards Aquifer transfers. By necessity, the study team had to make selections as to the type, structure, timing and magnitude of potential water transfers to be studied. Assumptions were made concerning applicable regulations governing future water use and water transfers. The study team made these decisions in consultation with the District and the TWDB.

The impact analysis makes further simplifying assumptions regarding the agricultural economy, responses to transfer opportunities, and local economic linkages. In addition, certain data were imperfect, or in some instances, unavailable. This somewhat limits the specificity and precision of the impact estimates.

PART A.
IMPACT FRAMEWORK

PART A.
Impact Framework

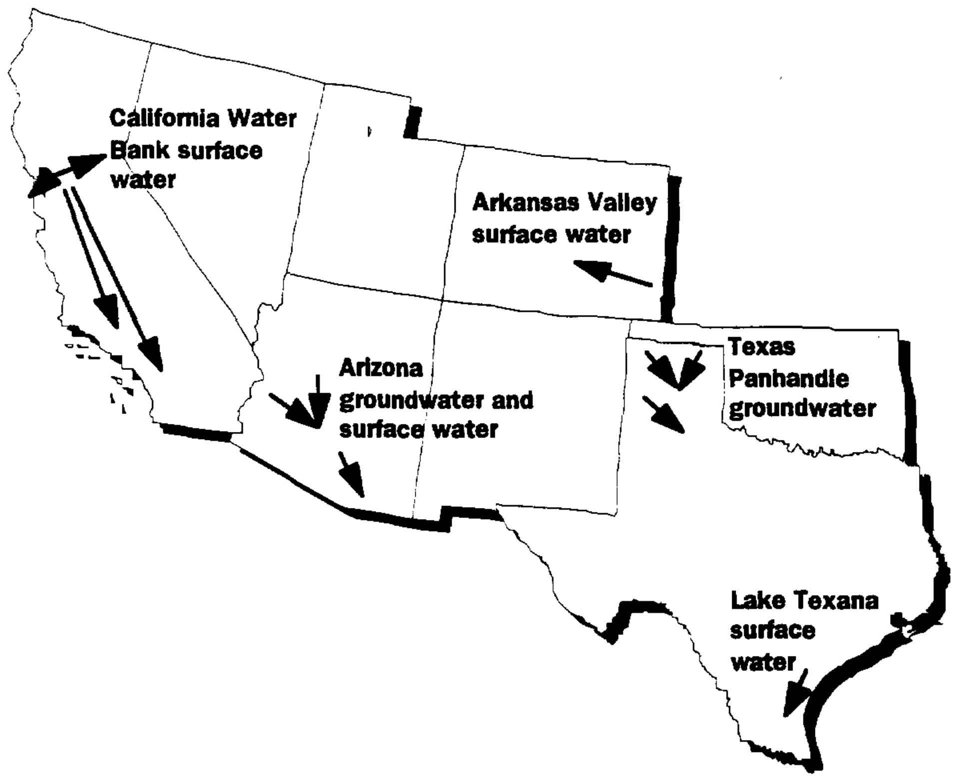
The first phase of this study was to develop the general steps to be followed to assess the social and economic impacts of water transfers that might be proposed in different Texas regions in the future. We begin by reviewing a sample of transfers that have taken place in Texas and other western states in the recent past (Section II). With this background, the study team then outlines the recommended framework for examining socioeconomic impacts of future transfers.

SECTION II.
Past Water Transfers in Texas and Other States

As background to the development of the impact framework, the study team examined a number of past water transfers in Texas and other western states. This review illustrates the varying forms of transfers, types of impacts and key issues to be examined in considering the socioeconomic impacts of any future water transfers in Texas.

Perhaps the best-known interbasin water transfers in the west are the transfers of water across the continental divide to the Colorado Front Range, and from the Sierras and Colorado River to Southern California. However, most of these transfers are now more than 60 years old. Rather than base our impact framework on information from these relatively old transfers, we focused our research on more recent water transfers shown in Exhibit II-1. Three areas of transfers in Texas are examined: Rio Grande Valley Water Marketing, planned surface water transfers to Corpus Christi and groundwater transfers in the Texas Panhandle. The first two sets of transfers illustrate the minimal socioeconomic impacts on areas of origin found when the transferred supplies are surplus water. While the Ogallala Aquifer supplies transferred to Amarillo and Lubbock are not surplus supplies to the region, they are to the selling landowners since most lands involved are marginal for irrigated agriculture.

EXHIBIT II-1.
Examples of Recent Water Transfers



Source: BBC Research and Consulting.

The water transfers examined in other states do involve socioeconomic impacts on areas of origin. In Colorado, Arkansas Valley irrigation company rights have been purchased by Front Range cities. The 1980s saw an active market for water transfers in Arizona. Finally, the California drought in the early 1990s precipitated a large volume of water transfers on a temporary basis. We review each of these examples in turn.

Lake Texana and Colorado River Water

The City of Corpus Christi, Texas is developing a program to make substantial interbasin transfers of surface water supplies to meet the future water supply needs in its service area. The City has executed agreements to buy water from Lake Texana on the Navidad River, owned by the Lavaca-Navidad River Authority, and Colorado River water from Garwood Irrigation Company. These sources of supply are approximately 80 and 120 miles distant from the City of Corpus Christi.

Background. The City of Corpus Christi has developed the surface water supply potential of the Nueces River with the prior construction of Lake Corpus Christi and Choke Canyon Reservoir. These projects have a firm yield of approximately 180,000 acre-feet per year, a supply sufficient to meet the City's needs to year 2007. Projections indicate a need for an additional 100,000 acre-feet of water to meet the service area needs to the year

2050.[1] To meet this long-term need the City has elected to pursue the purchase of the nearest available existing surplus supplies. The Lake Texana and Garwood Irrigation Company sources are the largest, most proximate uncommitted supplies available in the area.[2]

Lake Texana was constructed on the Navidad River in Jackson County by the Lavaca-Navidad River Authority in the 1970s. The project has a total annual firm yield of 74,000 acre-feet per year. It is permitted for municipal and industrial use. Forty–four percent of this supply has been committed to an industrial user nearby. The remaining 56 percent has been committed to the City of Corpus Christi.[3]

Garwood Irrigation Company, a private irrigation company, owns a run-of-the-river right (not backed up by storage) on the Colorado River. The diversion point is in Colorado County. The Garwood Irrigation Company right allows diversions of 168,000 acre-feet per year. This right was originally developed for rice irrigation. Recently, the water right was amended to include municipal and industrial use. Historic use for rice irrigation purposes has never exceeded 133,000 acre-feet per year and is not expected to in the future. The remaining 35,000 acre-feet has been committed to the City of Corpus Christi.[4]

Institutional conditions. Texas water law requires that the Texas Natural Resources Conservation Commission approve any interbasin transfer of surface water. That approval is subject to certain statutory required determinations that the future water needs of the basin of origin will not be adversely impacted by the proposed transfer.[5] The Lake Texana and Garwood Irrigation Company sources are both interbasin transfers when conveyed to the City of Corpus Christi. No studies have been completed to demonstrate the social or economic impact on the source basins.[6]

Description of transfers. The City of Corpus Christi has executed an agreement with the Lavaca-Navidad River Authority for the Lake Texana source. The contract amount is 41,840 acre-feet, the remainder 56 percent of the supply not presently committed to other uses. Of this amount 10,400 acre-feet of may be recalled by the Lavaca-Navidad River Authority for use in Jackson County. The contract is for forty-two years with a provision for a fifty year extension. The City will pay a proportionate share of the lake operating, maintenance and debt service costs based on the share of the total supply purchased as its cost of water. Based on projected costs for these items the cost of water to the City at the lake will be $40 to $65 per acre-foot range. The City will be responsible for all construction and operating costs to deliver the water from the lake to the City.[7] The Lavaca-Navidad River Authority has applied to the Texas Natural Resources Conservation Commission for approval of the interbasin transfer, which approval is conditional to final

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[1]HDR Engineering, Inc. study for the Trans Texas Water Program, Corpus Christi Study Area - Phase II Report, September 1995.

[2]Telephone interview with James Dodson, Water Resources Director for the City of Corpus Christi, Texas, January 1996.

[3]Telephone interview with Emmett Gloyna, General Manager for the Lavaca-Navidad River Authority, January 1996.

[4]Telephone interview with R. Nevola, attorney for Garwood Irrigation Company, January 1996.

[5]Texas Water Code, Chapter 11.

[6]Dodson, Interview, January 1996.

[7]Water Delivery and Conveyance Contract between Lavaca-Navidad River Authority and City of Corpus Christi, Texas, December 1993.

consummation of the contract. The total cost of raw water delivered to the City is estimated to be $355 per acre-foot in 1995 dollars.[8]

The City of Corpus Christi agreement with Garwood Irrigation Company is presently in an option period. The City has until January 1, 1997 to exercise its option on 35,000 acre-feet of the Garwood Irrigation Company rights. The price will be $440 or $450 per acre-foot at the diversion point, depending upon the date that the City exercises its options. This a permanent, one time purchase price. The City has the option to make the purchase conditional upon approval of the interbasin transfer or can make the purchase without regard to approval of the interbasin transfer and assume the burden for approval of the interbasin transfer at a point in the future when the City elects to pursue that requirement. The City will be responsible for all construction and operating costs to deliver the water from to the City.[9] If facilities are constructed to deliver this water to the City in conjunction with a project to deliver the Lake Texana water as proposed, the total raw water cost to the City will be approximately $333 per acre-foot.[10]

Impacts from transfers. The water supplies that were sold to the City of Corpus Christi by the Lavaca-Navidad River Authority and Garwood Irrigation Company are surplus to their current or projected needs, the exception being the recall amount in the Lavaca-Navidad River Authority contract. There has not been extensive opposition in the source areas to the proposed transfers, although some Lavaca Basin water rights holders have objected to the proposed transfer. Both transfers involve sales of surplus supplies not presently committed to present uses or required for future needs. Potential negative impact of the transfer to the local economies was not an issue in either case. No studies were done to assess impacts on the source areas. A positive benefit of the Lake Texana sale was noted. Jackson County has been responsible for interest payments on the unsold portion of the water supply. The City of Corpus Christi sale will relieve the County of that financial burden which is paid from property tax revenues in the County. The amount paid by the County through January 1996 is $9.5 million.[11]

Texas Panhandle

The drought of the 1950s significantly affected municipalities and certain farmers and ranchers in the Texas Panhandle — West Texas area. Municipalities that relied upon Ogallala Aquifer wells found that they were at risk without adequate backup supplies. "Borderline" farmers and ranchers with marginal terrain and soils but with significant groundwater supplies approached municipal water users to sell their "water rights." The cities proactively sought supplemental supplies as well. In most cases, farmers and ranchers only sold the rights to pump groundwater; they did not sell the associated surface acres. The water rights sold are generally from lands in the Sand Hill area over the Ogallala Aquifer that produce significant amounts of water.

From the 1940s through February 1996, water rights appurtenant to 286,000 acres of farm and ranch lands have been purchased by the City of Lubbock, the City of Amarillo and the Canadian River Authority. Additional water rights have also been acquired by numerous small communities throughout the Panhandle for future development and as

[8]HDR Engineering, Inc., September 1995.
[9]Agreement between the City of Corpus Christi and Garwood Irrigation Company, February 1994.
[10]HDR Engineering Inc., September 1995.
[11]Gloyna and Nevola, Interviews, January 1996.

insurance against a repeat of the 1950s drought. However, municipal water users have yet to use very much of this water.

Background. The first wells for irrigated agriculture in the Texas Panhandle were drilled around 1908. The Dust Bowl of the 1930s depressed the development of agriculture in this region. After World War II, the advent of good steel casing and reliable engines fostered more well drilling for agriculture. During the 1950s drought, thousands of irrigation wells were drilled into the Ogallala Aquifer. This pumping was unregulated. As a result of the drought and the massive expansion of irrigation use, there was a decline in saturated thickness of the aquifer. Both small and large cities began to buy up water rights as a hedge against the next drought.

Description of transfers. The principal purchasers of groundwater rights have been the City of Lubbock, City of Amarillo and the Canadian River Authority.

City of Lubbock. The City of Lubbock began purchasing water rights from farm and ranch land as early as the 1940s. Farmers and ranchers having a difficult time making a living in agriculture approached the City with the offer to sell their water rights. Lubbock began making purchases of water rights equivalent to $150 to $200 per acre in the region northwest of the city. In nearly all the purchases, the City only acquired the groundwater rights appurtenant to the surface acres. In some cases, Lubbock has purchased the surface acres, retained the groundwater rights, and sold the surface acres for non-irrigated agricultural uses. In the 1950s, the City built an aqueduct to bring the purchased water 70 miles from Muleshoe to Lubbock. The City transferred 15,000 to 25,000 acre feet per year from the early 1950s to 1967, after which Lake Meredith supplies became the City's primary water source. During the dry conditions in 1995, Lubbock reinstituted transfers, using about 15,000 acre feet of water from these lands to supplement Lake Meredith supplies.

Lubbock now owns groundwater rights underlying 82,000 acres in the Muleshoe area of Bailey and Lamb Counties. None of the land associated with the water rights acquired by the City has been affected as this land had been previously taken out of production by the owners or was otherwise very marginal farm or ranch land.

City of Amarillo. Beginning in the 1950s, Amarillo bought groundwater rights appurtenant to 120,000 acres in Hartley and Dallam Counties northwest of the city. However, none of these groundwater holdings have been developed and none of this water has been transferred from these areas. The City also purchased water rights associated with 16,000 acres in Carson County to the northeast of Amarillo. The City built a pipeline to transport this water, and in 1993-1994 used 19,340 acre feet of these supplies.

The City did not purchase any additional water rights until 1986 when it bought water rights underlying 25,459 acres in Potter County for the equivalent of $117 per acre (the northern half of Amarillo is within Potter County). To date, Amarillo has not used any of the rights purchased in Potter County.

While there generally has been no opposition to these water rights sales, there has been some opposition to the actual transfer of the water. The Panhandle Groundwater Conservation District Number 3 encompassing Armstrong, Carson, Donley, Gray and Roberts Counties and parts of Potter County attempted to regulate the transfer of groundwater beyond its district boundaries. On December 4, 1995, the District Judge from the 251st District Court of the State of Texas issued a summary judgment in favor of the seller of the water rights and the City of Amarillo. The Court held that the Panhandle GWCD could not regulate or prevent the transportation of water outside the District, and that it did not have the authority to impose more onerous regulation of water use for water transported outside the District than for water use inside the District.

Canadian River Authority. The Canadian River Authority manages Lake Meredith and purveys water from the lake to users including Lubbock and Amarillo. The Authority is currently closing on the purchase of water rights appurtenant to 42,765 acres of land 40 miles east of Lake Meredith with a projected in-place yield of 2 million acre-feet of water. These rights were purchased on a $339 per acre basis. Again, only the rights, not the land itself, were transferred.

This land will continue to be used for either dry land row cropping or cattle grazing. These water rights were originally assembled by Southwestern Public Service to provide cooling water for a proposed nuclear power project.

Impacts from transfers. There has been little impact on the areas of origin because the surface acres continue to be used for their original intended purposes: dry land farming and grazing. These has been no loss of tax revenue to the counties of origin. To date, only the City of Lubbock has made significant use of their purchased groundwater supplies.

Lower Arkansas Valley, Colorado

Water transfers from irrigation use in the Lower Arkansas Valley to municipal use along the Colorado Front Range began in the mid-1950s and continued through the 1980s. The long history of water transfers from this area, coupled with the area's traditional economic dependence upon agriculture and relative isolation from urban economies, has made the area a focal point for analysis of the economic impacts of water transfers.

Background. The area of origin for water transfers from the Lower Arkansas Valley includes portions of seven counties in Southeastern Colorado: Baca, Bent, Crowley, Kiowa, Otero, Prowers and Pueblo.

With the exception of western Pueblo County, which includes the City of Pueblo, the area is generally isolated from population and employment centers along the Colorado Front Range, as well as from other Colorado agricultural centers. While the Lower Arkansas Valley is generally sparsely populated, it includes several small communities with economies historically tied to local agricultural activity. Excluding the population of the City of Pueblo, the Valley had fewer than 75,000 residents in 1990 in an area of nearly 12,000 square miles.[12]

The Lower Arkansas Valley has an arid, high plains climate with rainfall averaging only 11 inches per year. Between the establishment of Bent's Fort in 1826 and the founding of the eventual town of Las Animas in 1867, the area was the scene of conflict between the Plains tribes and white traders and would be settlers. The beginning of rail access in the 1870s and the end of ethnic conflict in the area allowed additional settlements to be established in the Valley. Large scale irrigation in the area also began in the 1870s with the organization of canal and ditch companies established to divert Arkansas River flows to local farms.

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[12]Sally Groves, *Agricultural-to-urban Water Transfers and Economic and Population Changes from 1971-1990 in the Lower Arkansas River Valley, Colorado.* Masters Thesis, University of Denver, August 1994.

Between 1940 and 1985, the 25 canal and ditch companies operating in the Valley annually supplied water to an average of more than 320,000 acres.[13] Average annual total diversions by all of the ditch companies in the Valley have been estimated at nearly 840,000 acre-feet per year for the period of 1950 to 1987, including reuse of return flows by downstream ditches.[14]

The averages for irrigated acreage and volume diverted indicate that the various ditch companies on the Lower Arkansas River have diverted an annual average of more than 30 inches of water per acre irrigated. However, this average is misleading in several respects. The elderly ditch systems in the Valley are prone to high conveyance and seepage losses. Annual flows in the Lower Arkansas are also highly variable, despite releases of water diverted from the Western Slope to the Upper Arkansas through the Twin Lakes system near Leadville.

Seasonal variability, coupled with great differences in the seniority of the rights held by the various ditch companies, has resulted in substantial variation in irrigation deliveries per acre, both by year and by ditch company, within the Lower Arkansas Valley. The Colorado Canal Company, which has been involved in a large proportion of the transfers which have taken place in the Valley, supplied an estimated average of 1.69 acre-feet per irrigated acre between 1950 and 1975.[15] The Fort Lyon Canal Company, the largest ditch company in the Arkansas Valley, has historically supplied about 1.8 acre-feet per acre irrigated.[16] The Rocky Ford Ditch, which has the most senior water rights in the Valley, delivered an average of 5.8 acre-feet per irrigated acre within its service area between 1970 and 1994.[17]

Lower Arkansas River waters are highly saline, reaching levels of total dissolved solids (TDS) which may exceed 4,000 PPM. Despite these salinity levels, irrigated agriculture has been productive in the Valley. Historically, agriculture in the Valley depended upon sugar beets, processed at local factories. Closure of the last factory in 1967 ended sugar beet cropping, and more recently the principal crops in the valley have been sorghum, alfalfa and grass hay.

Even prior to the end of sugar beet cropping and processing, the economies of the Lower Arkansas Valley had experienced a long period of gradual decline. The rural population of the Valley peaked in about 1930 and has declined by about 25 percent over the past 65 years.[18]

Institutional conditions. Colorado water law follows the principle of prior appropriation. This principle is often characterized as "first in time, first in right" and historically allowed water users to establish their surface and groundwater rights by being the first to put the waters to beneficial use. In the event of water shortages, junior appropriators have inferior water rights to more senior appropriators.

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[13] Gronning Engineering Company study for the Colorado Water Conservation Board, *Fort Lyon Canal Company Water Transfer Alternatives Study - Final Report*, February 1994.

[14] *Ibid.*

[15] Kenneth R. Weber, *What Becomes of Farmers Who Sell Their Irrigation Water?: The Case of Water Sales in Crowley County, Colorado*. Unpublished study funded by the Ford Foundation, November, 1989.

[16] Estimated by BBC based on data provided in Gronning, 1994.

[17] Weber, 1989.

[18] Gronning, 1994.

Colorado water rights are transferable, subject to requirements that parties to the transfer can demonstrate that other appropriators will not be harmed by the transfer. This condition requires that water transfers from one basin to another be based upon the historic, consumptive use volume of the right. The establishment of water rights as firm property rights under Colorado law, coupled with the transferability of these rights, are conducive to water marketing and water transfers.

Description of transfers. The first substantial transfer of Lower Arkansas Valley irrigation water to urban use occurred in 1955. In this initial transfer, 9,000 acre-feet of consumptive use rights from the Otero Ditch were sold to the City of Pueblo, and the point of diversion transferred upriver to the City. A number of subsequent transfers occurred during the 1970s and 1980s, resulting in the transfer of approximately 90,200 additional acre-feet of consumptive use rights to various Front Range cities and water speculators.

Water originally owned by farmers served by the Twin Lakes Reservoir and Canal Company and by the Colorado Canal Company accounted for more than 80,000 of the nearly 100,000 acre-feet of water which has been transferred from the Lower Arkansas Valley. Shortly after the closure of the last of the Valley's sugar factories in 1967, speculators formed the Crowley Land and Development Company (CLADCO) and began to purchase local farms and their appurtenant water rights for about $900 per acre, a price about $400 above the going market rate for local farmland.[19] By 1972, a majority of Crowley County landowners had sold their farmlands and water rights to CLADCO, and the company controlled 55 percent of ownership in Twin Lakes Company. Following a 1974 decree from Colorado Water Court changing the purpose of use of this water from agriculture to multiple purpose, the water was marketed to urban users in Pueblo and Colorado Springs for $2,300 to $2,400 per acre-foot.[20] By 1980, virtually all of the Twin Lakes Stock was controlled by the Front Range cities. In most instances, farmers involved in later sales sold only their Twin Lakes shares and not their farmland.[21]

The rapid transfer of the Twin Lakes Company shares from agriculture to urban users during the 1970s was mirrored by equally massive sales of Colorado Canal Company shares in the mid-1980s. Colorado Canal Company shares sold for $1,500 per share. Between 1985 and 1988, more than 75 percent of ownership in the Colorado Canal Company had been transferred to municipalities. The Colorado Canal transfer was strictly a water transfer, with lands remaining in the hands of farmers.[22]

Other transfers of irrigation water from the Lower Arkansas Valley to the Colorado Front Range have involved the City of Aurora as well as Pueblo and Colorado Springs. Many of these transactions have been accomplished by acquiring majority stock in local ditch companies. Prices have typically been in the range of $2,500 per acre-foot.[23]

Pueblo and a suburb, Pueblo West, acquired more water than immediately needed from these transfers. A portion of water transferred for urban use is currently leased back to irrigators in the Valley.[24] Pueblo leases Twin Lakes Canal Company water back to

[19]Committee on Western Water Management, Water Science and Technology Board, *Water Transfers in the West: Efficiency, Equity and the Environment*. National Academy Press, 1992. And Weber, 1989.
[20]Committee, 1992.
[21] Weber, 1989.
[22] *Ibid.*
[23]*Ibid.*
[24]*Ibid.*

farmers under contracts with terms of 5 to 14 years, with an annual lease price in 1989 of $13 per share. Pueblo West leases water only on a year to year basis, with lease rates in the late 1980s reported to range from $6 to $20 per share.

During the early 1990s, discussion of the possible transfer of more than 100,000 additional acre-feet of water from the Fort Lyon Canal system generated considerable public controversy concerning water transfers and their impacts. In response, the Colorado Water Conservation Board launched a specific study of proposed transfers of Ft. Lyon water as well as a broader scoping study on out of basin transfers in general and a public conference on the issue.

Impacts from transfer. Several studies have examined the impacts of water transfers from the Lower Arkansas Valley on local farming activities and the local communities.

Farm responses to transfer. A retrospective study of Crowley County transfers, location of most of the farmland served by the Colorado Canal, indicates that 60 to 75 percent of the proceeds from land/water sales went to debt payment and taxes and that relatively little was reinvested in the local economy.[25] There was little evidence of new business formation in the county in response to the cash transfers to farmers. However, more than 75 percent of farmers involved in the Twin Lakes Company transfers, and more than 90 percent of farmers involved in the Colorado Canal Company sale and transfer, have remained in the county. Evidently, many of the former farmers have opted for local retirement, while a much smaller number have shifted from farming to ranching.[26]

The decrease in returns to local farmers, net of farm costs, due to transfer of water from the area has been estimated at $21 per acre-foot of water in Crowley County. This figure is based upon the difference between the annual net financial return to the farm-owner from irrigated land and the return available from ranching or dryland farming, divided by the average amount of irrigation water applied per acre. The relatively low estimated value of irrigation supplies in the area is attributable to the generally low quality of local soils and the variability and uncertainty of the irrigation water supply.[27]

Across the valley as a whole, acres planted in higher valued vegetable and specialty crops have remained fairly constant, indicating that higher valued crops were shifted from retired acres to the acres which continued to be irrigable. Farm job losses in the area, when urban owners terminate current leaseback arrangements, have been projected to ultimately reach approximately 150 jobs. The value of directly affected farm lands, severed from their irrigation rights, has declined.[28] Irrigated Crowley County lands were reportedly marketable at about $200 per acre in 1968, while lands without water have recently been sold for about $150 per acre.[29]

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[25] Weber, 1989.

[26] *Ibid.*

[27] R. Garth Taylor and Robert A. Young, "Economic Impacts of Rural to Urban Water Transfers: A Colorado Case Study," paper delivered at *Colorado Water Engineering and Management Conference*, 1991.

[28] Committee on Western Water Management, 1992, p. 155.

[29] Weber, 1989.

Broader community impacts. Population in the rural portions of the Lower Arkansas Valley has declined since the onset of water transfers. This decline is probably not entirely attributable to transfers of irrigation water from the area, but the transfers have likely accelerated the process.

The shifting of higher valued crops onto remaining irrigable lands has reduced the impacts of the transfers on forward linked industries, which were primarily associated with vegetable and specialty crop processing and shipping. Net income losses, including direct farm income, indirect effects on linked industries and induced effects on other sectors, have been estimated at $53 per acre-foot.[30] Comparison of this figure with the $21 per acre-foot estimate of lost farm income, suggests that secondary effects have been even greater than direct impacts on farmers. This conclusion is reinforced by estimates that water transfers will ultimately eliminate 250 secondary jobs in the Valley, or about 1.7 secondary jobs for each farm job eliminated.

Weber's study of Crowley County conditions in 1989, shortly after completion of the Colorado Canal Company sales, suggests that the ultimate impact of water transfers on the local tax base will be very severe. Land from which water has been transferred will be reclassified as either grazing land, or if revegetation is unsuccessful, as wasteland. Weber estimates that the tax reclassification may cost the County about 90 percent of its property tax base.[31]

Water Farms, Arizona

During the 1980s, a number of Arizona municipalities and private entities aggressively pursued efforts to lock-in agricultural water supplies to serve future municipal development. While relatively little water actually moved from agricultural to urban use during the decade, the large scale of potential future transfers generated a great deal of interest and concern about the "water farming" phenomenon. A 1990 economic study of water farming activities indicated that the water supplies involved could potentially provide municipal service to 3.2 million Arizonans, supporting a near doubling of the state's existing population.[32]

Background. Prior to 1980, relatively little water transfer activity had occurred in Arizona, particularly by comparison with other arid, Western states. In part, the lack of transfer activity may be attributed to the extensive groundwater basins underlying the state's municipal centers. The City of Tucson, however, did begin to purchase and retire agricultural land in the nearby Avra Valley in the 1970s. Apart from reserving water supplies in their common aquifer through agricultural retirement, Tucson Water also began to withdraw and transport water from Avra Valley wells to the city. By the late 1980s, Tucson had purchased more than 20,000 acres of farmland in the Avra Valley and was pumping and transferring about 14,000 acre-feet per year from the Valley to the city.[33]

While the Avra Valley land purchases and water transfers by the City of Tucson generated some controversy and opposition, the proximate location of the area of origin and

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[30] Howe, et. al., 1990.

[31] Weber, 1989.

[32] Alberta H. Charney and Gary C. Woodard, "Socioeconomic Impacts of Water Farming on Rural Areas of Origin in Arizona", *American Journal of Agricultural Economics*, December 1990.

[33] Elizabeth Checchio, *Water Farming: The Promise and Problems of Water Transfers in Arizona*, Water Resources Research Center - University of Arizona, January, 1988.

the receiving area in the same county, over the same hydrologic basin and in the same general economic area may have tended to minimize impacts from these transfers.[34]

During the 1980s, two new institutional factors fostered efforts by Arizona municipalities and private entities to purchase far greater amounts of agricultural land and appurtenant water rights from distant areas of the state. These efforts led to considerable controversy and political interest during the latter part of the last decade.

Arizona Groundwater Management Act. In 1980, the Arizona Legislature passed the Arizona Groundwater Management Act (the Act, or AGMA). The Act was intended to force Arizona municipalities to develop alternatives to mining the groundwater basins underlying their cities. Under the Act, municipalities within three of the four Active Management Areas (AMAs) — covering the Phoenix, Prescott, and Tucson areas — were required to achieve "safe yield" by the year 2025. Safe yield was defined as reducing withdrawal from aquifers within each AMA to the level of annual recharge or less. The fourth AMA, covering much of agricultural Pinal County (located between Phoenix and Tucson) had a different set of management objectives focused on sustaining agricultural use for as long as possible while still preserving sufficient water to develop an alternative economic base for the area.[35]

Outside of the AMAs, Arizona water policy continued to allow unrestricted groundwater pumping — similar to the rule of capture in Texas groundwater law. Arizona municipalities could, theoretically, have purchased land parcels just large enough to support a well field and then pumped and transported as much groundwater as was technically and hydrologically feasible from the field. However, provisions in Arizona law would have allowed other groundwater users in the same basin to sue for damages if municipal pumping reduced the water available from other wells in the basin or increased pumping costs. To reduce their legal exposure and also ensure that no nearby users would impact the water available for future transfers, the municipalities opted to purchase large tracts of land for use as water farms.

Central Arizona Project. The second major institutional factor encouraging interest in water farm purchases during the 1980s was the construction of the Central Arizona Project (CAP) canal. CAP was designed to divert waters from the Colorado River to reduce the reliance of Arizona's municipal and agricultural water users upon groundwater.

Ironically, several features of CAP served to increase the interest of Arizona municipalities in transferring water from distant agricultural areas. The future availability of CAP supplies, coupled with increasing restrictions on groundwater withdrawals from their own aquifers, meant that Arizona municipalities such as Tucson, Scottsdale, Mesa and other Phoenix suburbs would be increasingly reliant upon the variable surface flows of the Colorado River.[36] Importing groundwater supplies, or other surface water supplies, from areas outside of the AMAs became an attractive strategy for diversifying the water resource portfolios of the large cities.[37] Further, the likelihood of unused capacity in the CAP canal meant that the canal might be available as a relatively inexpensive means of transporting transferred water supplies to the municipalities.

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[34] Dr. Lawrence J. MacDonnell, *The Water Transfer Process as a Management Option for Meeting Changing Water Demands*, U.S. Geological Survey grant 14-08-0001-G1538, April 1990.

[35] MacDonnell, April 1990; and Checchio, January, 1988.

[36] Note that most of the City of Phoenix proper relies upon surface supplies provided by the Salt River Project.

[37] Checchio, January 1988.

Description of transfers. Following the passage of AGMA in 1980, municipalities, developers and other private entities began to purchase large tracts of agricultural as well as undeveloped land in La Paz County (on the Arizona/California border), Pinal County (between Tucson and Phoenix), and rural areas in Maricopa County (around Phoenix). The City of Tucson also continued to purchase nearby Avra Valley farmland.

During 1984 through 1986, the City of Scottsdale purchased 8,400 acres of land from the Planet Ranch in La Paz County and the City of Phoenix purchased about 14,000 acres of land in the McMullen Valley, also in La Paz County. Prices of land sold for these large water farms ranged from about $1,400 per acre for the Scottsdale purchase to about $2,200 per acre for the Phoenix purchase. A number of private developers and speculators also purchased substantial landholdings for future sale or trade to Arizona municipalities.[38]

By 1988, an estimated total of more than 82,000 acres in La Paz County had been purchased or were being actively marketed. About 30 percent of this land was under cultivation (23,978 acres), while the remainder was undeveloped land.[39]

Water farm activity was also occurring in other areas. More than 70,000 acres were for sale or had been purchased for water farms in the rural parts of Maricopa County, within the Phoenix AMA. Under AGMA, water rights obtained within an AMA cannot be transferred from the AMA. Maricopa County water farms were purchased to service future developments in the Phoenix area which would be outside of the Salt River Project service area.

The City of Mesa purchased nearly 12,000 acres of land and appurtenant water rights in Pinal County in 1985, seeking to exchange this water with the City of Tucson for a portion of Tucson's CAP allocation.[40]

Statewide, eighteen transactions had occurred or were under negotiation by 1990, involving nearly 188,000 acres of privately deeded property and more than 360,000 acres of land leased from the State of Arizona or from the Bureau of Land Management. The estimated surface and groundwater supplies appurtenant to these land purchases approached 500,000 acre-feet. Total cost of the transactions which had been completed or were being evaluated exceeded $300 million, implying an average cost of about $600 per acre-foot. Land purchase costs varied from less than $1,000 per acre to more than $3,000 per acre.[41]

Impacts from transfers. As stated earlier, apart from the City of Tucson's use of water from former Avra Valley agricultural lands nearby, little or no water has actually been transferred as a result of water farm purchases. Because of changing circumstances in the 1990s, discussed at the end of this section, water farm purchases have ceased in Arizona and much of the water supply secured through previous purchases may never be moved. Nonetheless, during the latter part of the 1980s and the early part of this decade, considerable effort was devoted to identifying the potential impacts of water farming activities on the areas of origin.

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38 MacDonnell, April 1990.

39 Checchio and Nunn, 1988.

40 *Ibid.*

41 MacDonnell, April 1990.

Potential Impacts. Economists studying the potential impacts from Arizona water farm purchases identified three distinct impact phases.[42] The first phase of impacts occurs with the transfer of land ownership from private owners to a municipality. Under Arizona tax laws in the 1980s, this phase was of particular concern from the standpoint of fiscal impacts on local jurisdictions in the area of origin. Municipal landholdings were tax exempt in Arizona, so the purchase of water farms directly reduced the local property tax base for school districts, county governments and other local government entities that relied upon property tax revenues.

In part because of the immediacy of this threat to the fiscal viability of local government entities, La Paz County became the focal point for the statewide debate over the impacts, and the ethics, of water farms and agricultural to urban water transfers. Although water farm purchases had occurred earlier in Pima County and were occurring simultaneously in other areas, La Paz County appeared singularly vulnerable to both fiscal and economic impacts of water farm purchases. With less than five percent of the land area of La Paz County in private ownership prior to 1980, the County's property tax base was already very limited. Land which had been purchased, or was for sale, for water farm purposes represented more than one half of the County's original private landholdings.[43]

The second impact phase occurs with the retirement of agricultural land which had been purchased for water farms. Most of the impacts upon the existing local economy would occur during this phase. As outlined in more detail in subsequent sections of this report, the economic impacts of ceasing agricultural production would include:

- direct effects upon agricultural income and employment,
- indirect impacts upon sectors of the local economy that supplied goods and services to the farms or relied upon farm produce for their businesses, and
- induced impacts resulting from diminished local spending by farmers and employees in indirectly impacted sectors.

In 1990, two University of Arizona economists projected second phase impacts upon La Paz County, using a combination of survey and econometric approaches. Direct, indirect and induced employment and income impacts were estimated at 17 jobs, and $363,000 in income (1987 dollars), per 1,000 acres of prime farmland retired from agricultural production. Assuming that 40,000 acres of La Paz County farmland would eventually be retired, including both high quality and marginal agricultural lands, the aggregate impact was estimated at 340 jobs — or 13.6 percent of La Paz County's 1987 employment.[44]

The third, and final, impact phase would occur with the actual transfer of water from the area of origin to municipal users. Impacts on local environmental conditions and the future economic development potential of the area of origin which may have commenced during the first and second phases would be fully realized with the permanent withdrawal of water from the area. These potential impacts were of great concern to community leaders in La Paz County and other areas where water farm sales were taking place, though these effects are likely to be more difficult to quantify than the impacts of the first and second phases. A 1989 survey of 317 community leaders in Arizona, New Mexico and the El Paso

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[42] Checchio, January 1988.

[43] *Ibid.*

[44] Alberta H. Charney and Gary Woodard, "Socioeconomic Impacts of Water Farming on Rural Areas of Origin in Arizona," *American Journal of Agricultural Economics*, December 1990.

area found that diminished potential for future economic growth was perceived as the most likely threat resulting from water transfers. This sentiment was particularly strong among leaders in La Paz County. Negative impacts on the environment were identified as the third most likely threat, behind impacts upon local agriculture.[45]

What actually has happened? Under considerable public pressure from the state's rural areas, the Arizona State Legislature sought to mitigate some of the potential adverse impacts of transfers. House Bill 2264 (1986) authorized municipalities owning water farms to make payments in lieu of property taxes to taxing authorities in the area of origin. A related bill in 1987 (HB2462), allowed counties containing water farms to include the value of the water farm property in their assessed valuation for purposes of calculating their share of Arizona's state-shared sales tax, which is pro-rated based upon county assessed value. Counties were also allowed to include the assessed value of the water farm property for purposes of determining their bonding capacity if the municipality owning the water farm had agreed to make voluntary payments in lieu of taxes under HB2264.

Legislation passed in 1991 related to water transfers was much more restrictive. Inter-basin transfers of groundwater were prohibited, with the exception of water supplies obtained from properties already purchased for water ranching. Pumping from properties which had already been obtained by Scottsdale, Phoenix, Mesa and other Arizona municipalities was limited to specified volumes or allowable increases in pump lift requirements.[46] While further water ranching of groundwater supplies was effectively prohibited by this legislation, other market factors had already begun to eliminate the attraction of this water supply strategy.

Apart from efforts to address impacts through legislation, the most significant development regarding water farming in the 1990s has been the actual completion of the CAP canal, the commencement of CAP deliveries and the market conditions for sale of CAP water. The delivered cost of CAP supplies has turned out to be substantially higher than was originally planned, and the costs are projected to continue to increase. As a result, many of the irrigation districts and other agricultural customers originally contracting to purchase CAP are seeking to escape from their contracts.[47] Further, municipalities which are outside of the CAP service area, such as Payson and Nogales, have made efforts to sell or trade their allocations to developers in the Phoenix and Tucson areas.[48]

The supply of CAP available for municipal purchase is much greater than anticipated and municipal interest in transferring groundwater from distant water farms has diminished correspondingly.[49] Further, with a considerable portion of the CAP supply uncontracted at the moment, the likelihood of the Central Arizona Water Conservancy District, the CAP administrative body allowing use of the canal to transport groundwater to municipalities appears remote.

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[45] Cy R. Oggins and Helen M. Ingram, *Does Anybody Win? The Community Consequences of Rural-to-Urban Water Transfers: An Arizona Perspective.* Udall Center for Studies in Public Policy, May 1990.

[46] Telephone conversation with Steve Olsen, Legislative Liaison for the Arizona Department of Water Resources, January 1996.

[47] Central Arizona Water Conservancy District rate schedule and various communications through City of Tucson, 1994-95.

[48] Olsen, 1996.

[49] Telephone conversation with Dr. Bonnie Colby, University of Arizona, 1996.

Water farm purchases have not led to substantial acreage going out of agricultural production. Following their purchase, much of the land on water farms in Arizona has been leased back to irrigators pending eventual transfer of the water supply.[50] A number of Arizona municipalities which purchased water farms during the 1980s have begun to seek arrangements with the Bureau of Land Management and other public agencies to dispose of the properties and recoup a portion of their original investments.[51]

The 1991 California Water Bank

In 1991, 13 counties in Northern California were the source of large scale water transfers to help boost municipal and industrial water supplies in other areas of the state suffering from a prolonged drought. The mechanism for the transfers was a state administered water market called the Emergency Drought Water Bank. This case study summarizes the activities of the Bank and subsequent research which estimated the impacts of the transfers on the areas of origin.

Background. In the early months of 1991, California faced the prospect of its fifth consecutive year of drought. At the end of 1990, reservoir storage throughout the state was only 32 percent of capacity and 54 percent of average historic levels. The reservoirs contained nearly one million less acre feet of water than they had at the previous record low in 1977. Precipitation, snowpack and runoff were only 25 to 30 percent of normal.

The California Department of Water Resources' State Water Project (SWP) announced that it would deliver just 10 percent (225,000 acre feet) of the water contracted to municipal users, and no water to agricultural users. The Federal Bureau of Reclamation's Central Valley Project (CVP) would deliver 25 to 50 percent of contracted water to urban customers, and 25 percent to agricultural customers. In mid-February, the Governor established the Emergency Drought Water Bank, to be administered by the Department of Water Resources, which would allow willing buyers and sellers to exchange water. Enabling legislation was quickly approved by state legislators, authorizing water suppliers to enter into contracts that would transfer water out of their service areas and declaring that temporary transfers related to the drought relief effort would in no way effect underlying water rights.

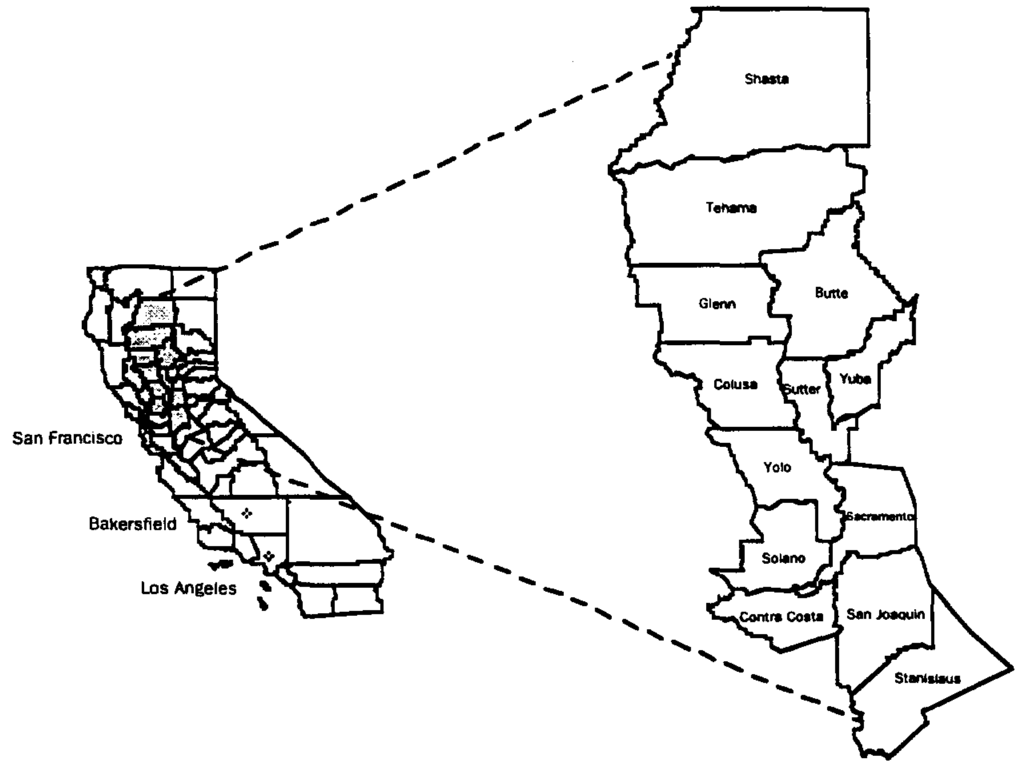
The selling region. The selling region consisted of 13 counties in north central California, depicted in Exhibit II-4. In 1987, prior to the prolonged drought, these counties were home to about 3.4 million people, or one out of every eight Californians. In that year, total farm income (including livestock operations) was approximately $1.2 billion and income in related agricultural services was about $335 million. Together, these sectors represented about 3 percent of the area's total personal income.

Farmers in the area harvested approximately 2.3 million acres of crops in 1987, 90 percent of which was irrigated. About one-quarter of crop acreage was in orchards. Other leading crops according to harvested acreage were rice, hay, wheat, vegetables, corn and sugar beets. The total market value of crops produced in these counties in 1987 was approximately $1.8 billion. In 1990, prior to the commencement of water banking activity, agricultural water use in these counties was approximately 6.2 million acre feet.

[50] Checchio, January 1988.

[51] Conversations with Bonnie Colby and Steve Olsen, 1996.

Exhibit II-4.
Counties in the Selling Region and Major Municipal Buyers



Source: California Department of Water Resources, January 1992.

Description of transfers. The California Department of Water Resources (DWR) acted as the clearinghouse for Water Bank transfers, with sole responsibility for locating, negotiating, purchasing and redistributing water. The DWR established a Water Purchasing Committee to negotiate the acquisition of water that would then be resold to users with critical needs. Health and safety related needs, such as drinking water and fire protection water, were given the highest priority. The next highest priority recipients were urban users with less than 75 percent of adequate supply and agricultural users whose permanent or high-value crops were threatened by drought. Water required to sustain fish and wildlife and to carryover as storage for the following year were lower-priority considerations.

The Department determined that most of the water acquired would likely be purchased from agricultural users, and so turned to an analysis of farm water uses to arrive at a common contract price. After studying crop budgets and talking to potential buyers, sellers, agricultural economists and others, the Department set a bid price of $125 per acre foot. Deliveries would be made primarily through the existing State Water Project.

The Water Bank entered into approximately 350 contracts with water sellers in about 6 weeks, acquiring nearly 821,000 acre feet of water. Water was made available for these purchases through three arrangements: storage withdrawal, groundwater substitution, and fallowing.

- ***Storage withdrawal.*** Approximately 142,000 acre feet (17 percent) of water acquired by the Bank was withdrawn from reservoir storage. The most significant transfer of stored water was between the Bank and the Yuba County Water Agency, which sold a total of approximately 139,000 acre feet. An additional 28,000 acre feet of the Agency's stored water was earmarked for use by the Fish and Wildlife Department.

- ***Groundwater substitution.*** Approximately 259,000 acre feet (32 percent) of water transferred to the Bank was made available from groundwater substitution contracts. In this arrangement, farmers agreed to irrigate only from groundwater pumping, allowing their surface water supplies to flow to other users. Water wells were metered and the amount pumped by the farmer was purchased by the Bank up to the amount of the contract. The same amount of water was then released by the local water district as surface water which would be available for redistribution. A small fraction (less than 10,000 acre feet) of groundwater contracts provided for direct pumping of groundwater into the Bank system.

- ***Fallowing.*** Approximately 420,000 acre feet (51 percent) of water acquired by the Bank was derived from fallowing contracts with about 300 farmers. In the fallowing arrangement, farmers agreed not to irrigate their crops, making water available for sale. Because some farmers were still able to produce dryland crops, this arrangement has also been referred to as a "no-irrigation" contract. More than half of the acreage was truly fallowed.

Water purchasers. Most of the water obtained by the Bank was sold for $175 per acre foot. DWR used the $50 increment over the $125 per acre foot acquisition price to defray administrative costs. The costs of conveyance, primarily the energy-related cost of pumping, were borne by the purchaser. About 48 percent of the Bank's water was sold to 12 water agencies and 30 percent was retained as carryover storage for 1992. The remaining 22 percent of water purchased was lost as seepage in the Sacramento-San Joaquin Delta, the pumping hub of the SWP and CVP which is open to San Francisco Bay.

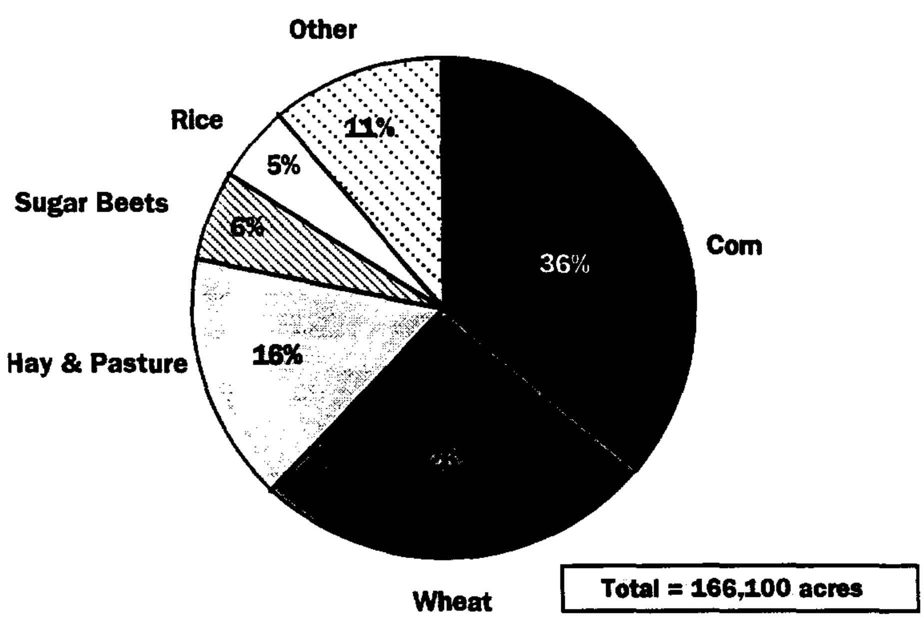
The single largest purchaser of water from the Bank was the Metropolitan Water District of Southern California, which serves the Los Angeles area. This District purchased about 215,000 acre feet of Bank water. The Kern County Water Agency, which serves the Bakersfield area, was the second largest water purchaser (54,000 acre feet) followed closely by the City of San Francisco (50,000 acre feet).

Impact assessments. Several attempts to quantify the economic effects of the Water Bank have been made by researchers in California. The DWR provided funding for an initial review of the Water Bank that was conducted by a team of academic researchers and private consultants. DWR then provided funds for a more detailed study of the Bank's economic impacts by the California research group RAND. Other analyses of the operations and impacts of the 1991 Water Bank include papers sponsored by the University of California's Agricultural Issues Center. Major themes from these sources are discussed below.

Most economic impacts in the area of origin related to Water Bank activity were attributed to no-irrigation contracts. These contracts reduced crop production activities, while groundwater substitution contracts simply required the farmer to change his irrigation source.

No-irrigation contracts. Most of the farmers who entered into no-irrigation contracts did so in February 1991, agreeing not to irrigate a specified number of acres until October 15, 1991. In total, 166,000 acres of cropland were temporarily converted to dryland production or fallowed as a result of no-irrigation contracts. Approximately 46 percent of these acres were planted whereas 54 percent of the acres were fallowed. As reflected in Exhibit II-5, corn and wheat were the leading crops that were placed under no-irrigation contracts.

EXHIBIT II-5.
Percent of Acres in No-Irrigation Contracts by Crop, 1991



Source: California Department of Water Resources, January 1992.

The Bank paid farmers for the net amount of water made available by foregoing irrigation. The amount of water was determined based upon estimated water consumption by crop and upon recent cropping use of the farmer's land. The estimated water consumption and no-irrigation payment schedule for selected crops is presented in Exhibit II-6, which indicates compensation of $125 per acre to $450 per acre entered into no-irrigation agreements. If the farmer breached the no-irrigation contract, damages equal to twice the contract price would be payable to the Bank.

EXHIBIT II-6.
No-Irrigation Payment Schedule by Crop, March 14, 1991

Irrigated Crop	Sacramento Valley and Delta Upland: ET AF/A[1]	Sacramento Valley and Delta Upland: $/Acre	Delta Lowland[2]: ET AF/A[3]	Delta Lowland[2]: $/Acre
Grain (wheat, barley, not oats)*	1.0	125	1.0	125
Rice	3.5	450	—	—
Sugar beets	3.0	375	2.5	325
Field corn	2.5	325	2.0	250
Milo	2.5	325	2.1	263
Dry beans	2.1	263	1.7	213
Misc. field	2.5	325	2.1	263
Alfalfa**	3.5	450	3.2	400
Pasture**	3.5	450	3.2	400
Asparagus**	2.6	325	2.2	275
Potatoes	2.0	250	1.6	200
Tomatoes	2.5	325	2.1	263
Misc. truck	3.0	375	2.5	325
Sunflower	2.5	325	2.0	250
Safflower	2.8	350	2.1	265

[1] Evapotranspiration in acre feet-per acre.

[2] Below sea level.

[3] Delta upland figures, except for grain, reduced in Delta lowland to account for part of ET requirement supplied by seepage.

* May be readjusted periodically in response to rainfall.

** Proposed; case-by-case analysis.

Note: The crop evapotranspiration (ET) numbers in acre – feet per acre (AF/A) used in this table are the estimated crop water needs that are expected to be satisfied by applied irrigation water. These amounts assume minimum future rainfall, such as occurred during 1977. If actual rainfall amounts are greater than assumed and would result in meeting a portion of the crop water needs, the amounts in this table will be reduced. Amounts used in fallowing contracts will be those values current at the time the contract revisions are agreed to.

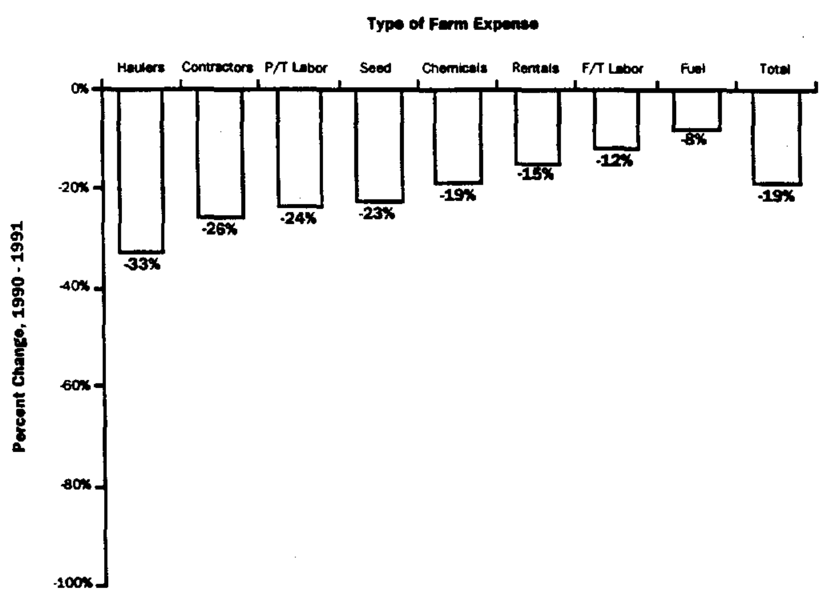
Source: California Department of Water Resources, *A Retrospective on California's 1991 Emergency Drought Water Bank*, March 1992.

The Water Bank spent approximately $52.5 million to acquire water from farmers through no-irrigation contracts. The impacts related to this trade-off, laying aside irrigated cropland in exchange for cash, are summarized below.

Changes in farm activity. Estimates of Water Bank impacts on direct farm activity were made based upon a survey of farmers who participated in the Bank. It was estimated that crop sales by farmers who placed at least a part of their crop acreage into the Bank via no-irrigation contracts were $58 million (29 percent) lower than would have been expected in the absence of the Bank. Overall crop sales in the area of origin were thought to be $77 million (20 percent) lower than would have been expected in the absence of the Bank.

Farm operating expenses were also lower for participating farmers. The decrease in operating costs incurred by farmers who entered into no-irrigation contracts was estimated to be $17 million (19 percent). (Although this drop was not definitively attributed to the Water Bank, its components were offered as an indicator of how the effects of the Bank may have been distributed.) Components of farm operating costs and the estimated decline in expenditures are presented in Exhibit II-7.

EXHIBIT II-7.
Changes in Farm Operating Costs by Type of Expense, Farms with No-Irrigation Contracts, 1991

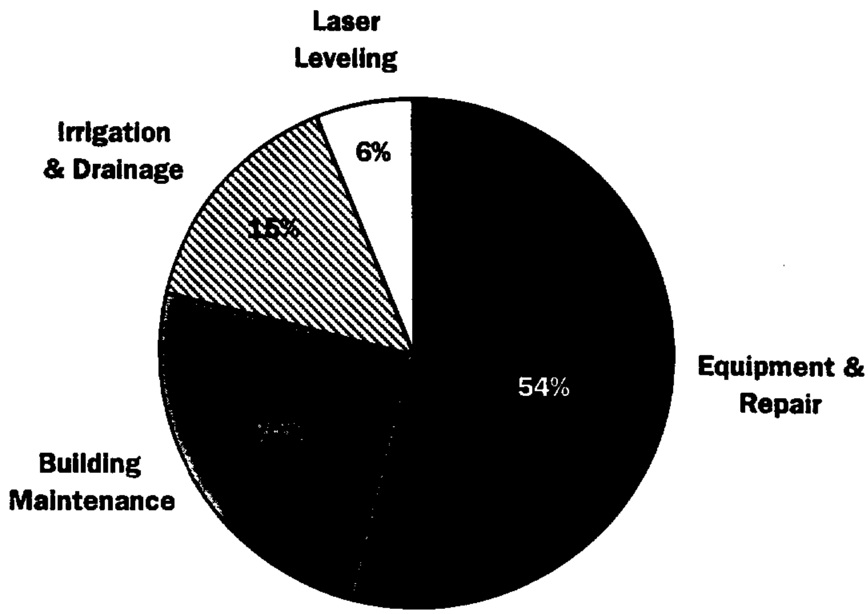


Source: RAND, *California's 1991 Drought Water Bank*, 1993

In percentage terms, the reduction in farm operating expenditures fell most heavily on haulers, who received 33 percent less revenue from farmers participating in no-irrigation contracts, and on other custom contractors, who received 26 percent less revenue from these farmers. Among farm workers, part-time laborers were estimated to suffer twice the proportional drop in aggregate wages (a 24 percent decrease) as did full-time laborers (12 percent). Farm operating costs were estimated to change very little for farmers with groundwater substitution contracts.

Farmers participating in no-irrigation contracts were thought to have invested some $2.5 million more in farm upkeep and improvements than in previous years. This investment was equivalent to 5 percent of the proceeds of the contracts. Again, it was not clear that this increase was due strictly to the activity of the Water Bank, but the estimated expenditure patterns (presented in Exhibit II-8) indicate how farmers may have apportioned the Bank proceeds toward reinvestment.

EXHIBIT II-8.
Composition of On-Farm Investment,
Farms with No-irrigation Contracts, 1991

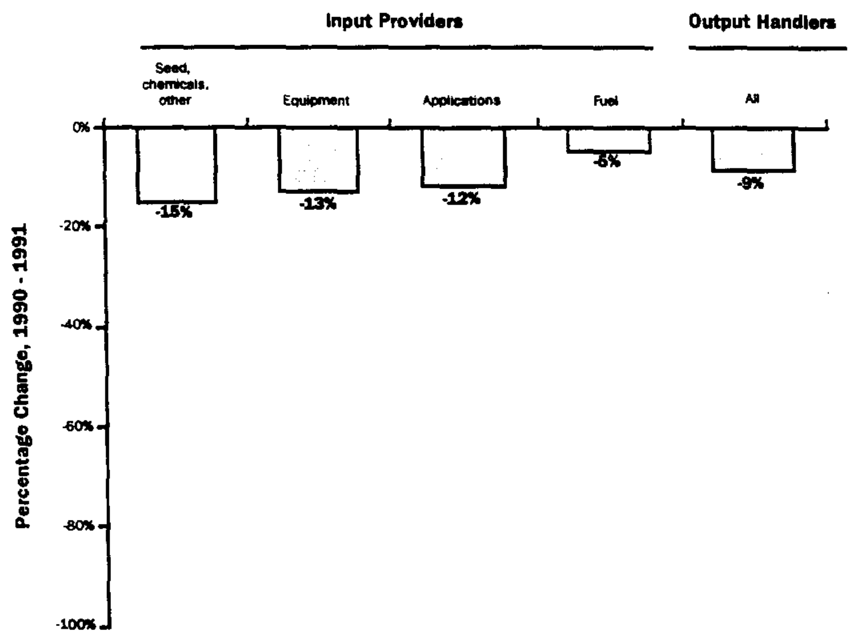


Source: RAND, *California's 1991 Drought Water Bank*, 1993.

Farmers with no-irrigation contracts reported that they spent over half of their investment dollars on farm equipment and one-quarter on building maintenance. About 15 percent of investment dollars were allocated to irrigation and drainage improvements among no-irrigation participants. Groundwater substitution participants invested approximately $3.2 million in their farms, two-thirds of which was spent on water well installation and overhaul.

Impacts on agricultural businesses. Researchers also conducted surveys to determine the effects of the Water Bank on non-farm agricultural businesses. The results did not attempt to distinguish the effects of the Bank from other factors, and no distinction is made between no-irrigation and groundwater substitution activity. Overall, the agricultural support businesses reported that their gross revenues fell 9 percent from 1990 to 1991; researchers attributed perhaps one-third of this decline to the activity of the Water Bank. As shown in exhibit II-9, those supplying crop inputs such as chemicals and fertilizers experienced the greatest decline in revenues (15 percent) in 1991, whereas fuel suppliers experienced relatively modest declines (5 percent).

EXHIBIT II-9.
Change in Gross Revenues Reported
by Local Agricultural Businesses, 1991



Source: RAND. *California's 1991 Drought Water Bank*. 1993.

Overall impacts on the regional economy. When these farm and agricultural impacts were studied for their influence on the overall economy of the selling region, the results were inconclusive. Researchers generally held that the Bank either had no net negative impact on the area of origin because the Bank payments to farmers offset the decline in agricultural activities, or that the impacts were present but were too small to be detected by the estimation methods that were used.

In any case, it appeared that the impacts of the Water Bank on the agricultural economy were within the realm of normal experience. That is, the aggregate changes in crop production, farm expenditures and agricultural business activity were not different from the variations experienced due to year to year changes in weather, commodity prices and worldwide market conditions.

Subsequent Water Bank activities. The 1991 California Water Bank was generally considered to be a success. Given the severity of the drought, the short response time required and the large volume of water and considerable distances involved, most participants were willing to overlook their frustrations. The basic Water Bank model has survived and is available for operation in emergency conditions.

The California drought relented somewhat in 1992, allowing the Water Bank to substantially reduce its operations. In that year, the Bank purchased about 193,000 acre feet of water from farmers. DWR was able to purchase nearly all of this water through groundwater substitution contracts, which were both more cost effective and less likely to cause significant economic impacts. Avoiding no-irrigation contracts has become one of the goals of the DWR when planning potential Water Bank operations.

The balance of supply and demand among California's water users allowed DWR to reduce the water purchase price in 1992 to $50 per acre foot. DWR then sold the water for $72 per acre foot. A Water Bank of similar scale was activated by DWR in 1994, in which the Bank purchased 220,000 acre feet at $50 per acre foot and sold it for about $68 per acre foot. Again, DWR avoided no-irrigation contracts.

Banking activities were also planned for 1995, but proved unnecessary. To prepare for the prospective banking operation, DWR purchased options on water for $3.50 per acre foot and negotiated purchase prices of $36.50 to $41.50 per acre foot if the options were exercised. Weather conditions improved before a selling price was established.

While the original character of the Bank remains, some of the Bank's practices have changed over time. For example, DWR has attempted to prepare for Banks during the Fall when farmers are making their plans for the following season. Groundwater substitution has come to be viewed as the preferred source of farm water because of its small effects on crop production. And, the most recent Bank preparations demonstrate more sophistication and flexibility, as evidenced by DWR's advance purchase of options and its new practice of negotiating individual purchase prices.

SECTION III.
Framework for Evaluating Economic and Social Impacts Related to Water Transfers

This section builds upon the preceding section's discussion of previous water transfers throughout the West to develop a framework for evaluating impacts of proposed transfers in Texas. The intent of this section is to provide an introduction to the elements and techniques of social/economic impact analysis for individuals without prior experience and training in these fields, as well as a more detailed discussion of each element for more technical readers. The focus of this section is on the social and economic impacts which may be particularly associated with water transfers.

The section begins with an overview of impact analysis applied to water transfers. The balance of the section presents a step by step approach for analyzing the impacts of Texas water transfers, including a discussion of the strengths, weaknesses and data requirements of alternative modeling approaches.

The emphasis in this section is upon pragmatic and understandable approaches to obtaining reasonable estimates of the impacts that may occur from transfers. More sophisticated modeling of many of the aspects of the transfer is certainly possible — at the cost of additional time, complexity and financial resources. It is not clear that more elaborate approaches always provide more comprehensive, credible or accurate information.

Although the steps are presented in their logical sequence, we do not intend to imply that each step must be fully completed and set aside prior to embarking upon the next portion of the analysis. In fact, each component of the analysis is likely to be continually modified and adjusted throughout the assessment as additional information becomes available from subsequent steps.

Overview

Impact analysis identifies the differences between conditions that would occur if (a) an event occurs, and (b) the event does not occur. The conditions that would result if the event did not take place, are typically referred to as "baseline conditions" or the "baseline scenario." Therefore, an impact analysis for proposed water transfers compares conditions projected to occur if the transfers took place with conditions expected under the baseline scenario (no transfers).

The analysis of differences may be quantitative, qualitative or a combination of both. Along with identifying the differences between the impact scenario(s) and the baseline, impact analysis normally involves an assessment of the importance, or significance, of the differences that would result from the action or policy.

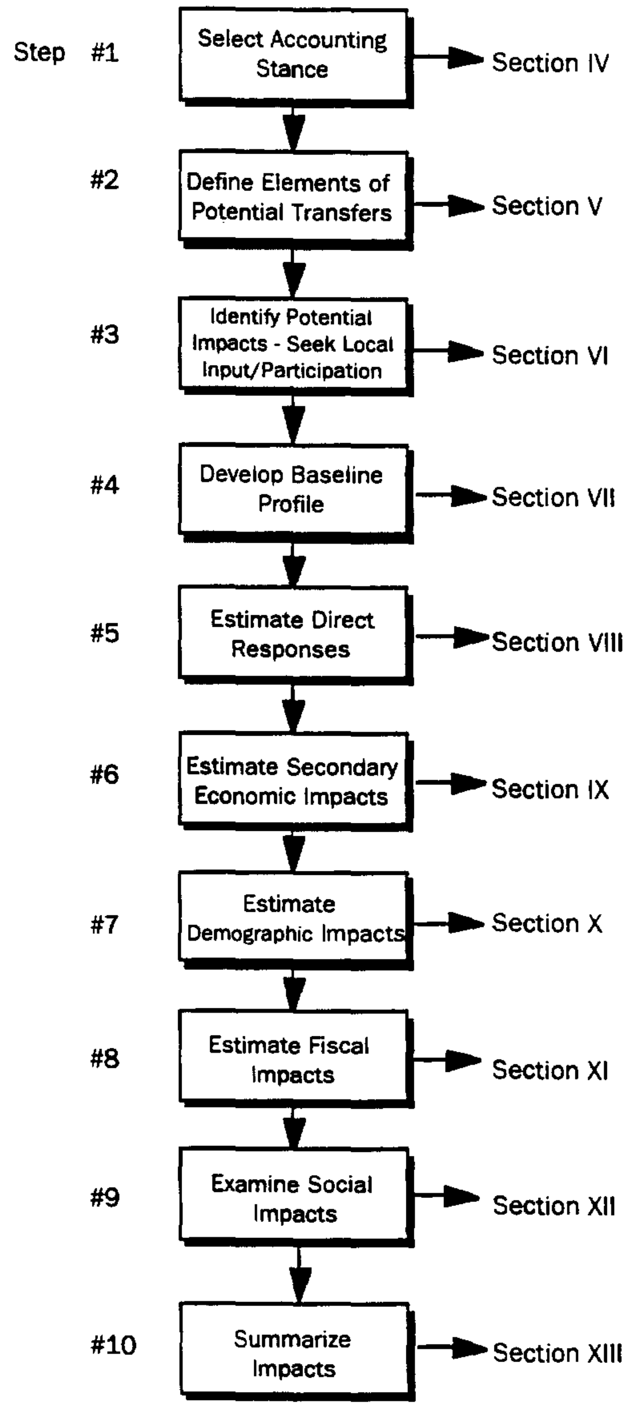
Impact analysis may be conducted retrospectively (after an action has already occurred) or prospectively. Since impact analysis is often used for purposes of selecting or refining public policies, prospective analysis is more common. Prospective impact analysis, like any forecast or projection, is prone to a number of uncertainties. Retrospective analysis, on the other hand, faces the challenge of separating the effects of the particular action or policy in question from many other influences continuously affecting local economies and communities.

In the broadest sense, impact analysis may be used to examine effects of an event upon a number of different types of conditions — including effects on the environment, cultural resources and other parameters. The focus of this study is limited, however, to the economic and social, or "socioeconomic", impacts that may result from future water transfers in Texas.

The following discussion presents a series of analytical steps required to examine the socioeconomic impacts of water transfers. These steps are primarily applicable to the transfer of scarce water supplies — presuming that the water to be transferred is currently in use in the area of origin. Modifications required for evaluating the transfer of surplus water supplies are discussed at the end of this section.

The sequence of steps required to analyze the impacts of the transfer of scarce water supplies upon the area of origin is shown in Exhibit III-1.

EXHIBIT III-1.
Development of Social/Economic Impact Assessment Framework



Step 1 – Select Accounting Stance

The initial step in designing and conducting a socioeconomic impact analysis is normally to choose the focus of the analysis, or the "accounting stance" for the study. This step requires considerable judgment on the part of the analyst, because the accounting stance is usually selected prior to most of the data collection and analysis.

Accounting stance options. There are two dimensions to consider in selecting the accounting stance for the analysis: the geographic focus and the socioeconomic focus. The geographic choice determines both the primary location(s) that will be the focus of the analysis and the span of the study. For example, the geographic stance determines whether the study will focus on impacts upon an individual community, a county, a sub-state region, the state as a whole, the United States as a whole, or the planet.

The second consideration is defining the particular groups that will be the primary focus of the study. Some impact studies may logically focus on specific groups, others might consider the economic and demographic conditions of the local community as a whole. For example, the focus of a study could be all residents of the area, all workers in the area, residents in specific occupations (e.g. farmers), residents in specific economic classifications (such as low income households or individuals), residents with specific demographic characteristics (such as gender, age, or ethnic groups) or other subgroups of the population as a whole.

How to select the accounting stance. The "correct" accounting stance for the analysis depends upon the questions the study is seeking to answer. Although investigations into the social equity of a proposed policy or action may legitimately focus on subgroups within the population, broader socioeconomic impact analysis normally encompasses all residents within the geographic span of the study. Analyses of the impacts of water transfers upon the area of origin typically include all residents within the affected area, although additional attention may be paid to special groups such as farmers or employees in farm support industries.

While there is no infallible rule for selecting the geographic accounting stance for a socioeconomic impact analysis, a common sense approach is often useful. The geographic accounting stance should normally encompass the groups that will incur most of the direct effects from the action or policy being analyzed. For an evaluation of the impacts of water transfers on an area of origin, this geographic area would normally encompass at least the areas in which the water supplies are currently used.

Since secondary economic and social effects (defined later in this section) of the action are also considered in a socioeconomic impact analysis, the geographic focus of the study may need to be expanded following subsequent steps in the analysis. For example, information on trade and commuting patterns developed for the baseline profile of the area of origin (step 4) may suggest that neighboring areas be included in the analysis as well.

Additional considerations. The accounting stance should be carefully tailored to suit the information desired from the analysis. An overly narrow accounting stance may result in the omission of important information from the results. For example, if the accounting stance for an analysis of the impacts of water transfers were limited to farmers in the area of origin, secondary effects of the transfers upon the local communities could escape consideration.

On the other hand, the accounting stance may be too broad to yield meaningful results. If the impacts of potential Texas water transfers were measured across the entire United States, the transfer effects would likely be relatively minuscule and insignificant — probably falling within the range of statistical measurement error within national economic data.

Another issue related to selecting the accounting stance for an impact analysis is the importance of separately identifying impacts upon particular groups within the accounting stance of the study. Often the groups that stand to gain from a particular policy or action are different from those that will pay for the action or suffer adverse effects from it. It is important not to overlook the effects of the action upon these groups individually, even though gains and losses may offset one another in the aggregate.

Although it might appear desirable to design the study to completely encompass all direct and secondary impacts, such a broad stance may lead to the problems discussed earlier in this section. For example, virtually any economic policy or action will have some impact on federal revenues due to effects upon income tax revenues and other variables. Yet a national perspective is usually not the most appropriate for assessing local actions or policies.

A final, pragmatic consideration in selecting the accounting stance for an economic or socioeconomic impact analysis is the availability of published data for the area under study. Economic data compiled and published by the United States Department of Commerce agencies (Census Bureau, Bureau of Economic Analysis, Bureau of Labor Statistics, etc.) are generally most extensive and most accurate at the state level, but are also good at the county level — particularly for counties with relatively large economies and populations. Data compiled by state agencies generally follow the same pattern. Published federal and state economic data for sub-county areas such as municipalities are normally very limited. If the selected accounting stance for the study involves only portions of one or more counties, the amount of primary data collection required, and the overall effort and expense of the study, can increase dramatically.

Step 2 – Define The Key Elements Of The Potential Transfer

The characteristics of the potential transfer will determine subsequent inputs to the impact modeling effort. In particular, definition of the following elements is critical for the impact evaluation:

- ***What would be transferred?*** Some transfers may involve water alone, while others would include appurtenant landholdings. Temporary versus permanent transfers must be clearly distinguished.
- ***Where will the water supplies come from?*** The location of the current owners and users of the water supplies will largely determine the accounting stance for the evaluation.
- ***How will the water be conveyed to the new user?*** A conveyance system may be required to physically move water from the original point of diversion to a new point of use. Alternatively, the water may be administratively transferred, by shifting the point of diversion. In the former instance, a projection of the costs and timing of the conveyance facility construction program should be developed for inclusion in the impact evaluation. Identification of the areas likely to supply workers and supplies for the construction work may also be important.

- ***How much water or irrigated acreage would be involved?*** The volume of water required for transfer is an important input for the evaluation of direct responses, discussed in step 5. Some transfers of water from agriculture to other uses make water available by directly removing farmland from irrigation. In such cases, the number of acres affected is the key variable.
- ***How much will be paid for the water supplies?*** A voluntary water transfer normally requires the purchase of the water rights, with or without appurtenant landholdings. The amount of compensation for the water supplies, on a per acre-foot basis if the right alone is purchased or a per acre basis if the land and water are purchased together, must be determined or estimated.
- ***When would the transfer take place?*** As noted in the case studies, the timing of the transfer of ownership of the water rights may or may not coincide with the actual removal of water from its prior use. Transfers projected to occur a number of years in the future will generally need to be examined against projected baseline conditions without transfer.

How to identify the key elements. Details of the potential transfer will often be uncertain at the time of the impact evaluation. For example, the price to be paid for the water rights and the volume of water to be transferred may not be determined prior to negotiations during the actual process of acquiring water rights (and landholdings). The analyst may begin by seeking as much information as possible from the party(ies) interested in acquiring the water supplies about their objectives and plans for the acquisition.

The analyst should recognize that the party seeking water supplies may be unwilling or unable to provide a complete picture of the potential transfer, or may have faulty expectations about the transfer. In cases where the available information is limited or uncertain, the analyst should be prepared to develop reasonable assumptions about aspects of the transfer proposal that are unclear, and to test the sensitivity of the results of the analysis to variations in these key assumptions. For example, the researcher may need to construct several scenarios concerning transfer volumes and compensation.

Estimation techniques when the price of water is unknown. Among the elements of the transfer that may be particularly uncertain is the price to be paid for the water supplies involved in the potential transfer. The analyst may, however, be able to bound the range of possible prices with some relatively straightforward research and analysis. The analysis can then be structured to permit an evaluation of the sensitivity of the results to changes within the bounds.

If the water supplies are to be transferred to municipal and industrial use, it may be possible to determine the ceiling price which the acquiring entity might be willing to pay based upon the avoided cost of alternative sources of supply. The total cost of purchasing water supplies from the prior owner(s), conveying the raw water to the municipal system and treating the water for potable use will normally be less than the cost of developing potable water supplies from another source, such as the development of additional surface water storage. In fact, the attractiveness of water transfers to municipal suppliers is that transfers are often a much cheaper alternative. Nonetheless, the avoided cost approach is a mechanism for determining the highest conceivable price that could be paid to the original owners, net of other costs for conveyance, storage, treatment, etc.

The floor price for transfer supplies is normally the economic benefit that the current user obtains from the water in its existing use. For example, the annual economic benefit of water currently used for irrigation can be estimated by comparing the net income from irrigated farm lands to the returns from non-irrigated land of comparable quality in the same area.

To assess the value of water permanently transferred from irrigation use, the annual economic value of the water can be capitalized into a single value based upon a couple of approaches. Under the "income valuation approach," the annual benefit of the irrigation supply is summed over a period of time, with future benefits being adjusted to present value based upon a discount rate. Unfortunately, the choice of the discount rate is both subjective and important. A simpler, but often still reasonable, alternative is to assume that the capitalized annual benefit of irrigation water is fully reflected in differences in the recent sales prices for irrigated and nonirrigated farmland of similar quality. This alternative allows the analyst to use market data to estimate the floor price for the sale of agricultural water supplies.

Generally similar approaches could be used to estimate the ceiling and floor prices for transfers other than from agriculture to municipal users. Since both the buyer and seller of the water supplies will also wish to recover their transaction costs (e.g. legal fees and other costs associated with the transfer), the actual price for the water is likely to be somewhat greater than the floor price and somewhat less than the ceiling price.

Estimation methods when quantity of water to be transferred is unknown. If the volume of water that might be transferred is unclear, the analyst may need to test the effects of a range of transfer levels. One extreme is to assume all agricultural water supplies in the area of origin will be transferred. The impacts from this transfer level can be compared with alternative assumptions. If the water is to be transferred to municipal use, long range water demand forecasts used for planning purposes by the municipal water supplier may provide additional clues about the volume of the potential transfer.

Construction of facilities. If water supplies are to be physically conveyed from the area of origin to the receiving entity, the impacts of construction of conveyance facilities should also be incorporated into the analysis. In particular, approximate information about the expenditures and employment associated with the construction phase is important. The entity pursuing the transfer may have performed reconnaissance engineering evaluations to approximate these costs. If these evaluations are not available, qualified engineers can normally produce a rough estimate of the construction requirements and costs based upon information concerning the number of miles of pipeline, pump lift requirements, and the volume of water that may be moved.

Step 3 – Identify Potential Impacts from Water Transfers/Seek Local Input and Participation

Review of previous studies of the social and economic effects of water transfers demonstrates that transfers can lead to a broad array of impacts, and that the extent and magnitude of impacts may vary considerably based upon a number of factors. Early identification of the full range of potential impacts and potentially affected parties assists in focusing the subsequent steps in the analysis and selecting appropriate analytical methods.

The following discussion outlines categories of potential impacts from water transfers and discusses some key considerations which will help determine the extent of each category. For purposes of this discussion, impacts have been segregated into several categories: direct socioeconomic impacts from the transfer, secondary socioeconomic impacts, and other impacts.

The range of potential impacts, and the specific nature of the economic and social effects, depend partly on the unique circumstances in the area of origin. Instituting a public participation program at this early stage in the impact analysis will provide an opportunity for the analyst to obtain local insights into key issues concerning the transfer. This program can assure that locally important considerations are not overlooked in the analysis. Public participation from early on in the impact evaluation is also likely to increase "buy in" from the area of origin which may ease subsequent data collection steps and enhance the ultimate understanding and credibility of the results.

There are a number of ways to begin the public participation program. Advertised, open public meetings at this stage of the analysis and later, to review preliminary findings, are likely to be helpful. It may also be possible to create a public advisory group to assist in the analysis through early discussion with community leaders.

Definitions. "Direct" impacts include all effects of water transfers upon the industries or entities which would provide the water supplies for the transfer. For example, in the case of water transfers from agriculture to other uses, direct impacts may include reduced crop production, reduced farm revenues, decreases in farm employment, a decrease in the farm population of the area, changes in farm land values and payments received by farmers for the water supplies. A more extensive discussion of the range of these impacts is presented later.

"Secondary" socioeconomic impacts result from "ripple" effects throughout the local economy in response to the direct impact. Secondary impacts are often further classified into indirect impacts and induced impacts. Indirect impacts result from changes in purchasing by the directly affected sector from other local businesses. For example, in the agricultural transfer case, indirect impacts may include effects on local farm equipment suppliers, banks, utilities, and other local businesses. In some transfers of agricultural water supplies, indirect impacts may also include effects on processors and shippers of agricultural production. (This is a special case, termed a "forward linkage.")

As a result of both the direct impacts and the indirect impacts, the number of jobs and income in the affected sectors would be reduced. This change in household spending capability can then affect the revenues of local businesses that cater to household needs, and the receipts of local governments. These secondary effects are known as "induced impacts."

Other Impacts. The category of "other" impacts, as defined for this study, includes less traditional types of impacts that nonetheless may be an important issue for a particular water transfer proposal. For example, this category might include possible impacts upon downstream water quality and effects upon recreational opportunities.

Examples of potential impacts. When water is transferred from agricultural use in the area of origin to alternative use in the receiving area, a number of direct impacts are likely to occur, including:

- ***Direct payments to landowners.*** To participate voluntarily in a water transfer, farmers must be compensated for the value of the water supplies that they are giving up. For farmers to be willing participants in the transfer, the payments should equal or exceed the value of the water to the farmer. Components of this value will be examined in greater detail later in this section. Whether or not compensation which the farmer receives for the transfer is reinvested in the local economy will have an important influence on the magnitude and nature of secondary impacts from the transfer.

- ***Change in land use and crop production.*** Farmers within the area of origin may supply water for transfer through any of four types of modifications in their farming practices depending upon how the transfer occurs and upon local agricultural conditions. First, farmers may simply apply less water across all of their lands, but continue to irrigate the same acreage. This response may require a change in the types of crops grown, or investment in more efficient types of irrigation. Second, farmers may retire a portion of their lands and continue current cropping and irrigation practices on the remainder of their land holdings. Third, farmers may shift some acreage to dryland farming or ranching. Finally, farmers may retire all of their lands and cease farming altogether. For example, if land as well as water is purchased by the entity seeking transfer, the lands may be retired rather than leased to farmers for continued production.

  The responses of individual farmers within the area of origin will depend upon specific characteristics of the transfer proposal, including the manner in which the transfer is administered, the price offered and the quantity sought. The responses will also depend upon distinctive local farming characteristics including the variability in quality of irrigated land and the potential for dryland farming or farming with reduced irrigation.

The magnitude of the water transfer and the manner in which farmers respond to a transfer offer will determine the extent of additional direct impacts within the area of origin, including:

- Changes in farm income,
- Changes in land value,
- Changes in temporary and permanent farm labor, and
- Changes in farm population.

Direct impacts on farm activity may lead to a range of secondary impacts within the area of origin. For example, if a farmer works fewer acres as a result of the transfer, he will likely purchase less seed, fertilizer, temporary labor and other inputs. Reduced revenues in these farm related activities may translate into decreases in purchases from local retail stores and a reduction in tax revenues for local governments. As in the case of direct impacts within the area of origin, the extent of secondary impacts will depend upon both the specifics of the transfer and the existing characteristics of the area of origin.

Secondary impacts within the area of origin are of particular concern because they are often uncompensated, unlike direct impacts which can be offset by payments to farmers for the transferred water supplies. Types of secondary impacts include:

- ***Backward-linked industries.*** Local businesses supplying goods and services to impacted farms and ranches may themselves be affected by the transfer. These may include suppliers of fuel, agricultural chemicals and seed, agricultural equipment, and other goods and services used by local irrigators. Other groups including lenders, power providers and equipment repair shops could also see changes in demand for their services. The significance of these impacts will partly depend upon the extent to which irrigators purchase goods and services locally.

- ***Forward-linked industries.*** Local businesses that depend upon local farm produce may be impacted. Forward linkages include businesses involved in storing and transporting local produce, marketing local produce, and processing local produce. Farm cooperatives, as well as conventional private businesses, could be affected.

- ***Local service industries.*** Retail stores, local service providers, and other community businesses not directly serving the agricultural sector may also be affected by water transfers. To the extent that transfers reduce employment and income on local farms and in linked industries, fewer dollars may be spent within the community to meet household needs. The relative magnitude of this impact will partly depend upon the nature of the area of origin economy. Effects will likely be greatest in cases where the local economy is both relatively isolated and highly dependent upon agriculture.

- ***Local governments.*** County and municipal governments, as well as school districts, may be financially impacted by water transfers. To the extent that direct impacts of the transfer reduce the value of local property and induced impacts result in diminished local sales activity, the principal sources of local government revenues may diminish. While decreases in local population may also reduce service demands upon local governments, the decrease in revenues could exceed the decrease in expenditures if there are substantial fixed costs or economies of scale in government and education. To compensate, local governments may be forced to increase tax rates or fees.

- ***Households.*** Diminished opportunities for local employment may require households to commute or move elsewhere for work.

- ***Social and cultural institutions.*** If transfers have substantial impacts upon local employment, income and households; social and cultural institutions such as churches and membership organizations may be faced with declining interest, participation and enrollment. These institutions may find that they can no longer continue to be viable if participation declines substantially.

- ***Foregone development.*** Water transfers, if substantial, might negatively affect the opportunity for future non-agricultural development in the area of origin if the remaining water supplies could not support prospective opportunities. Also, any downturn in the perceived long term economic prospects for the area may lead to other negative impacts (or this perception may be a negative impact in and of itself).

Apart from the impacts outlined above, transfers may have impacts upon other parties, including:

- ***Downstream water quality effects.*** To the extent that transfers change the timing and location of water return flows, they may positively or negatively impact water quality downstream from the area of origin. Along with potential environmental considerations, changes in water quality may have social and economic implications for downstream users in terms of the productivity and/or treatment costs of their water supplies.

- ***Recreation effects.*** Changes in the location of water use may impact in-stream flows or the volume of water in storage in the receiving area, with potential impacts upon fishermen, boaters and other recreationists.

- ***Construction effects.*** If the transfer scenario includes physical conveyance of water supplies from the area of origin to the receiving area, extensive construction may be involved. Construction may have impacts on the area of origin, the receiving area and any communities in between due to the creation of a temporary workforce based in those areas.

How to identify potential impacts. Identification of potential impacts requires:

- definition of the key elements of the transfer proposal (from Step 2),
- at least a general understanding of the ways in which the water resources to be transferred are currently used within the area of origin, and
- some knowledge of relationships between the water using sector and other economic activities in the area of origin; and between water use in the area of origin, local recreation and downstream water users.

Much of the information necessary to identify potential impacts can be gained from initial interviews with organizations of water users in the area of origin, and individuals knowledgeable about the local economy — such as local water conservation districts, local government staff and chamber of commerce representatives. It is not necessary to develop a complete and detailed understanding of the local economic structure at this stage of the analysis. A more comprehensive view of the local economy is the subject of later steps in the impact analysis.

Additional considerations. The purpose of the initial identification of potential impacts is to help focus the data collection effort which begins in the following step, and to identify key questions for the analysis. For example, this initial overview may suggest that the water supplies considered for transfer are largely or entirely surplus supplies. In this case, the impact analysis effort should likely be focused upon determining whether or not the supplies could likely be put to beneficial use in the area of origin within any reasonable planning horizon, any construction effects of the transfer, and potential impacts on local recreation or downstream water users.

If the reconnaissance evaluation of potential impacts indicates that transfer supplies are currently in use within the area of origin and immediate economic impacts are likely, the issue of the accounting stance for the study should be revisited. If the early interviews during this step indicate strong trade patterns between the affected sector and businesses in nearby counties, it may be prudent to consider expanding the focus of the analysis to also incorporate these areas.

Step 4 – Develop Baseline Socioeconomic Profile Of the Area Of Origin.

As noted in the overview at the beginning of this section, "baseline" conditions are the set of conditions (economic, demographic, social, etc.) that currently characterize the area being studied, or that could be expected to occur in the future if the action being studied did not take place. In evaluating water transfers, the baseline conditions identified in this step present a detailed picture of what the area of origin is like prior to transfer, or would be like in the future if the water is not transferred from the area.

The baseline profile serves two purposes. First, the baseline profile will ultimately be compared to the conditions that would result from the proposed water transfer to determine the magnitude and significance of socioeconomic impacts. Second, through development of the baseline profile, key relationships between the water using sector (e.g. agriculture), the remainder of the local economy, local institutions, and the population of the area of origin will be identified in much greater detail than the overview developed during the previous step of the analysis. The extent of these linkages is important in calibrating the impact model and estimating impacts.

Elements of the baseline socioeconomic profile. The baseline socioeconomic profile of the area of origin describes the area in quantitative terms. There are a number of elements which should be included in the baseline profile. Which elements should be profiled in greatest detail depend partly upon the characteristics of the transfer proposal. The following, however, is a generic list of elements which should apply to many transfer scenarios.

- ***Agricultural profile.*** (For any transfer involving irrigation supplies.) Trends in acres planted and acres irrigated. Cropping patterns, rotation practices, and crop yields for irrigated and non-irrigated farms. Water requirements for irrigated crops. Input requirements by type and value for each major irrigated and non-irrigated crop in the area and information on local versus non-local purchasing of major inputs. Land tenure, debt/equity position of farmers, land values for irrigated and dryland, leasing rates.

- ***Economic elements.*** Trends in total employment and employment by sector, including farm employment. Current unemployment rate and recent trends. Major employers in the area and key sources of basic employment. Decomposition of area income into wage and salary, and non-wage components. Median household income. Household income distribution. Extent of commuting to and from the area.

- ***Demographic elements.*** Current population of the county(ies) comprising the area of origin, and of principal communities within the area. Population growth trends and data regarding net migration to or from the area. Breakdown of the population by age and gender categories. Household structure within the area, including average household size. Labor force size, growth rate and participation rate.

- ***Public sector fiscal elements.*** Identification of principal local government entities in the area of origin, including county governments, municipal governments, school districts and special improvement districts. For entities that may be impacted: revenue base (e.g. assessed valuation), current revenue levels by source and trends in revenues by source, scope of services and expenditure levels by function. Outstanding general obligation and revenue debts and debt repayment requirements may also be important.

- ***Community institutions.*** Identification and general description of principal social, educational, cultural and religious institutions.

The baseline socioeconomic profile of the area of origin may be further illustrated by example. Section VII provides a summary profile for Medina and Uvalde Counties as part of the Edwards Aquifer case study.

How to assemble the baseline profile (data sources). Information that will prove useful in creating a profile of each of these socioeconomic elements can be gathered from the sources listed below, among others.

- ***Agricultural data.*** Information about local land use and cropping patterns can be assembled from the Census Bureau's Census of Agriculture, the Texas Water Development Board's Surveys of Irrigation and the Texas Agricultural Statistics Service's publication series entitled Texas Agricultural Statistics.

  In addition, the Census of Agriculture offers estimates of livestock inventories, irrigation patterns, agricultural production revenues and other production-related information. The Census also provides descriptive data regarding the farm population such as the type of farm ownership, tenure of farm operators, average farm size and number of hired farm laborers.

  The Texas Water Development Board compiles its Surveys of Irrigation every five years, publishing results regarding irrigated land acreage, crop acreage, crop water use, groundwater versus surface water irrigation sources and aggregate farm water use. Useful data from Texas Agricultural Statistics include estimates of crop acres planted and harvested, crop yields and prices, livestock production and prices. Additional local farm data are prepared by the Texas Agricultural Extension Service in its regional divisions in the form of crop budgets. The budgets provide estimates of the costs of crop inputs, yields, revenue, break-even prices and profitability.

- ***Economic data.*** The U.S. Bureau of the Census' decennial Census of Population data include estimates of employment, unemployment, household income distribution, commuting patterns and other economic-related information. Complementary data can be taken from the work of the U.S. Bureau of Economic Analysis, including total earnings by industry, wage and salary income, total personal income and employment estimates. State and local agencies such as employment offices, university business research departments and economic development commissions often maintain economic records at state, county and sub-county levels.

- ***Demographic data.*** The principal source of demographic data for many uses is the US Bureau of Census, Census of Population. The Census includes estimates of population, age and gender composition, race and ethnicity profiles, household structure and labor force characteristics. State Data Centers and/or other local government offices may provide population and demographic estimates for additional sub-state areas or by using different methods than the Census.

- ***Public sector data.*** County and municipal budget offices can be a wealth of local fiscal information. Direct contact with utility providers or regulatory bodies, state education departments and tax collection/redistribution entities may prove helpful. Estimates of assessed property values, tax structures, and public expenditures can be provided by these bodies.

- ***Community institutions.*** Long-time community residents, Chambers of Commerce, United Way agencies, lodges and similar contacts can help to identify the significant business, civic and social organizations in a community. General descriptions of these organizations can then be assembled from interviews with representatives of the institutions themselves and with appropriate regulators, licensers or public officials.

When to project baseline conditions. The impact scenario may ultimately be compared to either current conditions or to a forecast of future baseline conditions for the area of origin without transfers. Whether or not development of a baseline forecast is necessary and prudent depends upon both the timing of the proposed transfer and the social and economic stability of the area of origin.

Comparing an impact scenario to a baseline projection, rather than current conditions, increases the complexity and cost of the analysis and injects further elements of uncertainty. As development of a future baseline projection will require the analyst to make additional assumptions beyond those required to create the impact scenario, this approach poses the risk that the validity of the forecast may be debated and distract attention from the impact analysis itself.

Nonetheless, under certain conditions it may be necessary to develop a future baseline forecast for the area of origin. If the transfer is projected to occur a number of years in the future and involves water supplies that are currently surplus but that may become scarce, a future baseline projection is necessary to determine the opportunity cost of the transferred water supplies.

Alternatively, if the economy in the area of the origin is in a state of transition, a future baseline projection may be required to ensure that impacts attributable to the water transfer are not confused with the impacts that would occur anyway due to other factors. For example, in a suburban area that is undergoing rapid land use conversion from agriculture to residential and commercial property, the baseline projection may indicate that the demand for agricultural water supplies is declining. Under these conditions, irrigation supplies that would be scarce if the transfer occurred today might be surplus if the transfer is projected to occur ten or twenty years in the future.

Additional considerations — how to project future baseline conditions. The only thing certain about projections of future regional economic and demographic conditions is that they will, almost by definition, be wrong. Developing these types of projections is an endeavor which can easily become as complicated as regional impact assessment, and probably deserves a separate and comprehensive treatment beyond the bounds of this discussion. Since the focus of this effort is impact analysis, not socioeconomic forecasting, the best approach to projecting future baseline conditions may be to adopt and enhance existing population and employment forecasts for the area which may be available from the state, the local council of government, or the local municipal or county governments.

If existing forecasts are unavailable, there are simplified approaches to projecting future socioeconomic changes which may be useful if a projected baseline is warranted. Probably the simplest method of projecting future economic and demographic conditions is to forecast continuation of recent trends. To produce this type of forecast, historic employment growth rates in local economic sectors can be calculated from the data gathered for this step and used to forecast future employment in each sector and in the aggregate.

Of course, this approach begs the question of how long a historic period should be used in calculating the growth rates. As a rule of thumb, it is probably wise to review historic data for a period of time comparable to the length of the projection period, although more recent trends may be weighted more heavily in the forecast. It is almost never acceptable to produce a long term forecast (e.g. 20 years) based upon only very recent trends because short term economic data always reflect business cycles.

The trend based forecast can be subjectively modified to incorporate specific local information about foreseeable events. For example, if a major local employer will be significantly changing the scale of their operation and workforce, this information should be used to modify the trend based forecast (if it is not already imbedded in the forecast).

Once total employment and employment by sector have been projected, local income and demographics can be estimated based upon current relationships to employment and the employment forecast. Alternatively, the demographic forecast can be produced separately based upon population growth trends. If the latter approach is taken, however, population to employment ratios should be assessed for reasonableness over the forecast period.

It should be emphasized that the approach to projecting baseline conditions just outlined is a very simplified method. Much more sophisticated forecasting techniques are also possible, including cohort-component demographic forecasts (discussed further in Step 7) and econometric employment forecasts which relate local employment to state, regional, or national projections.

The reason relatively simple projection techniques can be used is that the focus of the impact analysis is the incremental difference between baseline conditions and the impact scenario. Even if the absolute employment or population projected under the baseline scenario is incorrect, the impact assessment can still be accurate if the baseline and impact scenarios consistently reflect the underlying employment and population projections.

Step 5 – Estimate Direct Responses (Direct Impacts)

With the potential transfer and baseline conditions in the area of origin clearly defined, the next logical step is to project the responses of the industries or entities directly affected by the transfer. The goal of this step is to produce a quantified description of the directly impacted sector's activities in the area of origin before and after the transfer of water supplies. This step will result in the estimation of most of the direct economic impacts from the transfer and provide critical information for subsequent determination of secondary economic, demographic, fiscal and social impacts.

How to estimate direct responses. The majority of potential Texas water transfers are likely to involve water that is currently used or controlled by irrigators. With this in mind, the focus of the discussion in this step is identifying farm responses to a potential transfer. However, the same basic technique, with some modification, could also be applied in other circumstances. For example, if the water supplies considered for transfer were in industrial use, identification of the activities of that industry before and after transfer would follow a similar approach to that described below. If the transfer were expected to primarily affect recreational opportunities, a similar assessment could be performed for the local tourism and recreation sector.

Agricultural responses. A conceptual model of farm responses to transfers is depicted in Exhibit III-2 on the following page. Prior to transfer, three types of farm activity are assumed to occur in the area of origin: irrigated crop production, dryland crop production, and livestock raising. From the detailed agricultural data developed as part of the baseline socioeconomic profile of the area of origin, existing farm activities of each type are further disaggregated into the number of acres planted by crop type or in use for livestock raising by animal type. These acreages are multiplied by crop specific factors for input use per acre, yield, price, water use, and contribution to farm income. The product of this multiplication is total farm input use, yield, value, water use and farm income for each crop type. When aggregated across all crop and animal types in the area of origin, this information will provides a quantitative description of baseline farm activity in the area of origin.

In response to the transfer opportunity, farmers may sell some or all of their water supplies and change the patterns of their land usage. In this model, the agricultural response is simulated by changing the number of acres planted by crop type. The crop specific per acre factors developed earlier are then applied to the new crop mix, and the resulting products are summed to produce a quantitative description of post-transfer farm activity in the area of origin. The difference between the pre-transfer and post-transfer calculations of farm production, value, income, water use and input uses are measures of the direct economic impacts of the transfer.

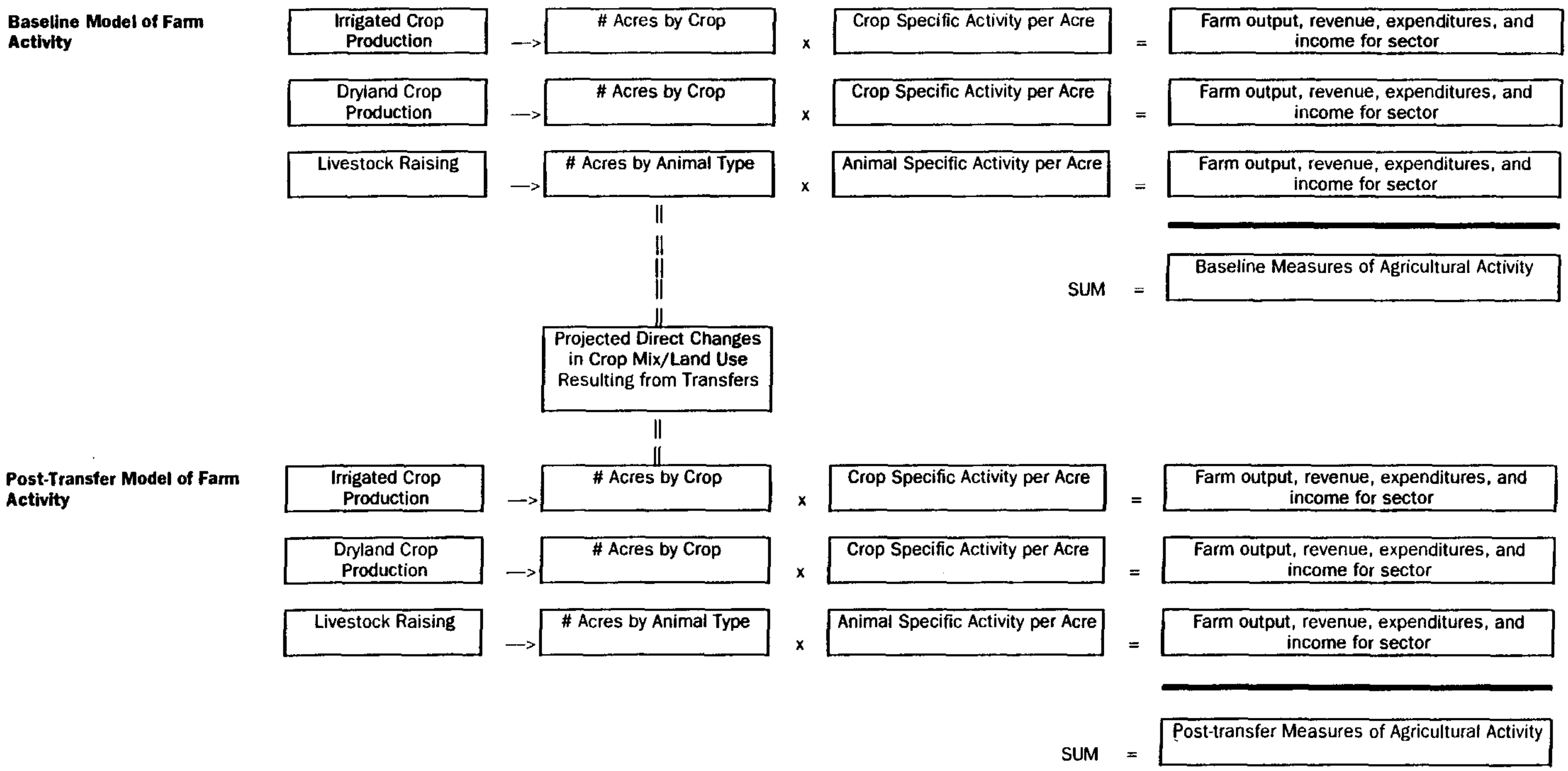
Agricultural economists have developed very sophisticated models of crop selection strategies. While these models may add precision to the analysis, a less complex and more transparent approach may be preferable when evaluating the permanent transfer of agricultural water supplies.

The simplified approach relies upon the fundamental assumption that farmers will act in their own economic and financial best interest. However, the multiple factors that may influence farmers' crop selection decisions are often oversimplified in crop choice models developed by economists. For this reason, we suggest two alternative approaches to modeling the changes in cropping patterns that could result from transfers.

Under an assumption that data on farm net incomes per acre by crop type fully reflect the value of alternative crops, it can be presumed that the uses of water that provide the least economic return to the farmer will be the first to be offered for transfer. Low value crops on more marginal lands will be the first to be withdrawn from irrigation, while high valued crops, such as vegetables, will generally be the last to be forsaken.

Crop selection decisions may be more complex than indicated on the basis of net income per acre alone. Historical cropping patterns in the area may indicate that certain crops, such as cotton and corn, are often grown in rotation on the same lands because the crops have complementary properties. Farmers are likely to continue these historical cropping rotations on lands that remain irrigated following the transfer. Crops also have different risk characteristics, and farmers may choose to grow a selection of crops to minimize risk while still meeting income goals. In cases of surface water transfers, the water buyer may target specific supplies based upon the priority date and quality of the water rights. For all of these reasons, a second option of simply making a proportional reduction in the acreage dedicated to each type of crop may sometimes be preferable to the pure net income maximizing approach.

EXHIBIT III-2.
Conceptual Model of Agricultural Responses to Water Transfers



Source: BBC Research & Consulting.

Once the farm activities that would be eliminated by the transfer have been identified, the next issue is to project the subsequent use of lands severed from their historic water supplies. Once again, farmers can be expected to maximize the return on these lands. Formerly irrigated lands may be shifted to dryland crop production if this practice is feasible and financially viable in the area. Alternatively, the lands may be shifted to grazing, or simply left in fallow if neither dryland cropping nor pasturage is feasible.

Responses of recreational users. Another type of direct economic impact can occur if water transfers lead to changes in recreational amenities. For example, transfers might lead to reduced streamflows or changes in the amount of water stored in reservoirs within the area of origin. These changes may, in turn, affect the "value" of the recreational opportunities available in the area.

The approach to evaluating economic impacts resulting from changes in the use of recreational sites is conceptually similar to identifying direct impacts on agriculture, as described earlier. Once again, the first step is to develop detailed information about the current characteristics of the recreational site(s) and its usage. Developing this baseline consists of five steps:

- characterize existing recreational amenities,
- identify annual number of users and seasonal usage profile,
- identify average length of visitor stay,
- estimate average visitor expenditures per day, and
- from the above, calculate local expenditures resulting from the recreational amenities.

Estimating the impacts of transfers on recreational usage and related local expenditures requires information on how the recreational amenities will be affected by the transfer, and how visitors will respond to these changes. If the recreational amenity(ies) will be eliminated with the water transfer, calculation of the direct economic impact follows directly from the baseline profile developed above. If the amenity will continue to exist, but be substantially modified, visitor responses may be inferred from surveys of current recreation users or analysis of visitor data from sites with conditions like those expected after transfer. From the revised estimate of annual visitors, the previous steps can be repeated to estimate the direct expenditures from recreation that will occur after transfer. The difference between this revised level of activity and the baseline represents the direct economic impact from changes in recreation.

The methodology just described is appropriate for evaluating what economists term the "use value" of recreational resources. Theoretically, environmental and recreational amenities also may involve "non-use (or existence) values." For example, preservation of the Grand Canyon is perceived to hold value for many Americans, even those who may never visit the National Park.

Evaluating changes in the non-use values of environmental or recreational resources impacted by water transfers is considerably more difficult than estimating changes in use values. This type of analysis is normally conducted by means of a technique called "contingent valuation" which involves the analysis of surveys to assess individuals' willingness-to-pay for preservation of existing amenities. While the technique of contingent valuation is fairly well established, economists continue to disagree about the validity of the estimated values derived from this technique.

Changes in water quality. Certain water transfers may lead to changes in water quality within the area of origin and/or downstream from the transfer. Conceivably, water quality may be either improved or degraded (or improved in one watercourse or aquifer and degraded in another) depending upon the specifics of the transfer and the manner of conveyance of the transferred supplies.

Changes in water quality may lead to direct economic impacts if there will be a substantial difference in the productivity of the water supplies following transfer (for example in irrigation use, or to sustain stream fisheries), or if additional treatment of the water will be required prior to consumptive use. In the former case, after projecting changes in the productivity of the water supply resulting from the proposed transfer, direct impacts on agriculture or recreation can be estimated using the approaches described earlier. In the latter case, an engineer's cost estimate of the additional treatment required following transfer can be used as the basis for evaluating potential impacts on consumer water rates.

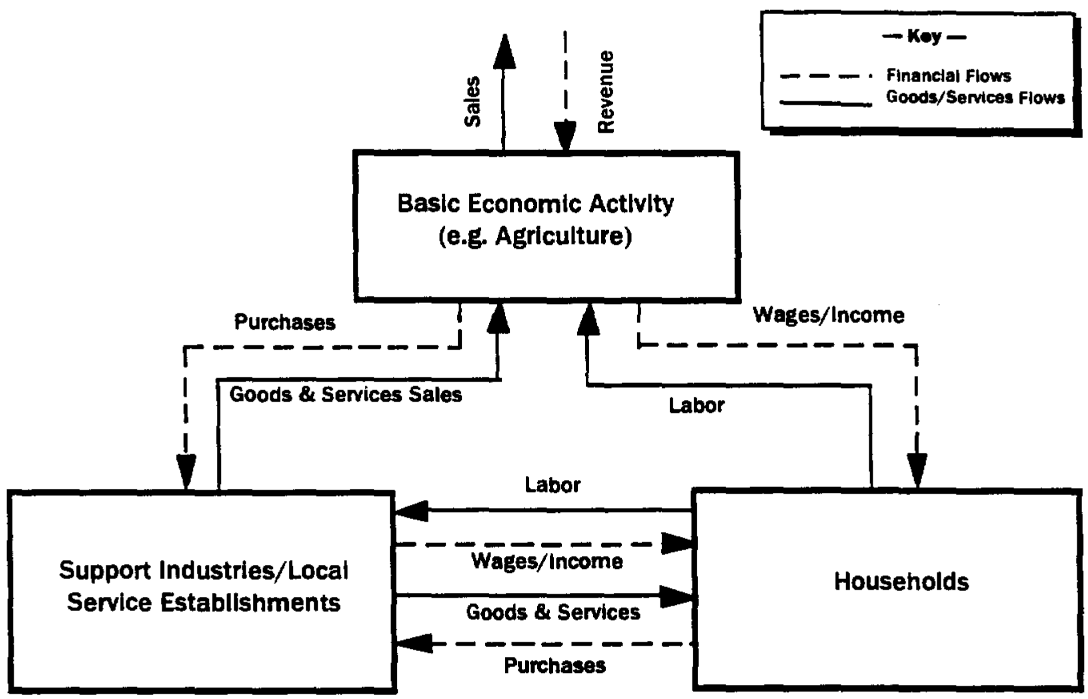
Step 6 – Estimate Secondary Economic Impacts - (Indirect and Induced Effects)

The projected farm responses (or responses of another directly impacted sector as appropriate) to the transfer proposal, developed in the previous step, provide a quantitative estimate of the direct economic impacts of the transfer proposal. The next logical step is to estimate secondary impacts upon other economic sectors that could be generated by the direct impacts.

As summarized in the previous discussion of Step 3, secondary economic impacts are changes in economic activity in sectors that supply goods and services to the directly impacted sector or to the households of employees in the directly impacted sector. This definition may be clarified by consideration of a conceptual model of a regional economy.

Conceptual model. Secondary economic impacts from water transfers can be readily visualized by considering a simplified and largely self-contained local economy consisting of three components. Agriculture is a "basic" economic activity, providing sales to consumers outside of the local economy and bringing revenues into the economy. These revenues are then split between payments to support industries and local service establishments for goods and services, and payments to households for labor (including the farm owner's household). The support industries/local service establishments, in turn, also hire labor from households and provide wages to them. Finally, households purchase goods and services from the support industries and local service establishments. These relationships are depicted graphically, in Exhibit III-3 on the following page.

EXHIBIT III-3.
Simplified Local Economic Structure



Source: BBC Research & Consulting.

The direct impacts of water transfers represent a reduction in the sales from the agriculture sector and the revenues accruing to the sector. As depicted in the graphic, this reduction then leads to an overall contraction in the economy as agriculture purchases fewer goods and services from support industries and less labor from local households, and so forth. Along these conceptual lines, secondary economic impacts are often distinguished into two types: indirect impacts and induced impacts. Indirect impacts occur as a result of changes in purchases of goods and services by the directly impacted sector (agriculture) from other sectors (such as seed and chemical suppliers, local banks, other local merchants). Induced impacts occur as a result of decreases in incomes and spending by workers and owners in both the directly impacted sector and the support industries.

In reality, of course, local economies are neither simple nor self-contained. Differences between the actual structure of the economy in the area of origin and the economy in the simplified model generally tend to reduce the magnitude of actual secondary impacts. From the standpoint of secondary economic impacts, the most important differences between most local economies and the model are diversity of basic economic activities and trade flows between regions.

Even in predominantly agricultural areas, local economies may include other basic economic activities such as tourism, manufacturing, mining, and energy production. A diversified economic base provides multiple sources of revenue for the region, a more solid base of support for local service establishments and a broader range of employment opportunities. Secondary economic impacts from water transfers are likely to be proportionally less significant in cases where the area of origin features a diversified economic base.

If there are extensive trade flows between the area of origin and surrounding regions, secondary impacts will tend to be diffused. In particular, if local farmers purchase many of their inputs from other areas and hire migrant labor forces, impacts within the area of origin will tend to be reduced. The same is true if much of the local population commutes to other areas for work. Secondary impacts will tend to be greatest in areas that are largely isolated and self-contained.

Alternative methods of estimating secondary impacts. There are several established methods for estimating secondary economic impacts, including the economic base approach, survey-based input-output (I-O) models, non-survey based I-O models, econometric models and composite models which incorporate one or more of these techniques and other features. These methods vary in complexity, cost, data requirements and specificity of output. A summary of these approaches is provided, followed by a discussion of considerations in selecting from the available approaches.

Economic base models. The economic base approach is the most straightforward of the three methods for modeling secondary economic impacts in conceptual terms. Under this approach, regional employment or income is carefully scrutinized and divided into basic and non-basic, or local service, categories. Basic economic sectors are those that produce goods and services for consumption beyond the local economy and bring revenues into the local area. Local service sectors are dependent upon consumers and other industries within the local area.

Under the economic base approach, basic employment is presumed to provide the support for local service employment in the economy. The objective of this approach is the estimation of the total employment/basic employment ratio, or multiplier. If, for example, a local economy includes 4,000 jobs in the basic economic activities of tourism, mining and energy production and 6,000 jobs in other sectors catering to local residents and businesses (10,000 total jobs), the total employment/basic employment multiplier would be 2.5 (total jobs divided by basic jobs). In this example, it can then be inferred that the elimination of 100 basic jobs would lead to a further reduction of 150 jobs in local service sectors, for a total of 250 jobs lost. An alternative, and sometimes more defensible, approach is to perform a comparable analysis based upon basic and total employment *income* in the economy.

Pre-packaged models include econometric forecasting/simulation models, non-survey input-output models and integrated modeling systems. These pre-packaged alternatives are discussed in turn.

Econometric models attempt to identify historical statistical relationships between economic variables and forecast future economic activity based upon these relationships. These models are widely used to develop forecasts of economic growth at the national level. For example, the models will statistically measure the relationship between interest rates and housing construction.

Econometric models have also been developed for regional forecasting purposes and, with the capability of simulating multiple scenarios, can be used for impact assessment. Typically, regional econometric models rely upon historical statistical relationships between regional measures of economic activity (output, income or employment) by sector and comparable measures of national activity in the same sectors. By tying these statistical relationships to national forecasts of economic growth, regional econometric models produce dynamic forecasts of regional employment, income and output by sector. Some of these models also have a demographic component and produce projections of population change as well.

The econometric model developed and marketed by Data Resources International (DRI) is used by a number of electric utilities for load forecasting and planning purposes. The DRI model allows the user to manually adjust employment in individual sectors or other policy variables at any point during the forecast period to simulate alternative scenarios. The econometric equations are sufficiently interrelated, through incorporation of population and per capita income factors, to allow the model to simulate some of the interaction between economic sectors. Comparison of the scenarios allows for impact estimation.

Input-output analysis is probably the most frequently used approach to assessing secondary economic impacts. An input-output model is a mathematical representation of an economy, in which a change in the output of an industry such as irrigated agriculture is linked to changes in sales from support industries, changes in wages paid to industry employees and changes in purchases by employee households from other sectors.

Regional input-output models were originally derived from extensive survey research into the purchasing and sales patterns of industries and households. During the late 1970s and the early 1980s, survey-based construction of input-output models became generally recognized as prohibitively expensive, while the demand for this type of tool increased substantially in response to environmental regulations and more proactive community planning efforts. Proliferation of personal computing power and electronic databases encouraged the search for non-survey approaches to regional economic impact analysis and forecasting.

A number of pre-packaged, non-survey based I-O models are currently available for regional analysis. Perhaps the most prominent models are the two I-O systems originally developed by Federal agencies: the RIMS II model developed by the United States Bureau of Economic Analysis (BEA), and the IMPLAN model, originally developed by the United States Forest Service (USFS).

There are at least two existing models that provide a more integrated approach to estimating demographic and fiscal impacts, as well as economic impacts. These include the model developed by Regional Economic Models Incorporated (REMI) and the model developed by Texas A&M (TAMS).

Selecting a method for estimating secondary impacts. To select from the approaches to estimating secondary economic impacts just described, the analyst should consider the specifies of the potential transfer, the amount of time and money that can be expended upon this portion of the analysis, and the strengths and weaknesses of each approach.

For the case study of the Edwards Aquifer, discussed in Part B of this report, we chose to rely primarily upon the IMPLAN input-output model, supplemented with additional information and analysis following general economic base approaches. Although IMPLAN could be applied to analysis of any county in Texas, this model may not be the most appropriate technique for analyzing every imaginable water transfer. To assist in the selection of the appropriate technique for the particular circumstance, the following discussion highlights strengths and weaknesses of each approach.

Economic base analysis. An advantage of the economic base approach is that the analysis is constructed from the bottom up — requiring a very close examination of the current state of the local economy. In practice, few broad industry categories (such as the one digit SIC classifications of agriculture; mining; construction; manufacturing; wholesale trade; retail trade; transportation, communications and public utilities; finance, insurance and real estate; services; and government) are exclusively basic or non-basic.

Disaggregation of local employment sectors into basic and non-basic components may require compilation of employment data at the two digit and three digit SIC code levels, and surveys of individual employers concerning their customer base, what they purchase for their business, where they purchase it from and other information.[1]

While simplicity and heavy reliance upon local information are strengths of the economic base approach, this method has several limitations, particularly for widespread application across a variety of areas. In its simplest form the model does not distinguish between the elimination of high paying basic jobs (e.g., in manufacturing) and lower paying basic economic activities (e.g., hotel workers), or between basic industries that purchase intermediate inputs locally and those that purchase these inputs from outside the region. A similar limitation is the lack of specificity under this approach concerning relative impacts within the local service sectors. These limitations can be overcome with additional analysis, but the simplicity and transparency of the approach suffers and data requirements increase.

Perhaps the major limitation of the economic base approach for the purpose of providing a standardized assessment tool is that the approach is not very formulaic. In contrast to non-survey based input-output models and econometric models, which can be purchased "off-the-shelf" and applied to different areas, each economic base model is built specifically for the region to be analyzed, requiring the judgment of an analyst trained in regional economics.

Econometric forecasting/simulation models. Advantages of the econometric forecasting approach include the availability of off the shelf models and the capability of the models to simulate impacts occurring in future time periods. Further, econometric models provide a more dynamic picture of impacts over a period of time than the static input-output approach.

There are, however, several disadvantages in employing econometric models for evaluating secondary economic impacts. First, these models have typically been developed primarily for forecasting purposes, not as impact assessment tools. The accuracy of the models in simulating a profound change in the structure of a local economy is subject to question. Econometric models rely primarily upon statistical relationships which are often somewhat abstract. As a result, factors underpinning the results of alternative scenario simulations are often not readily transparent. Finally, off the shelf econometric models are relatively expensive in comparison with input-output models.

Non-survey input-output models. Since the late 1980s, non-survey input-output models and other pre-packaged regional economic tools have come into widespread use for a variety of impact assessment, planning and forecasting purposes. Although now widely used in both academic and "real world" analyses, there is still disagreement about the quality and accuracy of these "synthetic" models.

The Regional Input-Output Modeling System (RIMS II), developed by BEA, is the latest version of a series of BEA input-output models originating in the mid-1970s. The economic relationships embodied in the current version of RIMS II are based upon 1989 data. For any region composed of one or more counties, RIMS II can provide output multipliers, earnings multipliers and employment multipliers resulting from a direct impact upon one or more of these variables in a specific industry. For example, RIMS II can estimate the impacts upon county output, earnings and employment, by sector, resulting from a $1 million increase or decrease in agricultural production.

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[1] An example of SIC coding schemes: SIC Division D - Manufacturing (one-digit); SIC Division D, code 24 - lumber and wood products (two-digit); SIC Division D, code 244 - wood containers (three-digit); SIC Division D, code 2448 - wood pallets and skids.

Two different levels of detail are available within the RIMS model, a 529 sector detailed breakdown of the local economy and a 39 sector aggregated breakdown. The 529 sector level of detail corresponds, approximately, to four digit SIC code industry classifications. For example, cotton production is one of the agricultural sectors in the 529 sector breakdown. In the 39 sector model, agricultural activities are aggregated without distinction among crops.

The Impact Analysis for Planning model (IMPLAN) was developed by the U.S. Forest Service with assistance from other government agencies in the late 1970s. Responsibility for updating and improving the IMPLAN model subsequently shifted to the University of Minnesota and, ultimately, to the Minnesota Implan Group, a private consulting firm developed from the University in 1993. IMPLAN provides capabilities which are generally similar to RIMS II.

There is no clear consensus on whether RIMS II or IMPLAN is more accurate in estimating secondary economic impacts. Since it is not normally possible to isolate economic impacts after the fact from the multitude of influences continually affecting a regional economy, there is no clear benchmark for evaluating the performance of these models. What is clear is that the models are different and produce different results.

Both IMPLAN and RIMS start from the 1977 national I-O model produced by BEA. Both models update and convert the national production functions to fit the local circumstance based upon secondary data such as the BEA employment, income, and wage series; state ES202 employment security commission data; County Business Patterns, and Bureau of Labor Statistics and CES consumption data. In this critical process, RIMS II has the advantage of access to non-published BEA data which is normally hidden for disclosure reasons. However, IMPLAN uses regional purchase coefficients (RPCs) to make the national to regional changes; an approach which is less transparent but generally considered superior to the location quotient approach used by RIMS II.

Perhaps the more important differences between the models are in how they are used and priced. BEA provides RIMS II users with sets of multiplier tables for each region requested, at a cost of $1,500 for the first region and descending thereafter. A region can be any area composed of complete counties, ranging from one county to the entire United States. IMPLAN provides an actual computer model (software) for $100 and then charges on a per county, or per state basis. Purchase of the model and software sufficient to develop I-O relationships for any county in Texas would cost $1,900.[2] Overall, IMPLAN offers more capability for user modifications (for example to improve the I-O coefficients to incorporate survey or case study data) and more cost effective pricing.

Although non-survey input-output models are now the most commonly used tool for assessing secondary economic impacts, there are important limitations of the input-output approach which the user should bear in mind. Input-output models assume constant input proportions to produce any amount of output and do not allow for factor or input substitution in response to changing prices. Perhaps more importantly, input-output models generally do not automatically account for "forward linkages" such as the impact of reduced crop production on local processors and shippers. These types of effects can be estimated using the models as a tool, as was done for the Edwards Aquifer case study described later in this report. However, capturing forward-linked effects using input-output techniques is not a simple and straight-forward process.

[2] Single site pricing for state totals and all county files, 1993 data - the most current available for IMPLAN.

Composite models. The REMI model is truly a breed apart in both scope and complexity. In addition to a static I-O component generally similar to the I-O models discussed earlier, REMI is a dynamic forecasting tool which also includes a demographic component and elements to estimate changes in factor prices and substitution in factor usage, changes in final goods prices and corresponding import/export substitution (to or from the region).

The inclusion of so many influences within the REMI model is both its strength and weakness. Theoretically, REMI is a better model than the static I-O models because it incorporates these factors based upon generally accepted neoclassical economic principles. In practice, the REMI model is the ultimate black box — it is very difficult to determine what all is happening within the model and to evaluate its reasonableness. For these reasons, many REMI users staunchly support the model while non-users are often highly skeptical of the model and its results.

Given its complexity and scope, the REMI model is also considerably more expensive than the alternatives. For the most detailed, 53 sector REMI model, purchase prices begin at $46,000 and increase as more geographic areas are added to the model. Prices for the greatly simplified 14 sector model begin at $16,000.

The TAMS model was originally developed by Texas A&M researchers during the energy development boom in the late 1970s. The model was originally specific to eastern Texas, and coupled the Texas I-O model (a survey based state-wide model), adjusted to suit regional areas, with demographic and fiscal modules. More recently, Texas A&M researchers have incorporated the IMPLAN I-O model into TAMS. At this time, however, TAMS is still being overhauled and developed into more of a statewide model. Given this transition, and the lack of available technical documentation subsequent to 1979, we could not fully evaluate the potential to use TAMS for purposes of assessing water transfer impacts throughout the state.

Summary. There is no demonstrably superior approach to assessing secondary economic impacts. Given the potential range of applications for this framework, the transitional condition of the TAMS model and the potential disadvantages associated with the complexity of the REMI model, we have focused on use of the IMPLAN input-output model with modifications to incorporate local information. Steps required to implement this model to assess secondary economic impacts from transfers are discussed below.

Use of the IMPLAN model. In its current form, the IMPLAN model includes a user friendly menu-driven interface for the DOS operating system. The Windows version was still under development at the time of this study.

Providing that no modifications are to be made to the model, use of the IMPLAN model to estimate secondary (and total) economic impacts is very straightforward:

- Purchase the software model and the appropriate county (or full state) datafiles from MIG, Inc.
- Load the software and follow the instructions in the manual to read in the appropriate county/state datafiles and create the baseline regional economic model.
- Develop impact "scenarios" to simulate the direct impacts of the water transfer.

- Use the models' impact commands to simulate the effects of each scenario on regional output, value added, employment, and many other economic variables.

A few technical points should be noted. Because of double counting considerations, the output which IMPLAN reports for the wholesale and retail trade sectors is actually the gross margin for each of those sectors. To derive estimates of the impact of transfers on total regional sales, the margined output from IMPLAN for wholesale and retail trade must be converted (outside of the model) to sales. The most straightforward method to accomplish this is to develop a ratio between the IMPLAN reported margins and total sales by comparing the baseline output for these sectors from the model (which is actually their aggregate margins) to baseline sales information for the sectors from data produced by the U.S. Bureau of Census economic census reports.

The IMPLAN datafiles present a snapshot of the regional economic activity in a particular year. For some sectors, and in particular for agriculture, this annual snapshot may not be representative of typical baseline conditions. IMPLAN provides the flexibility to modify the baseline economic information for the region to more closely replicate the baseline profile developed in Step 4 of this framework.

Similarly, crop budgets and local interviews may indicate that the national production functions underlying IMPLAN industries do not accurately reflect local production methods and that direct impacts from the IMPLAN model should be modified to more closely embody local circumstances. Any of these modifications should be made carefully, however, to avoid inadvertently modifying the internal consistencies of the model. First time users would be well advised to consult with MIG technical services about such modifications before attempting them.

In general, input-output models do not automatically capture economic impacts on "forward linkages." For example, in the Edwards Aquifer case study detailed later in this report, changes in the activities of vegetable shippers and processors in the wake of water transfers could lead to considerable changes in local economic activity. These impacts are not automatically captured in the IMPLAN impact results.

To include impacts on forward linked industries in the impact analysis, the analyst must first ascertain the direct effects of the transfer on these industries. For example, the transfer may eliminate the production of certain crops which provide the cornerstone of subsequent local processing activities. In this case, the analyst would need to interview the processor to determine how it would react to diminished local supplies of the key crop (for example, whether they could obtain this crop from other areas and continue their current operations.)

Once the direct impacts of transfers on forward linked industries have been estimated from local information, the IMPLAN model can be used to simulate the total impacts of these forward linkages on the local economy. However, caution must be used in interpreting the results to avoid double counting. For example, in the Edwards case study, reduced vegetable processing is projected to lead to a range of impacts on the local economy, including reduced purchases of vegetable crops from local farmers. However, the impact of reduced vegetable production had already been estimated in determining "backward linked" impacts, so this effect should be netted out of the projected impacts on forward linkages.

Step 7 – Estimate Demographic Impacts

The preceding two steps, involving the projection of direct economic impacts and secondary economic impacts, produce estimates of changes in employment and income in the area of origin linked to water transfers. These changes in employment are a key component in the following step: estimating the demographic impacts of water transfers.

Definitions. The term demographic impacts refers to changes in the resident population of the impact area from the population that would reside in the area under baseline conditions. These impacts may include changes in the size of the total population residing within the area, changes in the makeup of the population (e.g., age, gender and ethnic composition), and impacts upon related variables such as the number of households within the area of origin.

Prior to the discussion of how demographic impacts may be estimated, a discussion of some basic demographic concepts may be helpful. Demographers often separate population change into two components: *net natural increase* (or decrease) and *net migration.*

Net natural increase (or decrease) refers to the change in an area's population resulting from births and deaths effecting the resident population. To project the effects of net natural population changes over time, demographers use fertility rates and mortality rates. These rates may be calculated and used for the population as a whole (referred to as *crude birth rates* or *crude death rates*) or for specific subgroups of the population. The subgroupings are normally based upon age, gender and, sometimes, ethnicity — and are termed *cohorts.*

Net migration refers to the difference between the number of people migrating into the study area (*in-migrants*) from other places and the number of people moving away from the study area (*out-migrants*). Demographers sometimes further classify in-migrants and out-migrants into the categories of *economic* migrants and *non-economic* migrants. As these terms would suggest, economic migrants are workers and their families believed to have moved to or from the area for reasons of employment opportunity. Non-economic migrants are typically believed to have moved to or from an area for lifestyle reasons, such as retirees moving away from snowy northern climates to more temperate southern locations in Arizona and Florida.

Methods of estimating demographic impacts. The appropriate methods for projecting demographic impacts from water transfers will depend, in part, upon whether the analyst is assessing overall impacts against a projected set of baseline conditions or against a baseline of current economic and demographic conditions in the area of origin. To keep the organization of this discussion roughly parallel to the description of Step 4 (development of the baseline socioeconomic profile of the area of origin), the issues of when and how to produce population projections, and how to modify those projections to estimate demographic impacts, is deferred until later in the discussion of this step. The following discussion initially assumes that the analyst is operating with current conditions as the baseline and is not focused upon projecting demographic impacts over a number of years.

Projecting demographic impacts from water transfers or other economic events is both conceptually simpler and considerably more uncertain than projecting economic impacts. In a growth-related impact analysis, the primary challenges in projecting demographic impacts are to estimate the extent to which new jobs will be filled by individuals already residing in the area versus other workers, anticipating where economic in-migrants will choose to settle, and identifying the characteristics of the typical in-migrant worker family (ages, marital status, number of children, etc.).

In an impact analysis involving economic contraction, such as the analysis of impacts of water transfers upon the area of origin, there are a parallel but different series of challenges. The primary difficulties in this case involve anticipating how the affected population will respond to economic changes.

In part, the short-term responses will depend upon the detailed socioeconomic characteristics of the affected population. How this population may be characterized, and how these characteristics relate to the alternatives available for impacted residents, is discussed later under Step 9 — evaluating social impacts.

The simplest way to link impacts on employment to changes in the number of residents and households in the area is to take a long-term perspective. From this vantage point, the following series of estimates can be made to link changes in jobs to other demographic variables based on existing ratios:

- total number of jobs eliminated,
- change in the number of employed persons in the study area,
- change in the number of households in the area,
- change in the number of residents in the area.

A simple approach is to develop ratios of jobs to employed persons, employed persons to number of households, etc. based upon current data for the local area. U.S. Bureau of the Census, decennial Census of Population data may be used if more recent data are not available. A more complex technique using a cohort model is described on the following page.

When and how to project demographic impacts over time. The demographic impact scenario(s) should parallel the baseline conditions. As noted in the discussion of developing the baseline profile in Step 4, in situations in which the local economy is in a state of transition at present and/or the projected transfer is some distance in the future, it may be warranted to project baseline economic and demographic conditions. If, on the other hand, the analyst is comparing the impacts to current conditions, it is not necessary to project demographic impacts over a period of years in the future.

If the timing of the potential transfer and the characteristics of the area of origin mandate creation of a projected baseline, as discussed earlier, both baseline demographic conditions and demographic conditions under the impact scenario must be projected. Although there are a range of alternative methods for developing population forecasts, two relatively straightforward approaches which may be most readily combined with economic impact analysis are discussed here: an approach based upon employment to population ratios and the cohort-component approach.

The ratio approach is more crude, but also simpler and easier to implement, than the cohort-component technique. Under this approach, current relationships between employment and population are assumed to remain constant over the projection period. At the simplest level, the aggregate ratio of total population to total employment within the area of origin may be used, along with economic projections of baseline and impact conditions, to derive broad demographic measures over time. Alternatively, if the analyst has developed more specific information about the current demographic characteristics of individuals and households likely to be affected, as discussed earlier, this information can be brought to bear in place of the broad aggregates to provide a somewhat more realistic projection. This approach is weakest when making demographic projections 20 or more years into the future.

The cohort-component technique relies upon information regarding net natural population change and net migration, alluded to at the beginning of this step. This approach entails disaggregating the base population at the beginning of the projection period by age and gender (typically based upon the most recent Census data extrapolated to the present, or upon information calculated by the State Data Center). Age and gender-specific mortality rates, and age-specific fertility rates for the female population, are then applied to estimate net natural population change over the projection period resulting from births and deaths.

The remaining component of population change is net migration. This component can be tied to the employment forecasts on the basis of age and gender specific labor force participation rates for the area. By multiplying the appropriate labor force participation rate by the population pool in the corresponding age and gender cohort and summing the results, the total labor supply available from the "natural" population can be calculated. This supply is then compared with projected labor demand (projected employment multiplied by one plus the assumed future unemployment rate). If labor supply is greater than demand, out-migration is assumed to occur. If labor supply is less than demand, in-migration is projected. In an iterative process, immigrants and their families are then included in the cohort model to project births and deaths related to these individuals.

While the cohort-component technique is more theoretically sound and probably more accurate than the ratio technique, it is clearly more complex. The greatest difficulties arise in accurately estimating labor force participation rates by age and gender (though this can be approximated from Census data) and, to an even greater extent, identifying the profile of migrant households.

Step 8 – Estimate Fiscal Impacts

Previous steps in this framework have focused upon economic and demographic impacts that may occur within the area of origin as a result of water transfers (Step 5 through Step 7). In Step 8, we focus our attention upon potential financial effects of transfers on public sector entities within the area of origin. Although impacts on the providers of public services, such as the local electric company, are technically not *fiscal* impacts unless the utility is publicly owned, we include the evaluation of financial impacts on utilities in this step because this evaluation follows exactly the same approach as the fiscal impact assessment.

Definitions. Fiscal impact analysis considers the effects of a particular policy or action on the level of services that must be provided by the public sector, the costs of providing required services and the revenues available to pay for the services. Historically, fiscal impact analysis has most often focused upon the implications of new residential, commercial or industrial developments for local governments. In these instances, increased governmental operating requirements (such as a larger police force) and the cost of necessary capital investments in new or expanded infrastructure are compared with the additional revenues available to government entities as a result of the development from property taxes, sales taxes, user fees and other sources. Similar techniques, with some modifications, can be employed to evaluate the fiscal impacts of a decrease in economic and/or demographic activity within the area of origin for a water transfer.

Scope of the analysis and types of potential fiscal impacts. Fiscal impact analysis has a considerably narrower focus than the broader economic and demographic impact evaluations described earlier in the framework. In this step, we are concerned only with financial effects upon the public sector. In the case of water transfers, it is likely that we can further limit the scope of the fiscal assessment to local government entities in the area of origin since financial effects upon the state and federal government are likely to be relatively minimal and may be offset by fiscal gains from the area which receives the transferred water supplies.

Governmental entities of particular concern in this instance will typically include area of origin county governments, municipal governments, school districts and special districts (such as water districts, sanitation districts and fire protection districts). Estimating fiscal impacts upon each of these entities requires an understanding of the responsibilities of the entity, the service standards it must provide, what the entity's expenditures pay for, and the sources of revenue most important to the entity. In addition, outstanding debt obligations and the assumptions underlying debt repayment schedules may be particularly important in the case of a potentially declining revenue base. It is important to recognize that the magnitude of fiscal impacts may differ considerably among public sector entities in the area of origin due to differences in revenue sources, outstanding debt service obligations and other factors. Not all of these potential impacts have to be calculated if initial research finds relatively minimal fiscal effects (e.g., very small changes in revenues and small changes in service demands).

A range of potential fiscal impacts should be considered. Economic and demographic effects identified earlier in the analysis may be linked to declines in revenues available to local governments. Property tax revenues available to local governments may decline due to changes in value of agricultural land and other property or non-taxable municipal ownership of former agricultural lands, if land sales are a component of the potential transfer. Sales tax revenues may decline due to a general decrease in local economic activity. User fees and intergovernmental revenue transfers from the state may also be affected by declines in the economic and population base.

Operating expenditure requirements of local governments may decrease if the transfers lead to a lower local population base. The extent to which public sector entities can achieve savings in operating expenditures in serving a smaller population base will depend partly upon the proportion of their expenditures that is related to fixed costs (which may include insurance, facility costs, utilities, and other operating cost components). Debt service to repay outstanding capital cost obligations is largely a fixed cost, although refinance may be an option.

How to estimate fiscal impacts. A comprehensive fiscal impact analysis can be outlined in terms of nine basic elements. These elements are enumerated and briefly discussed below. Further details regarding data sources and nuances of completing the basic elements are discussed in the last part of this step, "additional considerations."

1. ***Identify public sector entities within the area of origin.*** As suggested earlier, potentially impacted entities may include a host of special districts as well as the more obvious municipal and county governments. A list of potentially impacted local governments should be compiled at the outset.

2. ***Obtain baseline information on each entity.*** Annual budgets and audited financial reports of local governments are public documents that should be collected as a starting point for the analysis.

3. ***Examine and model current funding conditions.*** Primary sources of revenues for each entity should be identified from the financial documents obtained in the previous element. For each major revenue source, the "revenue driver" should be identified (e.g., assessed property valuation, taxable retail sales, population, households, and other economic and demographic variables).

Current tax rates, including mill levies, which are applied to the revenue drivers must also be identified from the financial documents or interviews with staff. The revenue information can then be incorporated into a simple spreadsheet model which replicates baseline revenue conditions. A conceptual diagram of the fiscal impact model is depicted in Exhibit III-4.

4. ***Identify changes in revenue drivers***. This is one of the key links between the economic and demographic impacts described earlier and fiscal impacts. Changes in local economic activity and population must be translated into changes in the public sector revenue drivers. Further discussion about this translation is presented in the "additional considerations" paragraphs later in this step.

5. ***Recalculate revenues based upon modified drivers***. Changes in the revenue drivers are then incorporated in the simple revenue model to identify prospective revenues after transfer. These prospective revenues are compared with current revenues to identify the revenue impact resulting from the transfer.

6. ***Examine and model current expenditures***. From the baseline financial documents obtained during the second element, identify each entity's expenditures by function. This breakdown of expenditures should be sufficiently detailed to allow identification of fixed cost components and variable cost components.

   Variable cost components should be further analyzed to identify service standards. These standards will relate expenditures to underlying economic and demographic variables, such as local population or number of households, in much the same way that tax rates and mill levies relate to revenue drivers like assessed valuation. Identification of service standards and "expenditure drivers" will likely require interviews with public sector staff. A simplified spreadsheet model of expenditures can then be developed which replicates current outlays for operations and debt service.

7. ***Identify changes in expenditure drivers***. Changes in the expenditure drivers of variable costs should be identified based upon economic and demographic impacts estimated previously. These projected changes should be reviewed for reasonableness with local government staff.

8. ***Recalculate expenditures based on modified drivers***. Incorporating the changes in expenditure drivers with service standards identified earlier, use the simple model set up in Step 6 to estimate the revised level of variable costs following transfer. Fixed costs should be held constant in the model (however, over the long-run, few costs may be fixed). Combine the fixed and variable cost components in the model to estimate total expenditures following transfer. Comparison of this expenditure level with baseline expenditures modeled previously yields the net expenditure impact of transfer for each entity. These steps are conceptually illustrated in Exhibit III-4.

9. ***Calculate net fiscal impact for each entity***. The final step in the fiscal impact analysis is to calculate and evaluate net impacts on each entity. The net fiscal impact is calculated as:

   (change in revenues) - (change in expenditures) = (net fiscal impact)

EXHIBIT III-4.
Conceptual Model of Fiscal Impact Analysis
(Items in italics represent potential changes due to transfers)

	Post Transfer Fiscal Conditions		**Current or Baseline Fiscal Condition**		
Revenues	*Post Transfer Revenue Driver Levels*		Baseline Revenue Driver Levels		
	x		x		
	Tax Rates		Tax Rates		
	=		=		
	Post Transfer Revenues	minus	Baseline Revenues	equals	*Revenue Impact*
Expenditures	*Post Transfer Variable Cost Driver Levels*		Baseline Variable Cost Driver Levels		
	x		x		
	Service Standards		Service Standards		minus
	=		=		
	Post Transfer Variable Costs		Baseline Variable Costs		
	+		+		
	Fixed Costs		Fixed Costs		
	=		=		
	Post Transfer Expenditures	minus	Baseline Expenditures	equals	*Expenditure Impact*
					equals
Net Fiscal Condition					*Net Fiscal Impact*

Source: BBC Research & Consulting.

Projected net fiscal impacts should be compared with the existing levels of revenues and expenditures for each entity. If the comparison demonstrates that the impacts would represent only a small percentage of the entity's current budget (for example less than five percent) the analyst should recognize that the estimated impacts may fall within the range of estimate error and should not be given undue significance.

It may not be necessary to perform all of the steps enumerated above unless the fiscal impacts are relatively large in comparison to existing revenue and expenditure levels. If projected changes in employment and population are modest relative to their base levels, an abbreviated evaluation of changes in public sector revenues (presuming no significant changes in public sector expenditures) may be sufficient.

Additional considerations. The fundamental, nine element approach to fiscal impact analysis just described can be applied to virtually any type of local government. However, the application may be more complex in certain cases wherein a large share of revenues are derived from intergovernmental transfers. School districts, which are funded under the State of Texas equalization formula, may be the most complex case though certain county and municipal functions are also funded in large part by intergovernmental transfers based upon funding formulas.

Impacts on Texas school districts. Since 1993, Texas school finance has been administered under the system devised in Senate Bill 7. This new system has been found constitutional by both a district court and the Texas Supreme Court and remains in effect as of the date of this study.

Under the current equalization system, school districts in Texas are limited to a maximum wealth of $280,000 in property value per student. Districts with wealth above this amount must select one of several remedies to reduce their effective wealth to the cap. In effect, revenues above the cap are "recaptured" by the State. For these wealthy districts, a decrease in local property value would have no impact on their revenues as long as they remained above the maximum wealth level.

Districts with wealth below $205,500 per student receive additional revenues under the State's equalization program. For these districts, the State makes up the difference between the taxes applied against their actual wealth and the revenue they would receive if their wealth were $205,500 per student. For this group of districts, any decrease in property value would be offset by additional state equalization funds.[3]

The only school districts that would sustain a long-term revenue impact from a decline in local property values would be districts that have wealth per student greater than $205,500 and less than $280,000. For these districts, any decrease in local property values would result in lower property taxes. If any of these "gray area" school districts are within the area of origin for a potential water transfer, a more detailed examination of the potential changes in the area's property wealth and corresponding impacts on school revenues would be warranted.

Other issues. The quality of the fiscal impact analysis also depends, in part, on the reasonableness of the translation of economic and demographic effects into revenue and expenditure drivers. Many of these translations are not overly difficult. For example, the IMPLAN model applied during Step 6 produces estimates of changes in retail sales which can readily be related to changes in taxable sales. Service standards may be linked directly to population or to number of households, both of which are estimated in Step 7.

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[3] However, any school district could sustain a one year impact from reductions in local property values due to lags between local collections and state equalization

One of the more difficult tasks, however, is to translate economic and demographic impacts into changes in assessed property value, a key revenue driver for many local government entities. Declines in local population and economic activity may reduce the demand for commercial and residential property, without necessarily affecting the available supply. Precisely estimating the interaction of demand and supply to determine impacts on market value is likely beyond the scope of the fiscal impact analysis.

A few simple assumptions might be made for the purpose of obtaining a general estimate of changes in assessed value. The value of business and commercial property could be assumed to be directly related to the volume of business activity, an output of the IMPLAN model in Step 6. Similarly, the value of residential property could be assumed to be directly related to overall population size. Hence, if demographic impacts of a 15 percent decline in local population are projected, residential assessed value would be assumed to decline by a corresponding proportion.

These assumptions will obviously not provide a precise estimate of the changes in assessed valuation that may result from water transfers. They may serve, however, to provide an adequate ballpark estimate in the absence of sophisticated, time consuming and expensive analysis of real estate markets and other factors.

Step 9 – Examine Social Impacts

The last analytical step in the assessment of potential impacts from water transfers is the evaluation of social impacts resulting from the transfers. This step draws, in part, from results of previous steps analyzing baseline conditions, and demographic and economic impacts. The social impact assessment also considers other factors, however, and more closely examines effects on subgroups within the area of origin community

Definition and methodology. In the context of water transfers, social impact assessment can be defined as analysis of the effects of transfers upon community organizations, institutions and social structures; assessment of transfer impacts upon the interactions between groups and between individuals; and evaluation of transfer impacts upon social perceptions and attitudes.

Unlike some other components of the impact analysis, there is really no "cookbook" for conducting the social impact evaluation. A useful starting point may be to develop a list of potential social impacts related to the transfer of water supplies from the area. This list, combined with a careful assessment of the socioeconomic profile of the groups that are projected to be most affected by the transfer, can provide the starting point for identifying important social issues arising from transfers and conducting interviews with local individuals and institutions.

Potential social impacts from water transfers. The case studies of previous proposed and actual water transfers in Texas and other states illustrate a number of potential social impacts resulting from transfers:

- Division of community (farmers who may be compensated against others, farmers who wish to sell against those who do not, etc.).
- Uneven effects across the community.
- Impacts on social and educational organizations related to farming (e.g. ditch companies, granges, 4 H clubs, FFA, etc.).

- Impacts on other community groups (civic organizations, churches, etc.).

- Effects on the local residents' perception of the community (identity, independence, sustainability, relationship to other areas).

- Social dislocation, crime and substance abuse.

- Impacts upon future economic and community development potential.

Characterizing the affected population. As noted in Step 7 (projecting demographic impacts), evaluating the potential social and economic impacts of water transfers requires a socioeconomic profile of the population groups that will face the most severe dislocations. Unfortunately, standard Population and Housing Census tabulations do not detail demographic and household characteristics by occupation or industry of employment at the county level. There are, however, at least two alternative approaches which can supplement the information contained in standard Census tables: direct surveys of the potentially affected population, and analysis of the Public Use Microdata Sample data (PUMS) compiled by the Census Bureau.

Surveys can provide the most direct and relevant demographic information on the affected population under certain conditions. For example, a survey of the farm population in the area of origin *could* provide information that is both more current and more specific to the particular population group than information available from secondary sources. However, the difficulties of survey research should not be underestimated if this approach is to be undertaken. Accurate identification of a representative sample, follow-up to reduce non-response bias, and a carefully designed survey instrument are all critical to success of a survey effort. Survey research is generally expensive, if done well, and a poorly conducted survey is often less useful than no survey at all.

An alternative approach is to rely upon analysis of the Public Use Microdata Sample information compiled and made available by the U.S. Bureau of the Census. This very large and detailed data set contains a representative sample of all of the long form Census filings from the most recent decennial Census, stripped of identifiers (name and address). The data typically covered include a wealth of information on about five percent of the population and households within a state. By importing the data from the CD-ROM provided by the Census Bureau into database software (such as FoxPro or Access), it is possible to analyze the characteristics of subgroups of the population — such as the demographic and household characteristics of individuals who reported farming as their occupation.

There are some important limitations to the use of the PUMS data files, however. First, like all decennial Census data, the PUMS data may be several years out of date when the analyst is conducting the impact assessment. A second, and probably more important limitation, is the geographic aggregation of the data. Due to concerns about the potential disclosure of detailed personal information, the PUMS data can generally only be geographically associated with "PUMAs" (Public Use Microdata Areas) at the substate level. These areas normally include a population of at least 200,000 persons and, in rural areas, typically encompass a number of counties.

Despite these limitations, a combination of analysis of PUMS data with evaluation of standard Census tables may provide a more feasible method of identifying demographic characteristics of the affected population than a detailed survey.

Social impact assessment. The preceding tasks are designed to develop needed information including the baseline profile of the area; the projected impacts of transfers on the region's employment, incomes, residents and households; a more detailed profile of the individuals and households that may be most effected; and a list of potential social impacts to consider. The remainder of the social impact assessment consists of formulating questions about the manner in which the impacted groups and the local communities will respond to any "shock" created by water transfers, and developing reasonable assumptions about these responses from interviews with knowledgeable individuals in the area of origin.

Some of the key questions to guide this research may be:

- Will the transfer have uneven effects across the community — are some groups likely to gain and others to lose? Is the transfer likely to foster division among residents or community groups?
- How will the individuals and households that are most likely to be impacted respond to the transfer? Do they have skills that can be readily employed in other sectors? Are there local opportunities for re-training to move into new occupations? What sort of formal and informal support networks are available to them?
- How will the changes brought about by water transfers affect important community issues such as housing, health care and education? Will these changes exacerbate existing problems or create new ones?
- Are certain community organizations likely to be particularly affected by the transfer?
- How will the transfer affect perceptions of the community by its residents and outsiders?
- Is the transfer perceived to pose a risk to future economic development; and, if so, in what ways?

PART B.

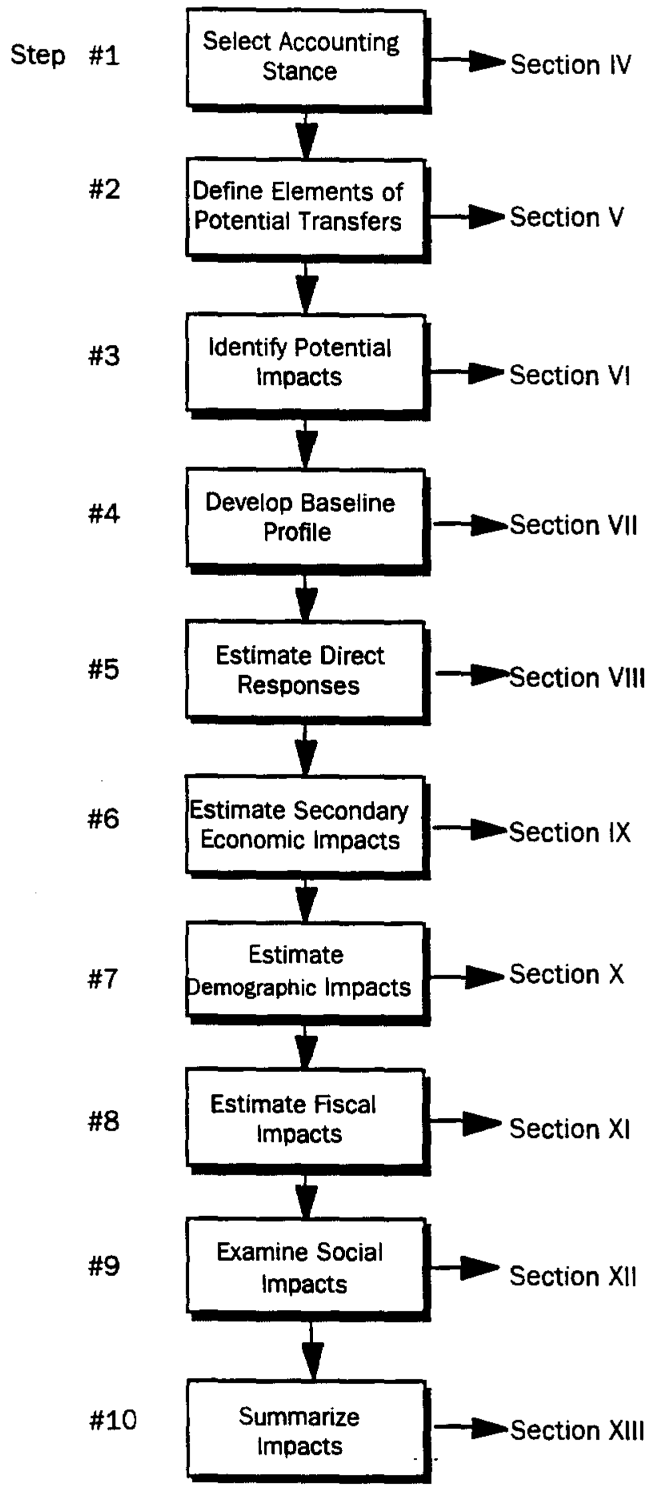
IMPACTS OF WATER TRANSFERS IN THE EDWARDS AQUIFER

PART B.
Impacts of Water Transfers in the Edwards Aquifer

Part B of this report presents our assessment of the impacts that would occur if water supplies were shifted from Edwards Aquifer irrigators to other water uses in the region. The primary source of these transfers would be Medina and Uvalde Counties.

Section III of the report outlined 10 steps to examining socioeconomic impacts of water transfers. These steps were followed to develop impact estimates for Edwards Aquifer water transfers. As shown in Exhibit B-1, each of the following sections of the report presents study team findings for a single step.

EXHIBIT B-1.
Steps to Examining the Socioeconomic Impacts of Edwards Aquifer Water Transfers



SECTION IV.
Accounting Stance

The first step in the Impact Assessment Framework is to select the "accounting stance" for the impact analysis. There are two dimensions to consider: the geographic focus and the socioeconomic focus.

Geographic Focus

The geographic focus for this analysis is Medina and Uvalde Counties. Combined, these two counties comprise the study area for this research.

Several factors led to the selection of these two counties as the geographic area of focus. First, Medina and Uvalde Counties represent the area of origin for potential water transfers and Bexar County and other counties to the east represent the likely destination for these supplies, either in municipal and industrial uses or for maintaining spring flows. Groundwater pumping from the Edwards Aquifer for crop irrigation is concentrated in Medina and Uvalde Counties.

The other primary area of Edwards irrigated agriculture lies in Bexar County immediately surrounding the San Antonio suburban communities. The amount of Bexar County land currently in irrigated agriculture is small relative to Medina and Uvalde Counties. The contribution of Bexar County crop production to the overall San Antonio economy is also relatively small. In addition, San Antonio and its suburbs are growing onto these irrigated lands. In effect, water used on irrigated land in Bexar County is already being transferred to other uses as these lands are urbanized.

Another factor supporting selection of Medina and Uvalde Counties as the study area is that these two counties represent distinct economies from the larger San Antonio Metropolitan Area. While both of these counties are linked to the broader San Antonio regional economy, they are also highly dependent upon locally generated economic activity. For example, most of the direct economic linkages with irrigated agriculture take place within these two counties and not elsewhere within the San Antonio Metropolitan Area.

Finally, the Medina County Groundwater Conservation District is interested in the impacts of water transfers on Medina and Uvalde Counties. There are a number of policy concerns that require identification of impacts on these counties. Summing all impacts into a total impact on the San Antonio region would not provide the information needed to address these policy issues.

Socioeconomic Focus

The scope of the study encompasses all employees, businesses and residents of Medina and Uvalde Counties. Particular emphasis is placed on impacts to farmers, farm employees, and those businesses and employees directly linked to local agriculture. Impacts on local governments and to local social institutions are also examined.

The reason for this broad socioeconomic focus is that agriculture and its linked industries form a large portion of the local economy. A significant portion of the Medina and Uvalde County non-agricultural economy is linked directly or indirectly to agriculture. Therefore, impacts on irrigated agriculture can have indirect and induced effects that could reach local businesses and residents throughout these two counties.

SECTION V.
Definition of the Transfer Elements

The second step in the impact assessment framework is to define key aspects of the proposed transfer. In many applications of the water transfers impact framework, the researcher would know the timing, amount of water, origin and destination, price and means of conveyance related to a specific proposed transfer. However, potential water transfers from agricultural users of Edwards Aquifer groundwater to other uses are still very general in nature. While the possibility of transfers has been discussed in the past, proposals are not specific as to location, amount of acreage, amount of water or timing. The price that would be paid for these supplies is not known. A comprehensive legal framework for accomplishing such transfers is not necessarily in place[1]. Currently, groundwater users in Texas may use amounts of water necessary for crop production but do not have quantified water rights. In sum, little is clearly established and much is uncertain about potential transfers of Edwards Aquifer supplies.

Edwards Aquifer water might be transferred from irrigation use through the operation of several programs. Sale of water supplies, permanent retirement of irrigated acreage, permanent shifts to dryland use, leasing of water supplies, reductions of water use through improved efficiencies of irrigation systems, permanent reductions through regulation and temporary reductions in irrigation are some of these programs. None of these programs are in place today and we can only speculate about which means may ultimately be used to enable the transfer of irrigation water to other uses. Nevertheless, the Medina County Groundwater Conservation District seeks information about what the impacts might be from possible transfers. To identify the range and magnitude of potential impacts, we must make some assumptions about what these transfers might be.

It was beyond the scope of this study to examine the impacts of each of the program options identified above. (Other research funded by the TWDB is specifically considering irrigation efficiencies and the dry year option approach to water transfers.) In order to simplify the analysis, the scenarios considered in this study only pertain to permanent cessation of irrigation use. The balance of this section reviews key assumptions that define each water transfer scenario.

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[1] Near the end of this study, on June 28, 1996, the Texas Supreme Court issued its decision that SB 1477, creating the Edwards Aquifer Authority, was constitutional. The Authority may provide the legal mechanism for administrative, de facto transfers of Edwards water supplies in the future.

Definition of What Would be Transferred

Only the water, not the land, would be transferred under the scenarios assumed for this study. Title to the land would remain with the present owner who could use the property for any previously possible uses except for irrigated agriculture. Groundwater pumping for domestic use, landscaping, small gardens, and livestock would still be permissible after transferring the rights to irrigation use. Restrictions on groundwater use would be maintained with any future sales of the property. Restrictions would also pertain to any leases of the previously irrigated land. This set of conditions replicates what is found for most of the transfers of groundwater found in the Texas Panhandle.

Geographic Location of Affected Supplies

Water transfers might pertain to any irrigated agriculture using Edwards wells. However, nearly all of the irrigation from the Edwards Aquifer occurs in Medina and Uvalde Counties. Because the irrigation in Bexar County is relatively small compared to the western counties, and because Bexar County agriculture has been rapidly urbanized, this study focuses on irrigated lands in Medina and Uvalde Counties.

The hydrogeology of the Edwards Aquifer might also determine the geographic focus of lands sought for retirement from irrigation within Medina and Uvalde Counties. Irrigation west of the Knippa Gap (most of Uvalde County) has been demonstrated to have a less immediate impact on Comal and San Marcos spring flows and Edwards Aquifer levels in Bexar County than irrigation east of this point (mainly in Medina County). There are other differences in hydrogeologic conditions between areas that could be important. These factors could influence which lands are first pursued by municipal water users. However, modeling of the hydrogeologic factors was beyond the scope of this study. This analysis makes no differentiation based on location of the Edwards Aquifer irrigation wells in Medina and Uvalde Counties.

Means of Conveyance

Although construction of pipelines to convey Edwards groundwater has been discussed, we assume no construction of conveyance facilities. We assume that irrigation would be retired, pumping for that acreage would cease and the water previously used would remain in the aquifer to be withdrawn elsewhere for other purposes or left in the aquifer to maintain spring flows and downstream flows. Because of its unique hydrogeology, the Edwards Aquifer is a natural means of conveyance available at no cost. There are questions about the rate of movement of water in the aquifer and changes in water quality, but these are not answerable within the context of this study effort. Therefore, we assume that the model for transferring water from irrigation to municipal uses in the Edwards Aquifer would differ from previous transfers in the Texas Panhandle where cities have drilled wells and built pipelines to move water from the agricultural land to the municipal water systems.

Timing

It is not known when transfers would take place, if they are to occur at all. However, the pressures for transfers to occur are in place now. Farmers could very quickly respond to any offers to cease irrigation. Because these transfers could happen with no investment in additional pumping or conveyance facilities, they could take place very quickly if the necessary institutional framework were present. Therefore, we examined the impacts based upon the assumption that the transfers were to occur at the present time. Advanced notice of potential transfers is assumed in this study analysis. The impacts would be far greater if farmers' irrigation were cut off without notice in the middle of the irrigation season.

Therefore, the impact analysis compares present baseline conditions with conditions as they would be at the current time if transfers had occurred. In other words, the "present without transfers" versus "present with transfers" conditions in Medina and Uvalde Counties are compared.

Over a multi-year period, agriculture in Medina and Uvalde Counties is relatively stable, with no recent trends indicating changes in the amount of irrigated acreage or major shifts between crop types. Therefore, the estimated impacts from the transfers would not differ considerably if the analysis assumed that transfers would occur 5 to 10 years into the future.

Magnitude of Potential Transfers

While there are many different possibilities for the percentage of Edwards irrigation in Medina and Uvalde Counties that might be transferred to other uses, this study focuses on two alternatives: (a) 100 percent of the irrigated acreage, and (b) 50 percent of the irrigated acreage. Under the 100 percent assumption, all irrigation from Edwards groundwater would cease in these two counties. Under the 50 percent assumption, one-half of the acreage currently in irrigation from Edwards groundwater wells in the study area would be withdrawn from irrigated use. The relative reductions in irrigation might be different for Medina and Uvalde Counties, however.

100 percent transfer. It is possible that nearly all of the current agricultural irrigation from Edwards wells could be transferred to other uses. This conclusion is based upon the following.

Municipal and industrial water use demand projections for the region relying upon Edwards Aquifer supplies suggest that non-agricultural demand could absorb all of the present supplies currently used in irrigation. Even if all this irrigation use shifted to municipal and industrial use, these projections suggest that new municipal water supplies would still be needed.

Second, past economic analyses of water supply alternatives indicate that the per acre foot cost of major new supply projects substantially exceeds the economic value of water to the farmer. This is generally true even for very high value crops such as vegetables. Therefore, municipal and industrial users could save money by purchasing the irrigation supplies from farmers (paying more than they are worth to the farmer) and avoiding the costs of developing one or more major new water projects.

For these reasons, one set of transfer scenarios assumes that nearly all of the irrigation acreage in Medina and Uvalde Counties based upon Edwards wells would cease and that this water would then be used for municipal and industrial uses and/or to maintain spring flows. For purposes of simplicity, we assume that 100 percent of the Edwards irrigation supplies in these two counties is transferred. This assumption does not include irrigation based upon sources other than Edwards wells such as users of Carrizo Sands wells, Leona wells and Medina Lake supplies. Also Edwards pumping for domestic uses and livestock would continue.

Whether or not eventual transfer of all Edwards irrigation supplies to municipal and industrial use is likely to occur, the 100 percent transfer scenarios are worthy of examination. These scenarios provide an indication of the current total economic benefits that Medina and Uvalde Counties derive from irrigation from Edwards wells. The scenarios also allow us to consider the full range of potential impacts from transfer of Edwards irrigation.

50 percent transfer. Most discussions of transfers of water from irrigation in the Edwards Aquifer have not contemplated transferring all of these supplies. Therefore, the study team evaluated conditions that would occur if a large portion, but not all, of the irrigation supplies were transferred to municipal users. There are several factors that suggest this set of scenarios is as plausible as the 100 percent transfer scenarios.

It is likely that some irrigators would be unwilling to sell all, or perhaps any, of their irrigation supplies to municipal and industrial users. For example, a farmer may want to sell irrigation supplies from the land that is most difficult to irrigate and keep irrigating the land most suited for irrigation. Those growing vegetables may be reluctant to sell any of their water supplies. Farmers might be more willing to sell irrigation rights for acreage in hay or other lower value crops. In addition, farmers with older irrigation systems may be more interested in selling irrigation rights than those that have recently invested in new center pivot systems.

For these reasons, one set of scenarios evaluated in this study assumes 50 percent of irrigated agricultural land in the study area is taken out of production and a corresponding amount of irrigation supplies are transferred to municipal use. This level of transfers is meant to be representative of impacts under future conditions in which a substantial portion, but not all, of irrigated agriculture goes out of production in the areas of Medina and Uvalde Counties dependent upon Edwards wells. In this study, we assume that such a transfer would occur through a sale of water supplies, but it is also possible that transfers could take place through leases of water supplies.

We examined two sets of assumptions concerning changes in crop types under the 50 percent transfer scenarios. Under the first set of 50 percent transfer scenarios, we assumed that one-half of Edwards irrigated cropland would shift to dryland crops. It is also possible that the acreage now in highest value crops — vegetables — would remain in production. In the second set of 50 percent transfer scenarios, we assumed that the total acreage devoted to vegetable production would remain unchanged.

Price Paid to Irrigators

The study team considered impacts of water transfers with and without compensation to the owners of the affected irrigated land.

As discussed above, there is currently no mechanism within the Edwards Aquifer for a farmer to cease groundwater irrigation pumping on certain lands and permanently transfer the water supplies to a buyer of those "water rights." There are several means available for a buyer to pay an irrigator not to irrigate certain lands, but under current water law, the buyer is not able to translate that purchase into increased pumping at a different location. Also, because there is no existing market for water rights purchases, there is no current "market price" established for these transfers.

Therefore, for the "with compensation" scenarios, the study team had to make a number of assumptions in order to consider the effects of purchases of irrigation water supplies in the Edwards Aquifer.

Market price compensation. Groundwater supplies have recently been transferred in the Texas Panhandle for the equivalent of a one-time price of $117 to $339 per acre. Research on the value of irrigated land in the Edwards Aquifer indicates higher values for irrigation. Different approaches to valuation indicate that Edwards irrigated land is generally worth about $300 to $600 per acre more than equivalent nonirrigated land, with some property worth more and some less than this increment.

This range of estimates was based upon the incremental sales price of irrigated versus nonirrigated land for representative property transactions, going lease rates for irrigated and nonirrigated land, analysis of crop budgets, and the cost of converting nonirrigated crop land to irrigation. Our examination of these factors suggests that these estimates of the incremental value of irrigated land have not changed significantly from the late 1980s. There has been little or no increase in the value of irrigated land over this period.

It is difficult to predict the "market price" if Edwards Aquifer water supplies were actively traded, but the current incremental difference in the value of irrigation farming versus dryland farming represents a floor for what this price would be. The cost of alternative municipal supplies might represent a ceiling to the possible range of market prices. The actual price would depend upon the market power of buyers and sellers, among other factors.

For this study, our assumption on the one-time price paid for farmers to no longer irrigate is $1,000 per acre. Farmers would retain title to the land and could still dryland farm. The price of $1,000 per acre is more than the incremental worth of irrigated versus nonirrigated land (about $300 to $600 per acre) and the value of the water for municipal use (a capitalized value of up to $10,000 or more on a per acre basis). In other parts of the country, the trading price for irrigation supplies is usually closer to the value of those supplies in irrigation than the value to the municipal user. This is because there are usually many sellers of irrigation rights and few buyers. Municipal and industrial users also often purchase irrigation rights before periods of water shortages which tend to drive prices up.

The price of $1,000 per acre is assumed to be the same under the 50 percent and 100 percent transfer conditions. Holding price constant for these two scenarios is necessary for the impact analysis to identify the effects of the amount of irrigation use transferred. However, under real world conditions, the market price necessary to induce farmers to forego irrigation on 50 percent of their acreage would be less than the price necessary to induce farmers to cease irrigation on nearly all of the acreage. While the impact analysis does not include this difference in the definition of the scenarios, it does analyze the sensitivity of the impact estimates to the price paid for irrigation supplies.

No compensation. Under the "no compensation" scenario, the study team assumed that acreage was withdrawn from irrigation with no compensation to the farmers. A new state law, not yet applied and now working its way through court tests, proposes that existing irrigation use may be reduced pro-rata with other uses to fit within a total cap on Edwards Aquifer pumping. The new law also provides for further reductions during droughts under a priority system that puts irrigation use behind municipal use[2].

Alternatively, aquifer levels could drop to a point at which irrigation was no longer economically viable for most agricultural uses. This could be another way the no compensation scenario could occur.

[2] The new law described in this paragraph, SB 1477, was ruled constitutional by the Texas Supreme Court on June, 28, 1996.

Scenarios

The combination of two sets of assumptions concerning the amount of irrigation transferred and the two assumptions relating to compensation leads to four scenarios for water transfers:

1. 100 percent of acres withdrawn from Edwards irrigation, with compensation to landowner;
2. 100 percent withdrawn, without compensation to landowner;
3. 50 percent of acres withdrawn from Edwards irrigation, with compensation to landowner;
4. 50 percent withdrawn, without compensation to landowner.

Each of these scenarios is compared with the baseline scenario, which assumes that there are no transfers of water and present levels of irrigation use continue. Each of the 50 percent transfer scenarios is further analyzed under the conditions that (a) vegetable acreage experiences a proportional decrease, and (b) vegetable acreage remains unchanged. The impact analysis presented in the following sections is based upon these definitions.

SECTION VI.
Identification of Potential Impacts

Step 3 in the Impact Assessment Framework is to identify the types of impacts that might occur from the proposed water transfer. The reason to develop a preliminary list of potential impacts before proceeding with the balance of the impact analysis is that the analytical methods used in the impact assessment depend in part on what types of impacts are to be studied.

Potential Impacts to be Examined in the Study

The following types of effects are the focus of our impact assessment for transfers of water supplies from Edwards irrigators in Medina and Uvalde Counties:

- direct payments to landowners,
- changes in land use and crop production,
- changes in net income from farm operations,
- changes in land value,
- changes in farm labor,
- effects on production and employment for linked industries (agricultural suppliers and processors),
- effects on revenues and employment for local service industries,
- effects on households, including changes in the number of resident households and population,
- fiscal impacts on local governments, and
- social impacts.

Types of Impacts Not Examined in the Study

There are several types of impacts that might be important in examining other proposed water transfers that are not a focus for this study.

Recreation effects. There would be little or no immediate effects on the environment or recreation within the study area from potential water transfers. Over the long term, however, more lands could return to a state favorable for wildlife and hunting. This study does not examine these impacts.

Construction effects. The study team assumed that water transferred from irrigated agriculture would remain in the aquifer to be pumped at another location or to maintain spring flows. While pipelines from groundwater-using areas to municipal users have been discussed in the past, it is as likely that transfers would occur without any construction of conveyance facilities. Therefore, no assessment of construction impacts was required as part of the impact analysis.

Impacts on the receiving area. Transfers of water from Edwards irrigation to other uses could substantially benefit municipal and industrial water users or those affected by spring flows. However, it is not clear at the present time how transferred water would be used. If transferred irrigation supplies had the effect of reducing the amount of new water development projects needed for the region, this would have a large economic benefit to those paying water bills and tap fees in the region. Some of these avoided or deferred water development projects negatively impact the local communities in which they would be developed, which would be another benefit from transferring irrigation supplies.

Economic benefits to water users and avoided impacts for deferred water development projects are important considerations, but they are outside the scope of this study. It is not known who would receive the transferred supplies and how they would be used, so it is not possible to determine associated economic effects on those receiving the transferred water. For the same reasons, it is not possible to isolate particular water development projects that could be deferred if irrigation supplies were transferred.

Reduced agricultural activity in the study area would also affect businesses in San Antonio. Medina and Uvalde County irrigators make some purchases of agricultural equipment and supplies in San Antonio and residents of both counties buy goods and services in the city. However, these effects would be far smaller relative to the size of the San Antonio economy than found for Medina and Uvalde Counties. Because possible positive impacts on San Antonio residents and business could not be quantified in this study, it was not appropriate to quantify potential negative impacts on San Antonio.

SECTION VII.
Baseline Conditions

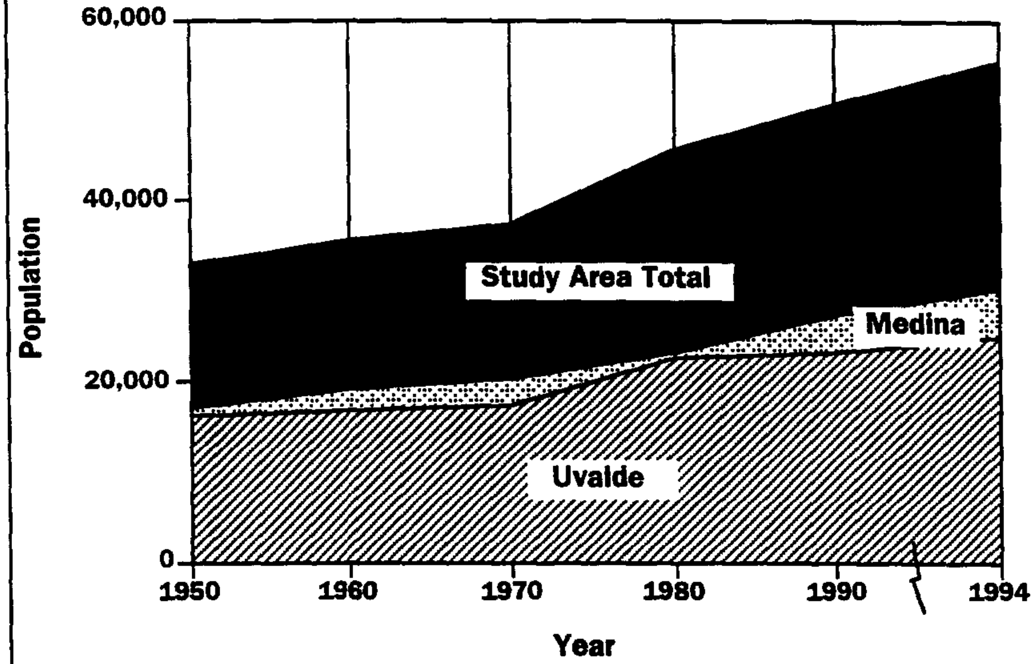
In order to examine the impacts of water transfers, one must first understand the economic and demographic characteristics of the study area without the transfers. In impact analysis, these conditions are referred to as "baseline."

This section of the report describes the population, labor force, overall economic activity and agricultural activity in Medina and Uvalde Counties. This information forms the basis for the impact projections presented in subsequent sections.

Demographic Characteristics

Total population. As indicated in Exhibit VII-1, the total population of the study area of Medina and Uvalde Counties grew from about 33,000 residents in 1950 to over 55,000 individuals in 1994. This represents an average growth rate of nearly 1.2 percent per year. In 1950, Medina and Uvalde Counties had about the same number of residents, but Medina County's total population grew an average of 1.3 percent per year, whereas Uvalde County's total population grew at an average annual rate of 1.0 percent over this period.

EXHIBIT VII-1.
Study Area Population, 1950 to 1994



Source: U.S. Bureau of the Census, Census of Population, selected years; 1994 population estimates.

In 1994, about 6,500 people resided in Hondo, accounting for about 21 percent of the residents of Medina County. Residents of the incorporated community of Uvalde numbered about 15,600 in 1994, representing over 60 percent of the Uvalde County population.

Age profile of study area residents. The study area has a greater proportion of older residents and young residents than the state as a whole. Residents age 50 years and over represented about 26 percent of study area inhabitants in 1990, compared to about 22 percent for Texas. Children under age 18 accounted for 31 percent of the study area population compared to 28 percent for the state. The relative concentration of older and younger residents is more profound for Uvalde County than Medina County.

Household size and structure in the study area. In 1990, about 50,600 residents of Medina and Uvalde Counties lived in 16,600 households, yielding an average household size of 3.0 occupants. Another 970 individuals, or 1.9 percent of the population, lived in groups quarters of different kinds.

Average household size was higher than found for Texas as a whole. Also, households in the study area were more likely to be families, especially families with children. These families with children comprised nearly 45 percent of households in the study area.

Race and ethnic composition of the study area population. In Uvalde County, over 60 percent of residents are Hispanic. Slightly less than one-half of the Medina County population is Hispanic based upon 1990 Census data. African Americans, Asians and Native Americans comprise less than 1 percent of study area population.

Income distribution. A large proportion of study area households have low incomes compared to state averages. U.S. Census data for 1989 indicated that about one-half of Medina and Uvalde County households reported annual incomes of $20,000 or less. For Texas, only 37 percent of households were in this income range. About 12 percent of study area households had incomes over $50,000, substantially below the 21 percent found for Texas. Within the study area, households in Medina County generally had higher incomes than in Uvalde County. Median household income in Medina County was $22,455 in 1989 higher than the $18,001 median income for Uvalde County and lower than the state median ($27,016).

Education levels. Educational attainment among adults age 25 and over is lower, on average, in the study area than in the state as a whole based upon 1990 Census data. These data indicate that about one-quarter of adults in the study area had curtailed their formal education prior to 9th grade, twice the proportion reported for the state. In the study area, about one out of eight adults had received a college degree compared to one out of five adult Texas residents.

Study Area Economy

Total employment. In 1993, employment in the study area numbered over 21,400 jobs based upon U.S. Bureau of Economic Analysis data. Job growth in the study area since 1970 has averaged 2 percent per year, one-third less than the growth rate for the state over this period. In general, the rate of job growth has slowed in the study area since the 1970s. The number of jobs in Uvalde County actually declined from 1988 to 1993.

EXHIBIT VII-2.
Study Area Total Employment 1970 to 1993
and Comparison to the State of Texas

	Medina County		Uvalde County		Combined Study Area		State of Texas	
Year	Number of Jobs	Annual Growth Rate	Number of Jobs	Annual Growth Rate	Number of Jobs	Annual Growth Rate	Number of Jobs	Annual Growth Rate
1970	6,443		7,130		13,573		5,032,337	
1971	6,580	2.1 %	7,248	1.7 %	13,828	1.9 %	5,112,447	1.6 %
1972	6,917	5.1	7,725	6.6	14,642	5.9	5,319,397	4.0
1973	7,136	3.2	7,928	2.6	15,064	2.9	5,595,344	5.2
1974	7,584	6.3	8,255	4.1	15,839	5.1	5,812,304	3.9
1975	7,542	(0.6)	8,378	1.5	15,920	0.5	5,919,170	1.8
1976	7,685	1.9	8,586	2.5	16,271	2.2	6,188,340	4.5
1977	7,814	1.7	9,063	5.6	16,877	3.7	6,506,759	5.1
1978	7,884	0.9	9,430	4.0	17,314	2.6	6,887,283	5.8
1979	8,171	3.6	9,282	(1.6)	17,453	0.8	7,197,135	4.5
1970-80 Average		2.5 %		2.6		2.6 %		4.0 %
1980	8,248	0.9	9,253	(0.3)	17,501	0.3	7,474,125	
1981	8,581	4.0	9,500	2.7	18,081	3.3	7,898,310	5.7
1982	8,844	3.1	9,614	1.2	18,458	2.1	8,094,702	2.5
1983	9,332	5.5	9,562	(0.5)	18,894	2.4	8,122,437	0.3
1984	9,483	1.6	10,079	5.4	19,562	3.5	8,517,287	4.9
1985	10,153	7.1	10,369	2.9	20,522	4.9	8,801,979	3.3
1986	10,313	1.6	10,317	(0.5)	20,630	0.5	8,728,348	(0.8)
1987	10,047	(2.6)	10,665	3.4	20,712	0.4	8,758,281	0.3
1988	10,000	(0.5)	10,981	3.0	20,981	1.3	8,914,739	1.8
1989	9,711	(2.9)	10,661	(2.9)	20,372	(2.9)	9,013,916	1.1
1980-90 Average		1.6 %		1.2 %		1.4 %		2.3 %
1990	9,700	(0.1)	10,442	(2.1)	20,142	(1.1)	9,334,854	3.6
1991	10,173	4.9	10,399	(0.4)	20,572	2.1	9,459,889	1.3
1992	10,103	(0.7)	10,311	(0.8)	20,414	(0.8)	9,552,589	1.0
1993	10,866	7.6	10,594	2.7	21,460	5.1	9,786,482	2.4
1990-93 Average		3.9 %		0.5 %		2.1 %		2.1 %

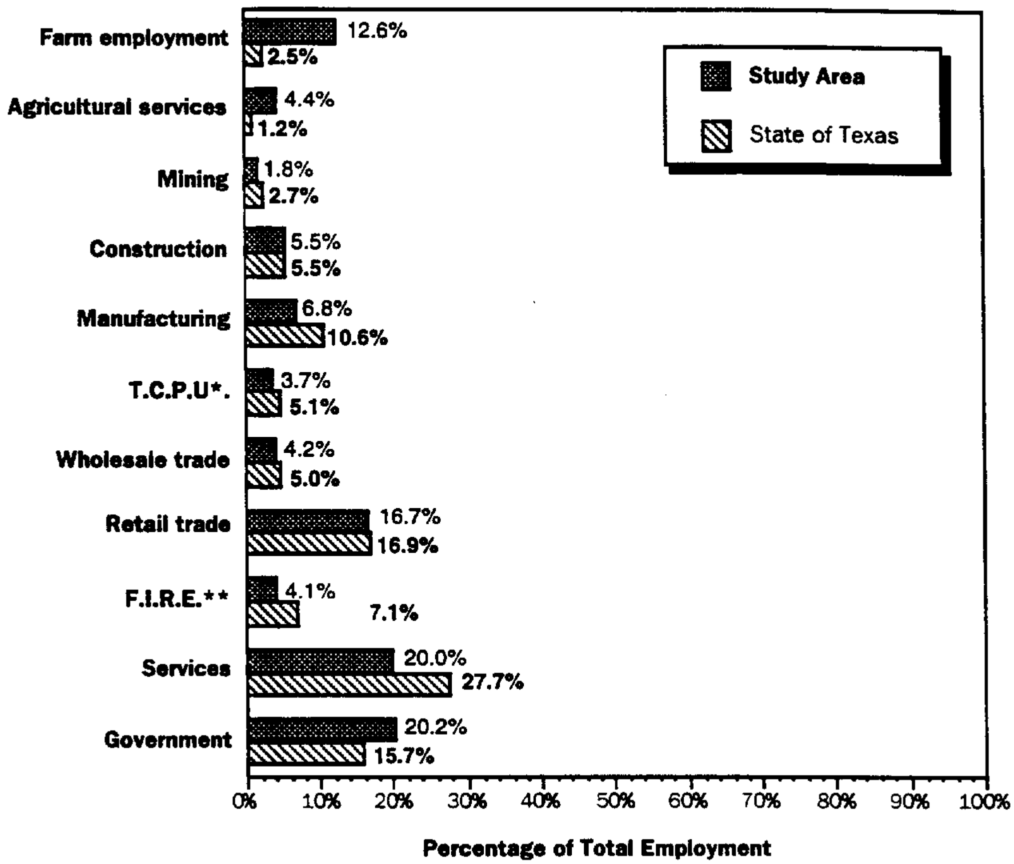
Source: U.S. Bureau of Economic Analysis, Regional Economic Information System, 1995.

Employment by sector. Based upon 1993 U.S. Bureau of Economic Analysis employment data for the study area, the three largest economic sectors are services (20 percent of total jobs), state and local government (19 percent of jobs), and retail trade (18 percent of jobs). The retail trade sector makes up the same proportion of study area employment as found for the state. While the services sector is the largest study area employer, it makes up a smaller proportion of total employment than the 28 percent found for Texas as a whole. State and local government jobs comprise a far larger proportion of total employment within the study area than the state (19 percent versus 12 percent). Exhibit VII-3 presents these comparisons.

The fourth largest sector in the study area in terms of number of jobs is farm employment. In 1993, farm employment accounted for 2,705 jobs, 13 percent of the study area total. This was substantially more than the 3 percent of total jobs this sector represented for the state as a whole. Jobs in agricultural services represented 4 percent of study area jobs compared to 1 percent for the state.

Manufacturing makes up a smaller proportion of the study area economy than found for the state. This is also true of federal civilian and military employment. This is significant because these sectors often represent "basic" employment; that is, employment that brings outside money into a community that then circulates in the local economy to support "non-basic" jobs. The large proportion of farm employment and relatively small number of manufacturing and federal jobs indicates that the study area is much more dependent upon agriculture as its economic base than is the state.

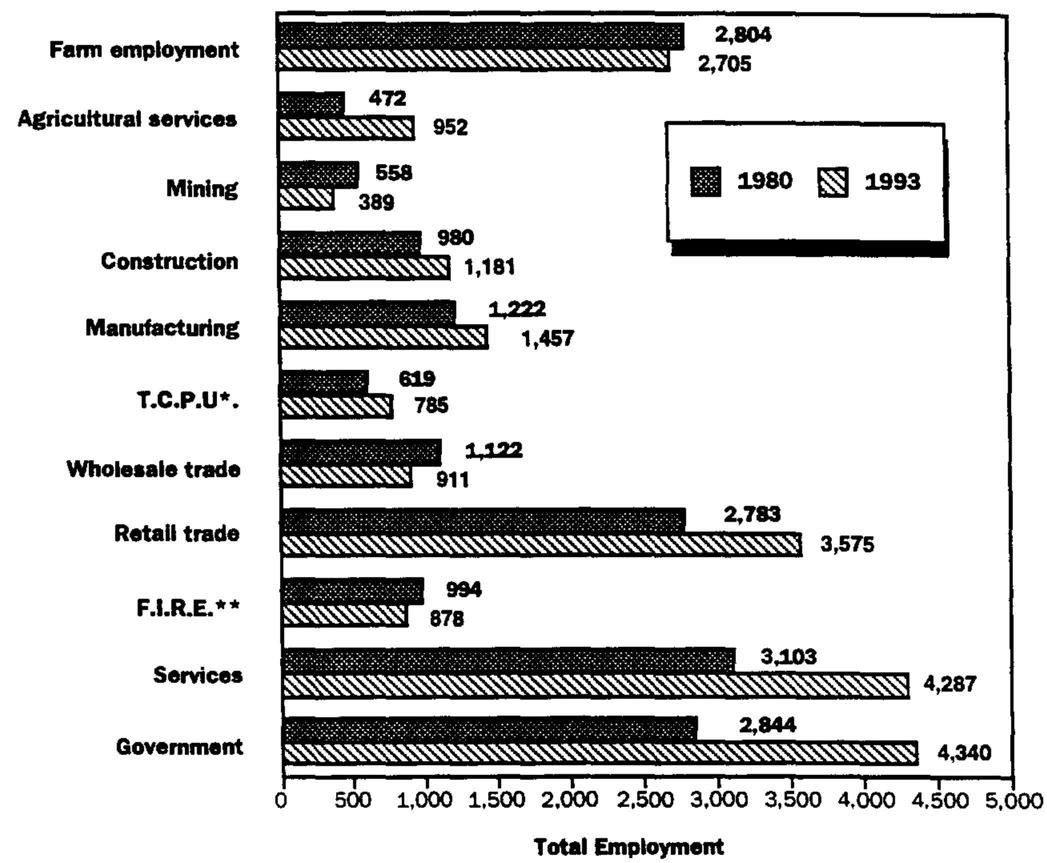
EXHIBIT VII-3.
Employment Distribution by Place of Work, Study Area and Texas, 1993



* Transportation, communications and public utilities.
** Finance, insurance and real estate.
Source: U.S. Department of Economic Analysis, Regional Economic Information System, 1995.

Exhibit VII-4 shows trends in the composition of employment in the study area from 1980 to 1993. In the study area, state and local government added 1,500 jobs and the services sector added over 1,100 jobs over this period. Employment in retail trade increased by 800 jobs. Combined, farm employment and jobs in agricultural services increased by nearly 400 jobs over this period. (Jobs shifted away from on-farm employment to agricultural services.) The manufacturing sector has seen slow growth in employment. The mining, wholesale trade and finance, insurance and real estate (F.I.R.E.) sectors lost employment.

EXHIBIT VII-4
Study Area Employment Composition, 1980 and 1993

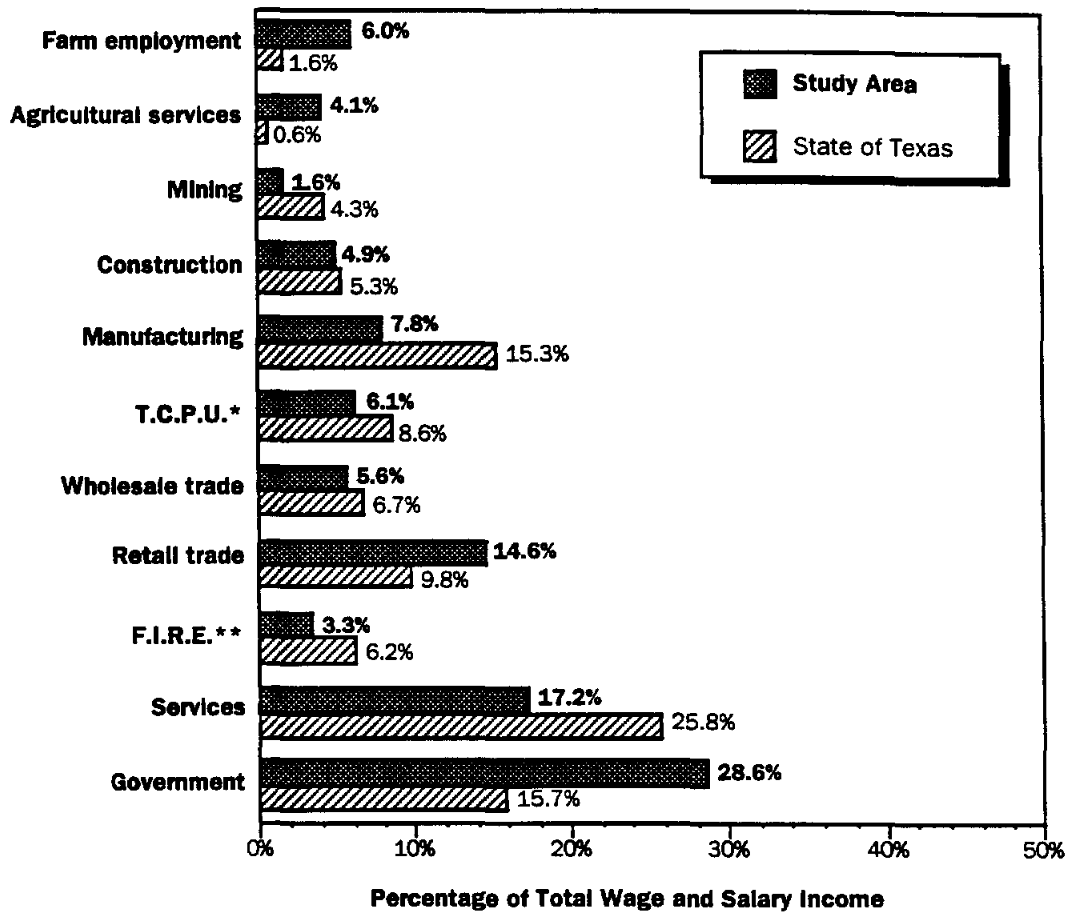


* Transportation, communications and public utilities.
** Finance, insurance and real estate.

Source: U.S. Bureau of Economic Analysis, Regional Economic Information System, 1995.

Wage and salary income by sector. Analysis of wage and salary income (including returns to proprietors) also shows the magnitude of state and local government, services and retail trade in the study area. These sectors accounted for 26 percent, 17 percent and 15 percent of study area wage and salary income in 1993. Farm employment represented 6 percent of income and agricultural services accounted for 4 percent of wage and salary income. Farm employment accounted for a smaller share of study area income than employment due to relatively low wages for farm workers and low returns to farm proprietors.

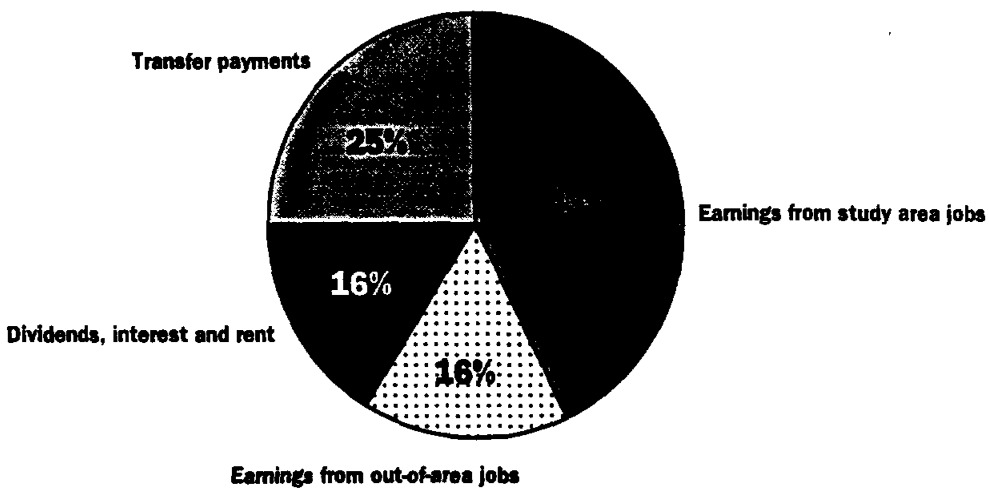
EXHIBIT VII-5.
Wage and Salary Income by Place of Work,
Study Area and Texas, 1993



* Transportation, communications and public utilities.
** Finance, insurance and real estate.
Source: U.S. Bureau of Economic Analysis, Regional Economic Information System, 1995.

Other income. Only 37 percent of household income in Medina County comes from wages and salaries for jobs held within the county. Nearly 30 percent is derived from income earned by Medina County residents commuting to jobs outside the county. About 12 percent of income comes from dividends, interest and rental income and 24 percent is transfer payments (e.g., social security). In Uvalde County, 56 percent of income is generated from wages and salaries for local jobs. There is negligible net outcommuting from the county (about as many people commute from other counties to Uvalde County jobs as outcommute from Uvalde County). Dividends, interest and rental income account for 21 percent of total income, much higher than the state average of 14 percent. Transfer payments are also relatively high, representing 26 percent of total income. The high importance of transfer payments in study area total income reflects the large number of low income residents and seniors within the study area.

EXHIBIT VII-6.
Sources of Personal Income, Study Area, 1993



Source: U.S. Bureau of Economic Analysis, Regional Economic Information System, 1995.

Labor force and unemployment. The civilian labor force in the two-county area numbered about 25,000 people in 1991 according to the U.S. Bureau of Labor Statistics. In that year, the Bureau estimated that over 1,950 civilian labor force participants were without work, placing the unemployment rate at about 7.8 percent. This rate of unemployment exceeded the 6.6 percent state-wide rate for that year. The unemployment rate for the study area has declined recently.

Overview of the agricultural economy. Agricultural activities in the study area include operations producing crops and livestock. Livestock production representing approximately two-thirds of total agricultural sales in the area. Significant livestock operations include cattle feeders, cow-calf grazing (often operated in conjunction with crop production), goat, sheep and hog production. Valued before further processing, crop production accounts for one-third of the local agricultural sales.

Local agricultural support businesses have grown alongside the farm and ranch operations. Local suppliers of livestock feed, crop fertilizers, chemicals and seed represent significant business activity in the area, particularly in the town of Uvalde. Substantial proportions of crops produced on local farms are purchased by local grain elevators, vegetable shippers and processors and other related businesses. Crop production is the focus of detailed study below.

Study Area Crop Production

A number of different state and federal agencies report data on crop production for Texas counties. County-wide farm activity is described in many different terms including acres of crops planted, acres of crops harvested, irrigated crop acreage, crop yields and production, and total crop value. Though no two years are alike, the study team developed a typical or "baseline" profile of county-wide farm activity based upon the activity of recent years. Of course, these data are not indicative of agricultural conditions during unusual circumstances such as severe drought.

Acres in farms. A profile of land use and agricultural employment in the study area in 1992 and 1987, the most recent years for which Census of Agriculture data are available, is presented in Exhibit VII-7.

The Census reveals that all land in farms in the study area increased slightly from 1982 to 1992, from about 1,560,000 acres to about 1,575,000 acres. The number of farms was also relatively stable over the period, increasing from 2,011 farms in 1982 to 2,077 in 1992. Total farm acreage considered to be cropland increased from about 326,000 acres to about 382,000 acres. Based upon these U.S. Bureau of the Census data, in 1982, approximately 84,000 acres were irrigated in the two-county area, rising to about 89,000 acres in 1992.

The slight growth in study area land in farms between 1982 and 1992 was the net result of distinct and differing trends in Medina and Uvalde Counties. Medina County land in farms decreased from over 710,000 acres in 1982 to under 660,000 acres in 1992. In Uvalde County, land in farms increased from 850,000 acres to about 917,000 acres over the same period. Despite the decrease in Medina County farmland, total cropland and irrigated land were estimated to increase slightly.

Farm employment. Farm employment as measured by the U.S. Census of Agriculture is represented by farm operators and hired laborers. Because one individual is considered the principal operator of each farm unit, the number of farm operators mirrors the number of farms in the area: 2,011 and 2,077 in 1982 and 1992, respectively. Those operators who made farming their principal occupation were 914 in 1982, or about 45 percent of all farm operators. For about one-half of these farm operators, farming was not their principal occupation.

In response to requests from data users, the 1992 Census of Agriculture was the first to inquire about the number of hired farm laborers. In that year, about 2,170 individuals were hired to work on farms in the study area, 560 (26 percent) of whom worked 150 days or more in this capacity. Hired farm workers in the study area and the surrounding region were predominately of Hispanic descent; over one-third of farm workers were either naturalized citizens or non-citizens of the United States in 1989. Nearly one-third of farm workers did not speak English or spoke it poorly in the same year.

Farm ownership. A large majority of the farms in the study area are owned by families. In 1992, about 88 percent of farms were owned by individuals, families or family-held corporations. Nearly six out of ten farm operators made their principal residence on the farm. There is little change in the operators of farms from year to year. In the study area, the current operators had spent an average of 19 years on the same farm in 1992, up from about 17 years a decade earlier. The average age of a farm operator increased from about 54 years in 1982 to 57 years in 1992.

EXHIBIT VII-7.
Study Area Agricultural Overview

Agricultural Activity	Medina County 1982	Medina County 1987	Medina County 1992	Uvalde County 1982	Uvalde County 1987	Uvalde County 1992	Combined Study Area 1982	Combined Study Area 1987	Combined Study Area 1992
Approximate Land Area (acres)	852,096	852,096	849,836	1,001,145	1,001,145	996,255	1,853,241	1,853,241	1,846,091
All Land in Farms (acres)	710,419	685,417	658,204	850,002	850,230	917,186	1,560,421	1,535,647	1,575,390
Proportion of Land in Farms	83 %	80 %	77 %	85 %	85 %	92 %	84 %	83 %	85 %
Number of Farms	1,480	1,570	1,460	531	575	617	2,011	2,145	2,077
Average Farm size (acres)	480	437	451	1,601	1,479	1,487	776	716	759
Irrigated Land (acres)	35,058	33,330	37,330	49,023	49,843	51,772	84,081	83,173	89,102
Total Cropland (acres)	202,654	210,838	213,020	123,576	143,468	169,828	326,230	354,306	382,848
Number of Farm Operators									
Farming principal occupation	646	715	688	268	305	340	914	1,020	1,028
Other principal occupation	834	855	772	263	270	277	1,097	1,125	1,049
Total Farm Operators	1,480	1,570	1,460	531	575	617	2,011	2,145	2,077
Number of Hired Farm Laborers									
Worked 150 days or more			236			328			564
Worked less than 150 days			631			971			1,602
Total Hired Farm Laborers			867			1,299			2,166

Source: U.S. Department of Commerce, Bureau of the Census, Census of Agriculture, 1992.

Net income from farming. Slightly over one-half of the farms in the study area reported a net loss in 1992. Net losses in that year averaged about $7,200 for those reporting losses, whereas net gains averaged about $26,300 for those with a gain. Losses were much more prevalent among smaller farms than for larger farm operations.

Crop acreage. Several sources of information were consulted to analyze recent county-wide acreage by crop. These sources tend to present somewhat differing information possibly due to different methods the agencies employed to collect the data.

Census of Agriculture. Every five years, the U.S. Department of Commerce compiles the Census of Agriculture by mailing a series of report forms to individuals and businesses associated with agriculture throughout the nation. For the 1992 Census of Agriculture, the final mail list consisted of 3.6 million agricultural entities. The Department of Commerce employs several different techniques to ensure high response rates. The information resulting from these efforts is maintained at the county, state and national levels.

Census of Agriculture information regarding the number of acres harvested by crop type is reported in whole acres. In general, if two or more crops are harvested from the same land during the year, the acres are to be reported for each crop harvested. (An exception to this method is hay; which is counted only once regardless of the number of cuttings obtained.) Tabulations of total irrigated land exclude multiple crop harvests, but tabulations of total irrigated crops harvested include each harvest, consistent with the general method for reporting crop acreage.

The Census of Agriculture reports that harvested cropland in Medina and Uvalde Counties totaled 185,000 acres in 1992 (counting one acre once each time a crop was harvested). Of that total about 77,900 crop acres harvested were irrigated crops. The U.S. Bureau of the Census estimates that 89,100 total acres were irrigated at least once for any purpose in Medina and Uvalde Counties in 1992.

Texas Water Development Board Survey of Irrigation. The Texas Water Development Board (TWDB), in cooperation with the U.S. Soil Conservation Service, also conducts the Survey of Irrigation every five years. This survey includes information about irrigated crop acreage. The most recent survey was completed for 1994. These data are collected by local area conservationists and staff of district conservation offices, personnel who are familiar with local agriculture and irrigation practices. Irrigated crop acreage is reported according to surface water and groundwater sources; nonirrigated crop acreage is not studied in the irrigation survey. Field personnel who gather the data consider it accurate within five to ten percent of total acres reported.

The Survey of Irrigation reports that a total of 91,400 acres in the study area were irrigated at least once during 1994, somewhat higher than the Census estimate of 89,100 acres for 1992. Including multiple crops, the Survey of Irrigation estimated that 103,100 acres of irrigated crops were planted in 1994.

Texas Agricultural Statistics. Information collected by the Texas Agricultural Statistics Service (TASS) is summarized in the annual publication series currently titled Texas Agricultural Statistics. This information is organized by crop type, with the primary intention of reporting statewide agricultural trends. Data for many crops are presented on a county by county basis. The number of crops examined is more limited than those available from the Census of Agriculture or the Survey of Irrigation, but additional information about crop yields, production and prices are included in the TASS publication.

TASS collects its information from surveys administered via the mail, telephone calls and personal interviews. Statistical estimation methods are used to prepare county-level totals based upon information gained from surveys completed within each county. Unlike the other sources considered here, TASS collects its data each year.

An estimate of total crop acreage in the study area can be made by aggregating the TASS individual crop harvest figures within each county. Because irrigated and nonirrigated acres are not specified for certain crops in the TASS publication, an estimate of total irrigated crop acreage cannot be derived directly from this source. For example, when the total crop acreages from Medina and Uvalde Counties are aggregated for each crop type identified, TASS figures imply a total harvest of 141,300 crop acres in the study area in 1992 (including multiple crops). TASS figures imply a total harvest of 138,800 crop acres in the study area in 1994. These estimates of total crop acreage fall far short of the Census of Agriculture and what is implicit in the Survey of Irrigation figures. This is primarily a result of the crops missing from the TASS reports (e.g. hay). A comparison of aggregate estimates of land and crop acreage from these sources is presented in Exhibit VII-8.

EXHIBIT VII-8.
Comparison of Crop Acreage and Farm Land Estimates in Medina and Uvalde Counties

	Census of Agriculture 1992	TWDB Survey of Irrigation 1994	Texas Agricultural Statistics 1992		Texas Agricultural Statistics 1994	
	(harvested)	(planted)	(harvested)	(planted)	(harvested)	(planted)
Total Crop Acres						
Medina County	105,340		83,180	115,000	77,150	95,400
Uvalde County	79,610		58,080	79,100	61,600	92,200
Study Area	184,950		141,260	194,100	138,750	187,600
Irrigated Crop Acres						
Medina County	31,989	43,996				
Uvalde County	45,913	59,109				
Study Area	77,902	103,105				
Irrigated Land						
Medina County	37,330	41,604				
Uvalde County	51,772	49,811				
Study Area	89,102	91,415				

Source: US Department of Commerce, Bureau of the Census, Census of Agriculture 1992; Texas Water Development Board, Survey of Irrigation 1994; Texas Agricultural Statistics Service, Texas Agricultural Statistics, 1994.

Sources of irrigation water. Most irrigation water in Medina and Uvalde Counties is drawn from underground sources. Groundwater sources include the Edwards aquifer in both counties, the Carrizo formation in Medina County and the Leona aquifer in Uvalde County. It is estimated that Carrizo wells are used to irrigate less than 3 percent of Medina County's irrigated crops, and that Leona wells are responsible for about 10 percent of irrigation in Uvalde County. Surface water irrigation accounts for about 20 percent of irrigation in Medina County, where the principal source of surface water is the Bexar-Medina-Atascosa Irrigation District. Surface water is not a significant source of irrigation in Uvalde County. Exhibit VII-9 details our estimates of total land acres irrigated from different groundwater sources in the two-county area.

EXHIBIT VII-9.
Land Acres Irrigated from Edwards Aquifer, Medina and Uvalde Counties

Acres irrigated by groundwater	81,830
Less acres irrigated from Carrizo wells	(1,600)
Less acres irrigated from Leona wells	(4,880)
Equals acres irrigated from Edwards wells	75,350

Source: TWDB and BBC Research & Consulting.

Cropping patterns. The composition of total cropland by crop type can also be estimated from these agricultural data sources. Cropping patterns reported by each source are detailed below.

Census of Agriculture. The U.S. Bureau of the Census estimated that about 185,000 acres of crops were harvested in the study area in 1992. Approximately 78,000 of these harvested crop acres were irrigated, 106,000 were not irrigated; 850 acres of soybeans were not categorized according to irrigation status. The crops with the greatest total number of harvested acres in the study area were corn (56,000 acres), sorghum (39,000 acres), hay (27,000 acres) and wheat (24,000 acres). Only counting irrigated crop acres harvested, the leading crops in 1992 were corn (38,000 acres), cotton (9,000 acres), and sorghum and wheat (7,000 acres each).

Based upon Census data, over 105,000 total crop acres were harvested in Medina County, of which 32,000 acres (30 percent) were irrigated. Nearly 80,000 crop acres were harvested in Uvalde County, of which nearly 46,000 acres (58 percent) were irrigated.

Texas Water Development Board. The TWDB reports that a total of about 103,000 irrigated crop acres were planted in 1994 in the Medina and Uvalde study area (with multiple crops counted as multiple planted acre). The leading crops according to irrigated acreage planted were corn (37,000 acres), sorghum (15,000 acres), wheat and other grains (12,000 acres) and vegetables (10,000 acres).

Medina County farmers planted more acres of irrigated corn in 1994, while Uvalde County farmers irrigated more sorghum; wheat and other grains; and vegetables.

Texas Agricultural Statistics. Estimates of harvested crop acres produced by TASS indicate that the leading crops by harvested acreage were corn, sorghum and wheat in each year. Estimates of hay acreage are not published by TASS.

Comparison of crop acreage estimates. Exhibit VII-10 compares crop acreage information from the three principal data sources. In general, individual crop acreage estimates are similar for each of the sources. The principal exception to this is in aggregated categories such as vegetables for which TASS data are incomplete.

EXHIBIT VII-10.
Comparison of Crop Acreage Estimates by Type of Crop

	Census of Agriculture 1992 (harvested)	TWDB Survey of Irrigation 1994 (planted)	Texas Agricultural Statistics 1992 (harvested)	1992 (planted)	1994 (harvested)	1994 (planted)
Corn						
Irrigated	38,283	37,170	-	-	-	-
Nonirrigated	17,743	-	-	-	-	-
Total	56,026	-	51,000	54,900	50,200	55,100
Cotton						
Irrigated	9,432	8,855	-	-	-	-
Nonirrigated	2,466	-	-	-	-	-
Total	11,898	-	11,900	12,100	10,700	11,300
Hay						
Irrigated	5,203	4,750	-	-	-	-
Nonirrigated	22,238	-	-	-	-	-
Total	27,441	-	-	-	-	-
Oats						
Irrigated	1,541	-	-	-	-	-
Nonirrigated	6,965	-	-	-	-	-
Total	8,506	-	9,800	44,900	7,100	34,200
Sorghum						
Irrigated	6,793	15,048	3,300	3,400	11,600	11,800
Nonirrigated	32,375	-	34,000	37,200	34,100	36,200
Total	39,168	-	37,300	40,600	45,700	48,000
Vegetables						
Irrigated	7,344	9,956	-	-	-	-
Nonirrigated	174	-	-	-	-	-
Total	7,518	-	3,960	-	3,350	-
Wheat						
Irrigated	6,817	7,319	4,600	5,100	4,500	6,200
Nonirrigated	16,866	-	20,700	34,500	15,500	31,000
Total	23,683	-	25,300	39,600	20,000	37,200
Other						
Irrigated	2,489	20,007	1,400	1,400	1,600	1,600
Nonirrigated	68	-	600	600	100	200
Total	10,710 *	-	2,000	2,000	1,700	1,800

* Includes other crops for which irrigation status was not reported.

Source: US Department of Commerce, Bureau of the Census, Census of Agriculture 1992; Texas Water Development Board, Survey of Irrigation 1994; Texas Agricultural Statistics Service, Texas Agricultural Statistics, 1994.

The study team concluded that the three data sources were generally consistent, and where differences arose, they could be explained. The differences between the Census of Agriculture and Survey of Irrigation estimates appear reasonable. For example, in the case of sorghum, the Census reported about 6,800 irrigated acres in the study area in 1992 whereas the Survey reported 15,000 irrigated acres in 1994. The implied increase appears to be supported by TASS data which show a dramatic increase in irrigated sorghum acres between these two years. Further, none of the three data sources alone were adequate to provide all of the information on crop production required for this study. Therefore, the study team used each of the three data sources in combination to develop baseline estimates of irrigated crop acreage, nonirrigated crop acreage, harvest ratios, yields and prices:

- irrigated crop acreage was estimated using TWDB information for 1994,
- nonirrigated crop acreage was estimated from Census of Agriculture data for 1992,

- when these sources did not offer a direct acreage estimate for a given crop, acreage estimates were prepared from the other sources or from the input of local experts, and

- crop harvest ratios, prices and yields were taken from Texas Agricultural Statistics Service publications (we used an average for 1990 through 1994).

These initial estimates were reviewed with individuals knowledgeable about local agricultural activity.

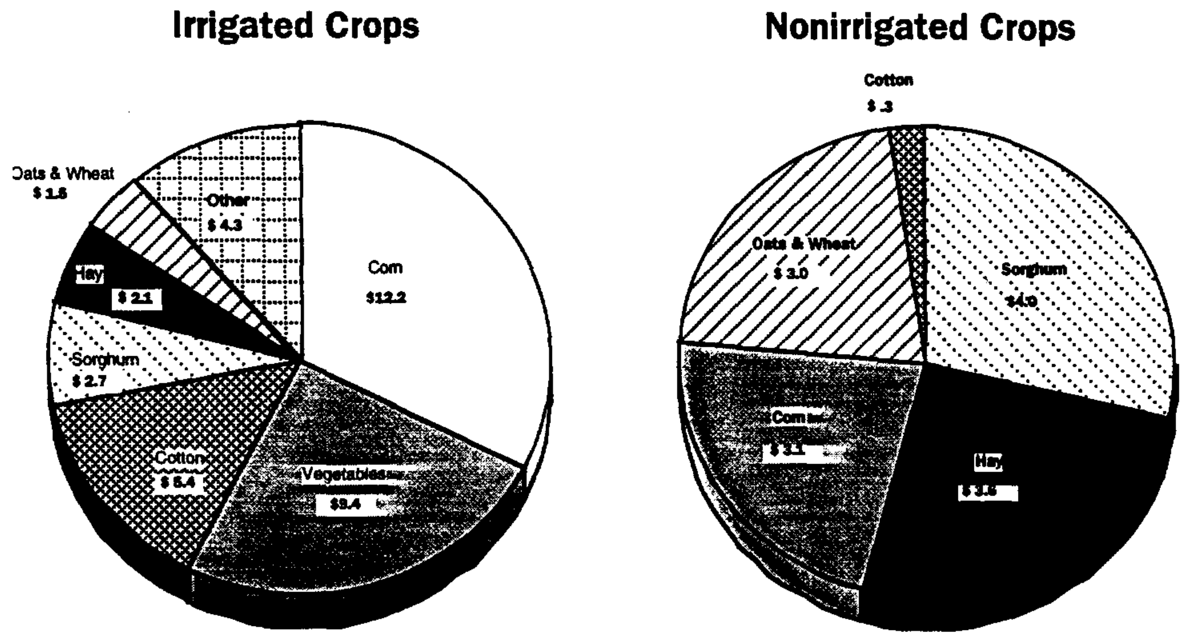
While the yields and prices used in the analysis reflect average 1990-1994 values, the 1994 irrigated cropping pattern included a higher than average proportion of acres in corn, cotton and vegetable production. If alternative irrigated cropping patterns found in earlier years were incorporated in the analysis, both baseline farm activity and potential impacts could differ somewhat from this analysis.

Value of crop production. The total value of crop production in Medina and Uvalde Counties is estimated to be $52 million in a typical year. Irrigated crops represent three-fourths of the total value of crop production, or about $38 million. Corn crops occupy the largest amount of irrigated acreage in an average year, producing over $12 million in farm receipts. The value of vegetable crops in the area exceeds $9 million.

The values attributed to oats and wheat include estimates of weight gain by cattle grazing on portions of these crops. An estimate of cotton seed value is also added to the value of cotton lint production.

Nonirrigated crops, which post smaller harvest ratios and yields, generate about $14 million of total production value. Estimates of total annual production value in the study area for irrigated and nonirrigated crops are presented in Exhibit VII-11. (Detailed tables illustrating the bases for these estimates are presented in Section VIII.)

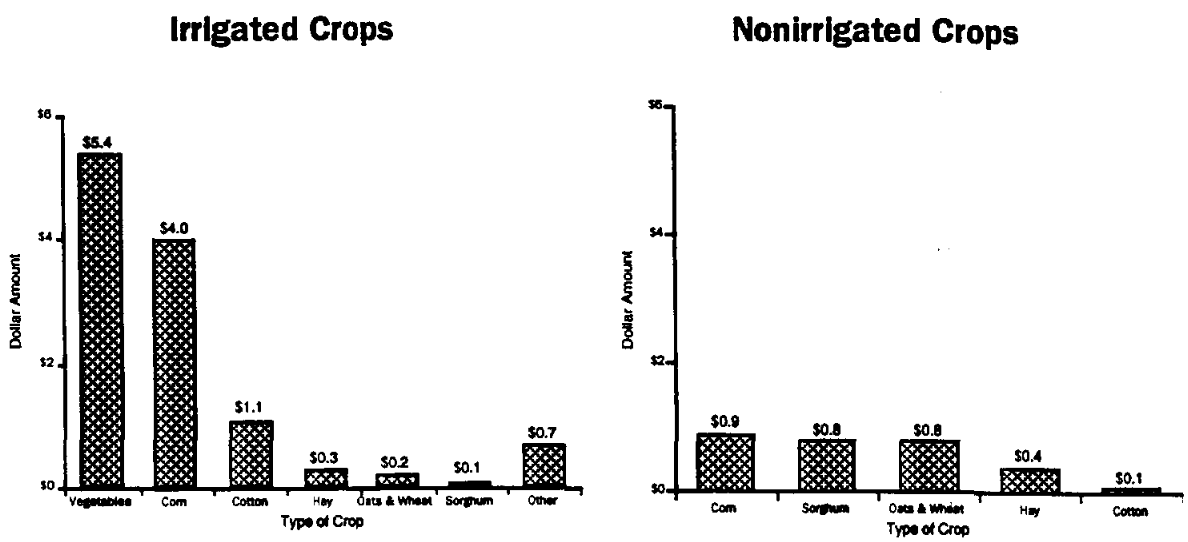
Exhibit VII-11.
Gross Value of Irrigated and Nonirrigated Crop Production in Medina and Uvalde Counties by Crop Type (Millions)



Source: BBC Research & Consulting.

Operating Income. Estimates of the costs of crop production, based upon crop budgets prepared by the Texas Agricultural Extension Service for 1994 and 1995, were subtracted from our estimates of crop value to identify aggregate farm operating income. Operating income, that income earned by farmers after deducting the variable costs of crop production, is estimated to be about $15 million in the study area in a typical year. About one-third of this income is attributed to the production of irrigated vegetables. Irrigated corn crops produce the next greatest proportion of total operating income, about $4 million. In total, irrigated crop production accounts for nearly 80 percent of aggregate farm operating income in the area. The approximate breakdown of farm operating income generated by different crops in the study area is presented in Exhibit VII-12.

EXHIBIT VII-12.
Aggregate Farm Operating Income
in Medina and Uvalde Counties by Crop Type (Millions)



Source: BBC Research & Consulting.

Farm expenses which remain to be paid out of the operating income figures presented here include crop financing costs; payments for land, buildings and equipment; taxes and general farm overhead costs.

Economic Sectors Directly Linked to Irrigated Agriculture

Local businesses that are directly linked to irrigated crop production include suppliers of farm inputs and those that purchase farm outputs.

Input suppliers. Local crop production requires large purchases of inputs such as seed, fertilizer and chemicals. Important suppliers in the area include Mumme's, Inc. (multiple locations), Helena Chemical in Uvalde, Uvalde Farmer's Co-op in Knippa, Central Valley Chemical in Uvalde and Chapman Grain in Hondo. Between 10 and 50 people might be employed at each location of these suppliers. Additionally, the application of chemicals on local cropland supports a number of aerial and field applicator businesses.

Most of the farms in Medina and Uvalde Counties make their input purchases from these local businesses and others. In the case of seed, chemicals and fertilizer, we estimate that 70 to 85 percent of farm purchases are made within the study area. Similarly, suppliers say that local farms account for most of their sales, ranging from 55 percent to 95 percent depending upon the business and type of supply in question. Several local farmer dealers also offer seed to farms in the study area. Purchases of fuel, repair services and lubricants are also significant components of farm costs, with most of these expenditures made locally.

Farm operators within the two-county area also purchase such equipment as farm machinery and irrigation equipment. Past unfavorable economic conditions have driven some farm equipment dealers out of the area. Most farm equipment purchases are now made from dealers in neighboring areas such as San Antonio and Pearsall, although, there are farm equipment dealerships in both Uvalde and Castroville which would likely be impacted by water transfers.

Output handlers. Local farms are also closely tied to those who buy their crops. The bulk of local grains are purchased by local elevators for local use and for shipment out of the area. Some grains are purchased directly by local feedyards. Additionally, white food corn is purchased by several local mills for processing and shipment to food manufacturers.

Many local vegetable companies acquire produce from local farms. Frequently, the relationships between local growers and shippers is well established, the grower contracting acreage to the shipper for the coming season. Shippers are heavily concentrated in the vicinity of incorporated Uvalde. Among them are Cargill Produce, Wintergarden Produce, Eddy Produce, Pentagon Produce, McBryde Produce and others. Frozen vegetable processor Dean Foods is a complementary business and a significant employer in the area.

During the harvest season, even a smaller shipper specializing in a single vegetable crop can employ hundreds of people in harvesting crews. The work is seasonal, but the climate and stable sources of irrigation allow most of the shippers to operate nine to ten months per year. (Laborers may work for one shipper during part of the year and for others during other seasons). Harvest crews and line workers tend to be local residents, though some migrant workers are employed.

Several cotton gins operate in Medina and Uvalde Counties, often ginning cotton lint on behalf of local farmers who are co-operative owners. Gin operators indicate that they hope to receive enough revenues from the sale of cotton seed to cover the expenses of ginning. Profits then flow back to the farmer-owners in the form of cash distributions or increased equity in the gin.

Finally, crop growers, handlers and input suppliers make use of trucking and rail transportation throughout the year. In some cases the transportation function is integral to the operation of the crop handler, such as the grain elevators. In other cases, these agricultural businesses make use of regional brokers and transporters to service their needs.

Farm finance. Farmers often rely on mortgages for financing purchases of land and buildings. These mortgages are rarely issued by local commercial lenders, however. Federal land banks make most of these mortgages. The Federal Land Bank has local offices in both Uvalde and Devine.

Farm operators do go to local banks to obtain operating loans and some equipment loans. There are nine commercial banks in Medina and Uvalde Counties. In total, they had assets of approximately $500 million and employed about 195 people at the end of 1995. Loans to irrigators are a much more important part of local banks' business than to dryland farmers because of the bigger operations of irrigators and due to the risky nature of nonirrigated farming in Medina and Uvalde Counties. Conversations with local bankers indicate that loans made directly to Edwards irrigators might represent six percent of their collective loan portfolios. Some banks have extended a much greater proportion of their loans to other businesses tied to irrigated agriculture.

Power purchases. Most farmers in Medina and Uvalde Counties receive their power from the Medina Electric Cooperative, Inc. This electric cooperative serves all or parts of 17 counties extending over 200 miles north to south from Edwards and Real Counties to Starr County on the Mexico border.

Medina Electric's long range financial forecast projects 1996 revenues of about $28 million. About 12 percent of 1996 revenues are expected to come from irrigation sales. Medina Electric reports that one-third of its irrigation revenues come from Edwards irrigators.

SECTION VIII.
Direct Effects of Potential Edwards Aquifer Water Transfers

This step of the impact analysis considers the direct effects on Edwards irrigators under the water transfer scenarios identified in Section V:

1. 100 percent transfer of Edwards irrigation *with* compensation,
2. 100 percent transfer of Edwards irrigation *without* compensation,
3. 50 percent transfer of Edwards irrigation *with* compensation, and
4. 50 percent transfer of Edwards irrigation *without* compensation.

Conditions under each scenario are compared with baseline conditions.

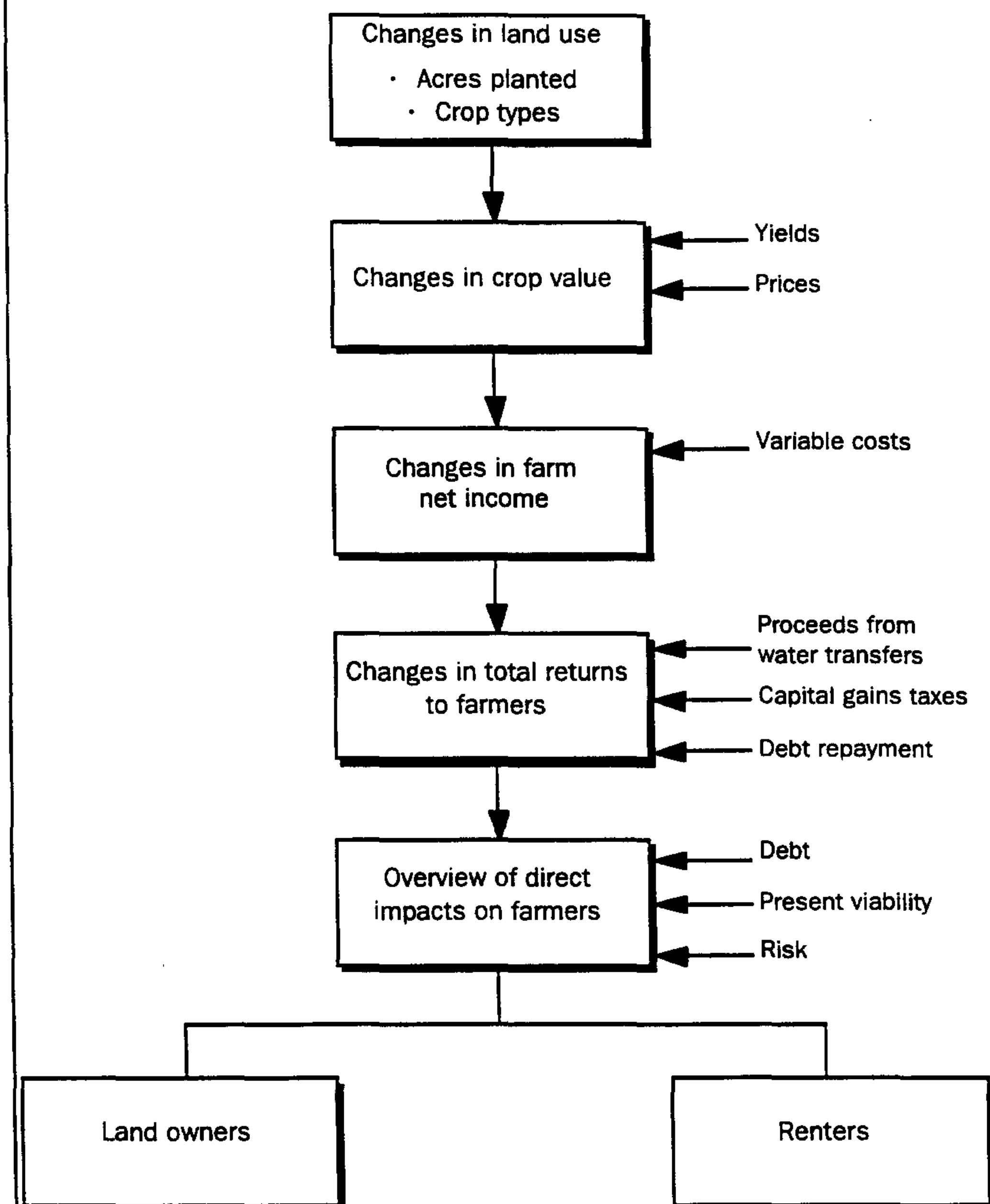
Exhibit VIII-1 outlines the steps applied in examining direct impacts of the water transfers on Medina and Uvalde County farmers. As shown, we began by projecting changes in land use. Changes in the total number of planted acres and changes in the number of irrigated and dryland acres by crop type were estimated. Combining these projections with estimates of average yields and prices, the study team then estimated changes in gross crop values for agriculture in the two counties.

Changes in farm net income before fixed costs were projected based upon gross crop value less our estimates of variable costs. This produced estimates of farm operating income. (We discuss our rationale for not including fixed costs in these estimates later in this section.)

Because the "with compensation" scenarios include payments to land owners for their irrigation supplies, analysis of changes in total returns to farmers also takes into account income earned from the proceeds of the water sales. This is the fourth box shown in Exhibit VIII-1. Our analysis considered capital gains taxes on the proceeds from the water transfers as well as the prospect that land owners might need to repay a portion of any outstanding debt on the formerly irrigated land.

We concluded our analysis of direct impacts with a qualitative assessment of how different types of farmers would fare under these scenarios. The long-term financial viability of farm operations under these scenarios was considered. Differential impacts on owners versus renters of irrigated land were also assessed.

EXHIBIT VIII-1.
Overview of Analysis of Direct Impacts on Farmers



Source: BBC Research & Consulting.

The balance of this section presents our findings for each of these elements of the direct impact analysis.

Changes in Land Use

While some land may be removed from agriculture altogether, there are several factors that support the assumption that most land would continue to be farmed without irrigation.

Changes in acres planted. Based upon analysis of the local agricultural economy and discussions with farmers, the study team projected that most crop land removed from irrigation would be converted to dryland farming. For simplicity, 100 percent of the acres no longer irrigated were assumed to be farmed on a dryland basis. Thus, our analysis reflects no change in the acreage devoted to farming in Medina and Uvalde Counties. Under the 100 percent transfer scenarios, 75,350 irrigated acres would shift to dryland farming. Under the 50 percent transfer scenarios, almost 38,000 irrigated acres would shift to dryland farming.

Factors supporting this assumption include the following. First, irrigation came relatively recently to Medina and Uvalde Counties beginning in the late 1950s with significant expansion in the 1960s and 1970s. Agriculture developed in both counties prior to groundwater irrigation (although surface water irrigation from Medina Lake dates back to the 1920s). Second, a substantial amount of nonirrigated land is now farmed. Third, analysis of crop budgets for the area indicates that the average returns from dryland farming cover variable costs. Finally, discussions with local farmers suggest that most irrigated acres would be converted to dryland farming. The lands most likely to go out of crop production would be those in the western portions of the study area which see lower rainfall than in eastern Medina County. While some of these western lands might convert to livestock; for the purposes of this study, all of the acreage is assumed to stay in crop production. (This assumption leads to somewhat understated estimates of potential impacts of water transfers on the local economy.)

Changes in crops. Projecting changes in crops by type required two steps. First, the study team identified the types of dryland crops that would be grown on the formerly irrigated acreage. Then, for the 50 percent transfer scenario, the study team projected the types of crops that would be removed from irrigation and the acres by type of crop that would remain in irrigation. (Under the 100 percent transfer scenario, all Edwards irrigated crops are removed from irrigation.)

Increases in dryland crops. The crop distribution on acres converted from irrigation to dryland farming was assumed to mirror the present dryland crop distribution in each county. This distribution is presumed to embody the best combination of expected income and manageable risk for local farmers. That is, irrigated land in Medina County would convert to dryland crops in the same proportions as currently found for dryland farming in Medina County (with the same true for Uvalde County). This approach was used for each of the transfer scenarios.

Based upon this assumption, the amount of study area acreage in dryland sorghum, wheat, oats and hay and pasture would substantially increase under any of the transfer scenarios. The total (irrigated and nonirrigated) acreage in hay, for example, might increase from 24,000 acres under the baseline to 43,000 acres under the 100 percent transfer scenario. Exhibit VIII-2 summarizes the estimated amount of irrigated and dryland crop acreage under the baseline, 50 percent transfer and 100 percent transfer scenarios.

EXHIBIT VIII-2.
Acres Planted by Crop Type for Each Scenario, Medina and Uvalde Counties

	Medina County				Uvalde County				Study Area			
Crop	Baseline	50 Percent Transfer A	50 Percent Transfer B	100 Percent Transfer	Baseline	50 Percent Transfer A	50 Percent Transfer B	100 Percent Transfer	Baseline	50 Percent Transfer A	50 Percent Transfer B	100 Percent Transfer
Corn												
Irrigated	22,600	12,995	11,938	3,390	14,500	8,120	7,418	1,740	37,100	21,115	19,357	5,130
Nonirrigated	18,462	22,010	22,017	25,558	1,515	2,484	2,479	3,453	19,977	24,494	24,496	29,010
Total	41,062	35,005	33,955	28,948	16,015	10,604	9,898	5,193	57,077	45,609	43,853	34,140
Cotton												
Irrigated	3,300	1,650	1,469	-	5,600	3,192	2,927	784	8,900	4,842	4,396	784
Nonirrigated	1,064	1,268	1,269	1,473	-	-	-	-	1,064	1,268	1,269	1,473
Total	4,364	2,918	2,737	1,473	5,600	3,192	2,927	784	9,964	6,110	5,664	2,257
Hay												
Irrigated	3,900	3,783	3,770	3,666	900	495	450	90	4,800	4,278	4,221	3,756
Nonirrigated	14,444	17,220	17,226	19,996	10,000	16,394	16,364	22,789	24,444	33,615	33,591	42,785
Total	18,344	21,003	20,996	23,662	10,900	16,889	16,815	22,879	29,244	37,893	37,811	46,541
Oats												
Irrigated	500	270	245	40	4,800	2,640	2,402	480	5,300	2,910	2,647	520
Nonirrigated	16,000	19,075	19,081	22,150	6,667	10,930	10,910	15,193	22,667	30,005	29,991	37,342
Total	16,500	19,345	19,326	22,190	11,467	13,570	13,312	15,673	27,967	32,915	32,638	37,862
Peanuts												
Irrigated	1,600	1,600	1,600	1,600	-	-	-	-	1,600	1,600	1,600	1,600
Nonirrigated	-	-	-	-	-	-	-	-	-	-	-	-
Total	1,600	1,600	1,600	1,600		-	-	-	1,600	1,600	1,600	1,600
Sorghum												
Irrigated	3,400	1,887	1,721	374	11,700	6,552	5,986	1,404	15,100	8,439	7,706	1,778
Nonirrigated	25,824	30,787	30,797	35,750	9,783	16,038	16,009	22,293	35,607	46,825	46,806	58,044
Total	29,224	32,674	32,518	36,124	21,483	22,590	21,994	23,697	50,707	55,264	54,512	59,822
Vegetables												
Irrigated	4,000	2,340	4,000	680	6,000	3,300	6,000	600	10,000	5,640	10,000	1,280
Nonirrigated	-	-	-	-		-	-	-	-	-	-	-
Total	4,000	2,340	4,000	680	6,000	3,300	6,000	600	10,000	5,640	10,000	1,280
Wheat												
Irrigated	500	270	245	40	6,800	3,740	3,403	680	7,300	4,010	3,648	720
Nonirrigated	13,043	15,550	15,555	18,057	12,903	21,154	21,115	29,405	25,947	36,704	36,671	47,462
Total	13,543	15,820	15,800	18,097	19,703	24,894	24,519	30,085	33,247	40,714	40,319	48,182
Other												
Irrigated	4,700	2,632	2,405	564	8,900	5,029	4,603	1,157	13,600	7,661	7,007	1,721
Nonirrigated		-	-	-		-	-	-	-	-	-	-
Total	4,700	2,632	2,405	564	8,900	5,029	4,603	1,157	13,600	7,661	7,007	1,721
Total												
Irrigated	44,500	27,427	27,392	10,354	59,200	33,068	33,190	6,935	103,700	60,495	60,581	17,289
Nonirrigated	88,837	105,910	105,946	122,983	40,868	67,000	66,878	93,133	129,705	172,911	172,824	216,116
Total	133,337	133,337	133,337	133,337	100,068	100,068	100,068	100,068	233,405	233,405	233,405	233,405

Note: 50% transfer A assumes that 50 percent of Edwards irrigated vegetables remain in production. 50% transfer B assumes that all Edwards irrigated vegetables remain in production.

Source: BBC Research & Consulting.

Decreases in irrigated crops. Under the 100 percent transfer scenarios, all crop irrigation in Medina and Uvalde Counties using Edwards wells would cease. The only remaining irrigated agriculture would be from Medina Lake, and Carrizo and Leona wells. As shown in Exhibit VIII-2, the remaining irrigation would total about 17,000 crop acres. While there might be shifts to higher value crops on the remaining irrigated land, we assumed that the crops grown on the non-Edwards irrigated acres would not change from the crops seen today.

We examined two sets of assumptions concerning changes in crop types under the 50 percent transfer scenarios. Under the first set of 50 percent transfer scenarios, we assumed that one-half of Edwards irrigated cropland would shift to dryland crops. This set of assumptions in reflected in the 50 percent transfer-A column in Exhibit VIII-2.

Under the 50 percent scenarios, it is possible that the acreage now in highest value crops — vegetables — would remain in production. Vegetable farmers might be the last to sell their irrigation supplies, and if they did, others might shift irrigated lands into vegetables to meet the demand of local shippers and processors. Similarly, if irrigated land went out of production due to regulation, vegetable farmers might purchase or lease additional irrigated land to make up the lost vegetable production (or other farmers could begin growing vegetables on their remaining irrigated land).

If vegetables stayed in production, the decreases in irrigated crops under the 50 percent transfer scenarios were assumed to come proportionately from all non-vegetable crops currently irrigated within each county. For example, because corn comprises about one-third of all non-vegetable acreage that is now irrigated from Edwards wells in Medina and Uvalde Counties, one-third of the acreage coming out of irrigation would be irrigated corn. The net result is that, except for vegetables, acreage in each Edwards irrigated crop in Medina and Uvalde Counties would be reduced by 55 percent. (This number is higher than 50 percent to make up for all of the vegetable acreage remaining in irrigation.) The resulting crop mix is shown as 50 percent transfer-B in Exhibit VIII-2.

Changes in Crop Value

Transfers of irrigation supplies would reduce the total value of crop production in the study area because of changes in the crops grown, the lower percentage of dryland acres planted that are actually harvested, and lower dryland yields for each harvested acre of any crop. (We assumed no changes in crop prices, although the analysis does reflect the fact that dryland corn for grain brings a lower price than corn for food, an irrigated crop.)

100 percent transfer scenarios. Exhibit VIII-3 presents a model of farm activity in Medina County under baseline or "pre-transfer" conditions. Exhibit VIII-4 presents farm activity in Medina County if 100 percent of the Edwards irrigation were transferred. The models portrayed in these two exhibits calculate the gross crop value for irrigated and non-irrigated crop acres based upon:

- number of irrigated and dryland acres planted by crop type,
- the proportion of planted acres for each crop type that is harvested,
- the yield per harvested acre, and
- the crop price per yield unit.

The only difference between the baseline model (Exhibit VIII-3) and the 100 percent transfer model (Exhibit VIII-4) is the number of irrigated and dryland acres in each crop. The assumptions for harvest percentages, yields and prices are the same under the baseline and the 100 percent transfer scenario. The study team estimated values for each of the factors listed above from historical averages, crop budgets and other local data. Assumptions were then reviewed with local farmers, agricultural extension agents, and other individuals knowledgeable of local farming. It is important to note that these assumptions represent average conditions and are not reflective of any one year. For example, these estimates of gross crop production reflect neither the high grain prices seen in 1996 nor the impact on dryland yields from the drought. In Exhibits VIII-3 and VIII-4, the total value for each type of crop (a row in the table) is determined by multiplying across the row. Gross crop value for vegetables pertains to value in the field (unpicked).

As shown in Exhibit VIII-3, the gross value of irrigated crops in Medina County is estimated to be $19 million under the baseline conditions. There is about $10 million in dryland crop production estimated in the baseline model.

The only acres remaining in irrigation in Medina County under the 100 percent transfer scenarios (Exhibit VIII-4) are those with Medina Lake supplies or Carrizo wells (about 10,000 acres planted). The study team projected gross production for remaining irrigation to be $5 million under the 100 percent transfer scenario. All formerly Edwards irrigated acreage is in dryland crops under this scenario. The gross value of dryland farming increases from the $10 million seen under the baseline to $14 million under the 100 percent transfer scenario. Combining irrigated and non-irrigated crops, the total value of crop production in Medina County would be $19 million. This production would be $10 million per year less than under baseline conditions (a 35 percent decrease).

Exhibit VIII-5 and VIII-6 summarize the baseline and 100 percent transfer models for Uvalde County. As shown in Exhibit VIII-5, baseline crop production in Uvalde County totals $23 million (about $19 million in irrigated crops and $4 million in dryland crops). Under the 100 percent transfer scenario (Exhibit VIII-6), only the acreage with Leona wells remains in irrigation. The total value of irrigated crop production in Uvalde County under the 100 percent transfer scenario would be $2 million per year, nearly $17 million less than found in the baseline. Production of dryland crops would increase from less than $4 million under the baseline to nearly $9 million under the 100 percent transfer scenario. Thus, the total value of crop production in Uvalde County would decline by $12 million per year (52 percent decrease).

Combining the two counties, crop production would decline by $22 million per year under the 100 percent scenario. In other words, the value of crop production would decrease by about 45 percent for the study area as a whole. This relative impact would be greater but for the small amount of Medina Lake, Carrizo and Leona-based irrigation remaining under the 100 percent transfer scenario.

EXHIBIT VIII-3.
Baseline Farm Activity in Medina County

Crop	Acres Planted	Percent of Planted	Acres Harvested	Yield per Harvested Acre	Production	Crop Price per Yield Unit	Gross Crop Value	Acres Irrigated by Edwards Wells	Edwards Irrigated Crop Value
Corn									
Irrigated	22,600	98 %	22,148	120.0 bushels	2,657,760	$ 2.85	$ 7,574,616	85 %	$ 6,438,424
Nonirrigated	18,462	91	16,800	67.3 bushels	1,130,640	2.60	2,939,664		
Total	41,062		38,948		3,788,400		10,514,280		
Cotton									
Irrigated	3,300	99	3,267	1,045.0 pounds	3,414,015	0.58	2,242,109	100	2,242,109
Nonirrigated	1,064	94	1,000	424.2 pounds	424,200	0.58	276,836		
Total	4,364		4,267		3,838,215		2,518,945		
Hay									
Irrigated	3,900	99	3,861	6.5 tons	25,097	66.40	1,666,408	6	99,984
Nonirrigated	14,444	90	13,000	2.5 tons	32,500	66.40	2,158,000		
Total	18,344		16,861		57,597		3,824,408		
Oats									
Irrigated	500	20	100	56.0 bushels	5,600	1.61	59,016	92	54,295
Nonirrigated	16,000	30	4,800	34.0 bushels	163,200	1.61	902,752		
Total	16,500		4,900		168,800		961,768		
Peanuts									
Irrigated	1,600	100	1,600	22.3 cwt	35,680	31.00	1,106,080	0	-
Nonirrigated	-		-				-		
Total	1,600		1,600		35,680		1,106,080		
Sorghum									
Irrigated	3,400	97	3,298	47.3 cwt	155,995	3.96	617,742	89	549,790
Nonirrigated	25,824	91	23,500	31.9 cwt	749,650	3.96	2,968,614		
Total	29,224		26,798		905,645		3,586,356		
Vegetables									
Irrigated	4,000	99	3,960	1.0 acres	3,960	952.00	3,769,920	83	3,129,034
Nonirrigated	-								
Total	4,000		3,960		3,960		3,769,920		
Wheat									
Irrigated	500	81	405	50.0 bushels	20,250	2.94	69,035	92	63,512
Nonirrigated	13,043	69	9,000	30.5 bushels	274,500	2.94	968,769		
Total	13,543		9,405		294,750		1,037,804		
Other									
Irrigated	4,700	97	4,559				1,458,880	88	1,283,814
Nonirrigated									
Total	4,700		4,559				1,458,880		
Total									
Irrigated	44,500		43,198				$ 18,563,806		$ 13,860,963
Nonirrigated	88,837		68,100				$ 10,214,635		
Total	133,337		111,298				$ 28,778,441		

Source: BBC Research & Consulting.

EXHIBIT VIII-4.
Farm Activity In Medina County, 100% Edwards Irrigation Reduction

Crop	Acres Planted	Harvested Acres as Percent of Planted	Acres Harvested	Yield per Harvested Acre	Production	Crop Price per Yield Unit	Gross Crop Value
Corn							
Irrigated	3,390	98 %	3,322	120.0 bushels	398,664	$ 2.85	$ 1,136,192
Nonirrigated	25,558	91	23,257	67.3 bushels	1,565,218	2.60	4,069,568
Total	28,948		26,580		1,963,882		5,205,760
Cotton							
Irrigated	-	99	-	1,045.0 pounds	-	0.58	-
Nonirrigated	1,473	94	1,384	424.2 pounds	587,248	0.58	383,242
Total	1,473		1,384		587,248		383,242
Hay							
Irrigated	3,666	99	3,629	6.5 tons	23,591	66.40	1,566,423
Nonirrigated	19,996	90	17,997	2.5 tons	44,992	66.40	2,987,459
Total	23,662		21,626		68,583		4,553,883
Oats							
Irrigated	40	20	8	56.0 bushels	448	1.61	4,721
Nonirrigated	22,150	30	6,645	34.0 bushels	225,928	1.61	1,249,738
Total	22,190		6,653		226,376		1,254,459
Peanuts							
Irrigated	1,600	100	1,600	22.3 cwt	35,680	31.00	1,106,080
Nonirrigated	-	-	-	- cwt	-	-	-
Total	1,600		1,600		35,680		1,106,080
Sorghum							
Irrigated	374	97	363	47.3 cwt	17,159	3.96	67,952
Nonirrigated	35,750	91	32,533	31.9 cwt	1,037,789	3.96	4,109,645
Total	36,124		32,895		1,054,949		4,177,596
Vegetables							
Irrigated	680	99	673	1.0 acres	673	952.00	640,886
Nonirrigated	-	-	-	-		-	
Total	680		673		673		640,886
Wheat							
Irrigated	40	81	32	50.0 bushels	1,620	2.94	5,523
Nonirrigated	18,057	69	12,459	30.5 bushels	380,008	2.94	1,341,130
Total	18,097		12,492		381,628		1,346,653
Other							
Irrigated	564	97	547				175,066
Nonirrigated	-	-	-				
Total	564		547				175,066
Total							
Irrigated	10,354		10,175				$ 4,702,843
Nonirrigated	122,983		94,275				$ 14,140,782
Total	133,337		104,450				$ 18,843,625

Source: BBC Research & Consulting.

50 percent transfer scenarios. If one-half of the acres currently irrigated by Edwards wells in Medina and Uvalde County were converted to dryland farming, the value of crop production in these two counties would drop by $11 million per year, or about 21 percent. If 50 percent of the Edwards irrigated acres were converted to dryland crops, but irrigated vegetables remained in production, study area crop production would decrease by $8 million or about 15 percent.

Exhibit VIII-7 presents acreage by crop, crop production and gross crop value for Medina County under the 50 percent transfer scenario assuming a 50 percent decrease in all Edwards irrigated crops. Exhibit VIII-8 presents the same information for Uvalde County. Exhibits VIII-9 and VIII-10 present these same figures assuming no change in vegetable production.

Changes in Farm Net Income

The impact estimates presented above represent changes in the total value of crop production. Total changes in net income to the farmer would be less because non-irrigated crops require fewer inputs. The following analysis of changes in farm net income account for these differences in variable costs. These estimates represent average conditions for the "average farm"; in any given year, high or low crop prices, input prices or yields could substantially alter these figures. These estimates reflect input ratios and input prices from the most recent available TAEX crop budgets for the region including Medina and Uvalde Counties, with crop prices and yields based upon five year averages. The impacts on net income are in pre-tax dollars.

EXHIBIT VIII-5.
Baseline Farm Activity in Uvalde County

Crop	Acres Planted	Percent of Planted	Acres Harvested		Production	Crop Price	Gross Crop Value	Acres Irrigated by Edwards Wells	Edwards Irrigated Crop Value
Corn									
Irrigated	14,500	93 %	13,485	120.0 bushels	1,618,200	$ 2.85	$ 4,611,870	88 %	$ 4,058,446
Nonirrigated	1,515	66	1,000	61.3 bushels	61,300	2.60	159,380		
Total	16,015		14,485		1,679,500		4,771,250		
Cotton									
Irrigated	5,600	98	5,488	856.4 pounds	4,699,923	0.58	3,166,038	86	2,722,793
Nonirrigated	-	83	-	432.0 pounds	-	0.58	-		
Total	5,600		5,488		4,699,923		3,166,038		
Hay									
Irrigated	900	99	891	6.5 tons	5,792	66.40	384,556	90	346,100
Nonirrigated	10,000	90	9,000	2.5 tons	22,500	66.40	1,494,000		
Total	10,900		9,891				1,878,556		
Oats									
Irrigated	4,800	20	960	56.0 bushels	53,760	1.61	566,554	90	509,898
Nonirrigated	6,667	30	2,000	34.0	68,000	1.61	376,147		
Total	11,467		2,960		121,760		942,700		
Peanuts									
Irrigated	-	-	-	-	-	-	-		-
Nonirrigated	-	-	-	-	-	-	-		
Total							-		
Sorghum									
Irrigated	11,700	93	10,881	48.5 cwt	527,729	3.96	2,089,805	88	1,839,028
Nonirrigated	9,783	92	9,000	27.6 cwt	248,400	3.96	983,664		
Total	21,483		19,881		776,129		3,073,469		
Vegetables									
Irrigated	6,000	99	5,940	1.0 acres	5,940	952.00	5,654,880	90	5,089,392
Nonirrigated									
Total	6,000		5,940				5,654,880		
Wheat									
Irrigated	6,800	76	5,168	46.0 bushels	237,728	2.94	862,120	90	775,908
Nonirrigated	12,903	62	8,000	23.6 bushels	188,800	2.94	751,201		
Total	19,703		13,168		426,528		1,613,321		
Other									
Irrigated	8,900	97	8,633				1,761,132	87	1,532,185
Nonirrigated									
Total	8,900		8,633				1,761,132		
Total									
Irrigated	59,200		51,446				$ 19,096,955		$ 16,873,750
Nonirrigated	40,868		29,000				$ 3,764,392		
Total	100,068		80,446				$ 22,861,346		

Source: BBC Research & Consulting

EXHIBIT VIII-6.
Farm Activity in Uvalde County
100% Edwards Irrigation Reduction

Crop	Acres Planted	Percent of Planted	Acres Harvested	Yield per Harvested Acre		Production	Crop Price per Yield Unit	Gross Crop Value
Corn								
Irrigated	1,740	93 %	1,618	120.0	bushels	194,184	$ 2.85	$ 553,424
Nonirrigated	3,453	66	2,279	61.3	bushels	139,696	2.60	363,209
Total	5,193		3,897			333,880		916,633
Cotton								
Irrigated	784	98	768	856.4	pounds	657,989	0.58	443,245
Nonirrigated	-	83	-	432.0	pounds	-	0.58	-
Total	784		768			657,989		443,245
Hay								
Irrigated	90	99	89	6.5	tons	579	66.40	38,456
Nonirrigated	22,789	90	20,510	2.5	tons	51,275	66.40	3,404,653
Total	22,879		20,599					3,443,109
Oats								
Irrigated	480	20	96	56.0	bushels	5,376	1.61	56,655
Nonirrigated	15,193	30	4,558	34.0		154,964	1.61	857,195
Total	15,673		4,654			160,340		913,850
Peanuts								
Irrigated	-	-	-	-		-	-	-
Nonirrigated	-	-	-	-		-	-	-
Total	-		-					
Sorghum								
Irrigated	1,404	93	1,306	48.5	cwt	63,327	3.96	250,777
Nonirrigated	22,293	92	20,510	27.6	cwt	566,075	3.96	2,241,656
Total	23,697		21,816			629,402		2,492,433
Vegetables								
Irrigated	600	99	594	1.0	acres	594	952.00	565,488
Nonirrigated	-	-	-	-				
Total	600		594					565,488
Wheat								
Irrigated	680	76	517	46.0	bushels	23,773	2.94	86,212
Nonirrigated	29,405	62	18,231	23.6	bushels	430,253	2.94	1,711,900
Total	30,085		18,748			454,026		1,798,112
Other								
Irrigated	1,157	97	1,122					228,947
Nonirrigated	-		-					
Total	1,157		1,122					228,947
Total								
Irrigated	6,935		6,110					$ 2,223,204
Nonirrigated	93,133		66,088					$ 8,578,613
Total	100,068		72,198					$ 10,801,818

Source: BBC Research & Consulting.

EXHIBIT VIII-7.
Farm Activity in Medina County
50% Edwards Irrigation Reduction

Crop	Acres Planted	Harvested Acres as Percent of Planted	Acres Harvested	Yield per Harvested Acre		Production	Crop Price per Yield Unit	Gross Crop Value
Corn								
Irrigated	12,995	98 %	12,735	120.0	bushels	1,528,212	$ 2.85	$ 4,355,404
Nonirrigated	22,010	91	20,029	67.3	bushels	1,347,929	2.60	3,504,616
Total	35,005		32,764			2,876,141		7,860,020
Cotton								
Irrigated	1,650	99	1,634	1,045.0	pounds	1,707,008	0.58	1,121,055
Nonirrigated	1,268	94	1,192	424.2	pounds	505,724	0.58	330,039
Total	2,918		2,826			2,212,731		1,451,094
Hay								
Irrigated	3,783	99	3,745	6.5	tons	24,344	66.40	1,616,415
Nonirrigated	17,220	90	15,498	2.5	tons	38,746	66.40	2,572,730
Total	21,003		19,244			63,090		4,189,145
Oats								
Irrigated	270	20	54	56.0	bushels	3,024	1.61	31,869
Nonirrigated	19,075	30	5,722	34.0	bushels	194,564	1.61	1,076,245
Total	19,345		5,776			197,588		1,108,114
Peanuts								
Irrigated	1,600	100	1,600	22.3	cwt	35,680	31.00	1,106,080
Nonirrigated	-	-	-	-	cwt	-	-	-
Total	1,600		1,600			35,680		1,106,080
Sorghum								
Irrigated	1,887	97	1,830	47.3	cwt	86,577	3.96	342,847
Nonirrigated	30,787	91	28,016	31.9	cwt	893,720	3.96	3,539,129
Total	32,674		29,847			980,297		3,881,976
Vegetables								
Irrigated	2,340	99	2,317	1.0	acres	2,317	952.00	2,205,403
Nonirrigated	-	-	-	-			-	
Total	2,340		2,317			2,317		2,205,403
Wheat								
Irrigated	270	81	219	50.0	bushels	10,935	2.94	37,279
Nonirrigated	15,550	69	10,730	30.5	bushels	327,254	2.94	1,154,950
Total	15,820		10,948			338,189		1,192,228
Other								
Irrigated	2,632	97	2,553					816,973
Nonirrigated	-	-	-					
Total	2,632		2,553					816,973
Total								
Irrigated	27,427		26,687					$ 11,633,325
Nonirrigated	105,910		81,188					$ 12,177,709
Total	133,337		107,874					$ 23,811,033

Source: BBC Research & Consulting.

EXHIBIT VIII-8.
Farm Activity in Uvalde County
50% Edwards Irrigation Reduction

Crop	Acres Planted	Percent of Planted	Acres Harvested	Yield per Harvested Acre		Production	Crop Price per Yield Unit	Gross Crop Value
Corn								
Irrigated	8,120	93 %	7,552	120.0	bushels	906,192	$ 2.85	$ 2,582,647
Nonirrigated	2,484	66	1,639	61.3	bushels	100,498	2.60	261,294
Total	10,604		9,191			1,006,690		2,843,941
Cotton								
Irrigated	3,192	98	3,128	856.4	pounds	2,678,956	0.58	1,804,642
Nonirrigated	-	83	-	432.0	pounds	-	0.58	-
Total	3,192		3,128			2,678,956		1,804,642
Hay								
Irrigated	495	99	490	6.5	tons	3,185	66.40	211,506
Nonirrigated	16,394	90	14,755	2.5	tons	36,887	66.40	2,449,327
Total	16,889		15,245					2,660,832
Oats								
Irrigated	2,640	20	528	56.0	bushels	29,568	1.61	311,604
Nonirrigated	10,930	30	3,279	34.0		111,482	1.61	616,671
Total	13,570		3,807			141,050		928,275
Peanuts								
Irrigated	-	-	-	-		-	-	-
Nonirrigated	-	-	-	-		-	-	-
Total	-		-					
Sorghum								
Irrigated	6,552	93	6,093	48.5	cwt	295,528	3.96	1,170,291
Nonirrigated	16,038	92	14,755	27.6	cwt	407,237	3.96	1,612,660
Total	22,590		20,848			702,765		2,782,951
Vegetables								
Irrigated	3,300	99	3,267	1.0	acres	3,267	952.00	3,110,184
Nonirrigated	-	-	-	-				
Total	3,300		3,267					3,110,184
Wheat								
Irrigated	3,740	76	2,842	46.0	bushels	130,750	2.94	474,166
Nonirrigated	21,154	62	13,116	23.6	bushels	309,527	2.94	1,231,551
Total	24,894		15,958			440,277		1,705,717
Other								
Irrigated	5,029	97	4,878					995,040
Nonirrigated	-		-					
Total	5,029		4,878					995,040
Total								
Irrigated	33,068		28,778					$ 10,660,079
Nonirrigated	67,000		47,544					$ 6,171,502
Total	100,068		76,322					$ 16,831,582

Source: BBC Research & Consulting.

Another way to consider financial impacts on farmers is to examine net income after both variable and fixed costs. However, the primary components of fixed costs are the cost of land and irrigation equipment. Under the transfer scenarios, the land converting to dryland farming was formerly irrigated, and the fixed costs reflect its former use in irrigation, not dryland farming. Therefore, it is not appropriate to distinguish between the fixed costs of irrigated versus dryland agriculture. The study team separately examined potential resale value of irrigation equipment.

100 percent transfer scenarios. As discussed in Section VII, annual net income from crops to irrigators and dryland farmers in Medina County, before fixed costs, is estimated to be $9 million under baseline conditions (see Exhibit VIII-11). Net income per planted acre (including irrigated and dryland acres) averages $66 in Medina County.

Under the 100 percent transfer scenario (Exhibit VIII-12), net farm income before fixed costs would be $5 million for Medina County, $4 million per year below baseline conditions. Average returns per planted acre would decline to $37 under the 100 percent transfer scenario.

As shown in Exhibit VIII-13, net income to farmers in Uvalde County before fixed costs is estimated to be $6 million for the baseline. Returns per planted acre average $61.

For Uvalde County, net farm income before fixed costs under the 100 percent transfer scenario would be $2 million per year, $4 million below baseline conditions. Average net income per acre would be $18 in Uvalde County under the 100 percent transfer scenario. Exhibit VIII-14 details these calculations.

Adding Medina and Uvalde County impacts from the 100 percent transfer scenario, study area net farm income before fixed costs would be $8 million per year lower than under baseline conditions. Net income before fixed costs would decrease by about one-half.

50 percent transfer scenarios. As shown in Exhibit VIII-15, net farm income before fixed costs is estimated to be $7 million per year for Medina County under the 50 percent transfer scenario. The corresponding income figure for Uvalde County is $4 million per year (see Exhibit VIII-16). Thus, the impact on annual net income from transferring 50 percent of the Edwards irrigation is $2 million on Medina County farmers and $2 million on Uvalde County farmers ($4 million per year combined impact, a 25 percent reduction). If production of vegetables remained unchanged, the impact on study area farm net income before fixed costs would be $1 million for Medina County farmers (see Exhibit VIII-17) and $1 million for Uvalde County farmers (Exhibit VIII-18).

EXHIBIT VIII-9.
Farm Activity in Medina County
50% Edwards Irrigation Reduction, All Vegetables Remain in Production

Crop	Acres Planted	Harvested Acres as Percent of Planted	Acres Harvested	Yield per Harvested Acre		Production	Crop Price per Yield Unit	Gross Crop Value
Corn								
Irrigated	11,938	98 %	11,700	120.0	bushels	1,403,962	$ 2.85	$ 4,001,291
Nonirrigated	22,017	91	20,035	67.3	bushels	1,348,380	2.60	3,505,788
Total	33,955		31,735			2,752,342		7,507,079
Cotton								
Irrigated	1,469	99	1,454	1,045.0	pounds	1,519,237	0.58	997,739
Nonirrigated	1,269	94	1,193	424.2	pounds	505,893	0.58	330,149
Total	2,737		2,646			2,025,130		1,327,888
Hay								
Irrigated	3,770	99	3,732	6.5	tons	24,261	66.40	1,610,916
Nonirrigated	17,226	90	15,504	2.5	tons	38,759	66.40	2,573,590
Total	20,996		19,236			63,020		4,184,507
Oats								
Irrigated	245	20	49	56.0	bushels	2,741	1.61	28,882
Nonirrigated	19,081	30	5,724	34.0	bushels	194,629	1.61	1,076,605
Total	19,326		5,773			197,370		1,105,488
Peanuts								
Irrigated	1,600	100	1,600	22.3	cwt	35,680	31.00	1,106,080
Nonirrigated	-	-	-	-		-	-	-
Total	1,600		1,600			35,680		1,106,080
Sorghum								
Irrigated	1,721	97	1,669	47.3	cwt	78,941	3.96	312,608
Nonirrigated	30,797	91	28,026	31.9	cwt	894,019	3.96	3,540,313
Total	32,518		29,695			972,960		3,852,922
Vegetables								
Irrigated	4,000	99	3,960	1.0	cwt	3,960	952.00	3,769,920
Nonirrigated	-	-	-	-			-	
Total	4,000		3,960			3,960		3,769,920
Wheat								
Irrigated	245	81	198	50.0	bushels	9,910	2.94	33,786
Nonirrigated	15,555	69	10,733	30.5	bushels	327,364	2.94	1,155,336
Total	15,800		10,931			337,274		1,189,122
Other								
Irrigated	2,405	97	2,332					746,363
Nonirrigated	-	-	-					
Total	2,405		2,332					746,363
Total								
Irrigated	27,392		26,694					$ 12,607,585
Nonirrigated	105,946		81,215					$ 12,181,782
Total	133,337		107,909					$ 24,789,368

Source: BBC Research & Consulting.

EXHIBIT VIII-10.
Farm Activity in Uvalde County
50% Edwards Irrigation Reduction, All Vegetables Remain in Production

Crop	Acres Planted	Harvested Acres as Percent of Planted	Acres Harvested	Yield per Harvested Acre		Production	Crop Price per Yield Unit	Gross Crop Value
Corn								
Irrigated	7,418	93 %	6,899	120.0	bushels	827,871	$ 2.85	$ 2,359,433
Nonirrigated	2,479	66	1,636	61.3	bushels	100,314	2.60	260,817
Total	9,898		8,535			928,185		2,620,250
Cotton								
Irrigated	2,927	98	2,869	856.4	pounds	2,456,650	0.58	1,654,888
Nonirrigated	-	83	-	432.0	pounds	-	0.58	-
Total	2,927		2,869			2,456,650		1,654,888
Hay								
Irrigated	450	99	446	6.5	tons	2,899	66.40	192,470
Nonirrigated	16,364	90	14,728	2.5	tons	36,820	66.40	2,444,851
Total	16,815		15,174					2,637,321
Oats								
Irrigated	2,402	20	480	56.0	bushels	26,907	1.61	283,560
Nonirrigated	10,910	30	3,273	34.0		111,278	1.61	615,544
Total	13,312		3,753			138,185		899,104
Peanuts								
Irrigated	-	-	-	-		-	-	-
Nonirrigated	-	-	-	-		-	-	-
Total	-		-					
Sorghum								
Irrigated	5,986	93	5,567	48.5	cwt	269,986	3.96	1,069,144
Nonirrigated	16,009	92	14,728	27.6	cwt	406,493	3.96	1,609,714
Total	21,994		20,295			676,479		2,678,858
Vegetables								
Irrigated	6,000	99	5,940	1.0	acres	5,940	952.00	5,654,880
Nonirrigated	-	-	-	-				
Total	6,000		5,940					5,654,880
Wheat								
Irrigated	3,403	76	2,587	46.0	bushels	118,983	2.94	431,491
Nonirrigated	21,115	62	13,092	23.6	bushels	308,961	2.94	1,229,300
Total	24,519		15,678			427,944		1,660,792
Other								
Irrigated	4,603	97	4,465					910,769
Nonirrigated	-		-					
Total	4,603		4,465					910,769
Total								
Irrigated	33,190		29,252					$ 12,556,636
Nonirrigated	66,878		47,457					$ 6,160,226
Total	100,068		76,709					$ 18,716,861

Source: BBC Research & Consulting.

EXHIBIT VIII-11.
Baseline Farm Operating Costs and Income in Medina County

Crop	Acres Planted	Acres Harvested	Variable Preharvest Costs per Planted Acre	Variable Harvest Costs per Harvested Acre	Total Variable Production Costs	Total Gross Crop Value	Government Farm Payments	Total Farm Operating Income	Acres Irrigated by Edwards Wells	Edwards Irrigated Farm Operating Income
Corn										
Irrigated	22,600	22,148	$ 197.76	$ 37.40	$ 5,297,711	$ 7,574,616	$ 329,562	$ 2,606,467	85 %	$ 2,215,497
Nonirrigated	18,462	16,800	89.20	30.26	2,155,045	2,939,664	158,592	943,211		
Total	41,062	38,948			7,452,756	10,514,280	488,154	3,549,678		
Cotton	-	-								
Irrigated	3,300	3,267	318.13	211.79	1,741,764	2,242,109	147,015	647,360	100	647,360
Nonirrigated	1,064	1,000	84.36	77.94	167,685	276,836	17,500	126,651		
Total	4,364	4,267			1,909,449	2,518,945	164,515	774,011		
Hay	-	-								
Irrigated	3,900	3,861	136.09	227.44	1,408,879	1,666,408	-	257,528	6	15,452
Nonirrigated	14,444	13,000	39.24	102.78	1,902,927	2,158,000	-	255,073		
Total	18,344	16,861			3,311,806	3,824,408	-	512,601		
Oats	-	-								
Irrigated	500	100	105.90	24.75	55,423	59,016	1,200	4,793	92	4,410
Nonirrigated	16,000	4,800	38.30	20.75	712,368	902,752	28,800	219,184		
Total	16,500	4,900			767,791	961,768	30,000	223,977		
Peanuts	-	-								
Irrigated	1,600	1,600	434.02	59.81	790,120	1,106,080	-	315,960	-	-
Nonirrigated	-	-	130.27	15.70	-	-	-	-		
Total	1,600	1,600			790,120	1,106,080	-	315,960		
Sorghum	-	-								
Irrigated	3,400	3,298	144.28	42.50	630,717	617,742	41,225	28,250	89	25,142
Nonirrigated	25,824	23,500	70.87	27.00	2,464,659	2,968,614	176,250	680,205		
Total	29,224	26,798			3,095,376	3,586,356	217,475	708,454		
Vegetables	-	-								
Irrigated	4,000	3,960	401.89	-	1,607,561	3,769,920	-	2,162,359	83	1,794,758
Nonirrigated	-	-	-	-	-	-	-	-		
Total	4,000	3,960			1,607,561	3,769,920	-	2,162,359		
Wheat	-	-								
Irrigated	500	405	115.49	27.50	68,883	69,035	14,580	14,733	92	13,554
Nonirrigated	13,043	9,000	45.43	22.50	795,065	968,769	162,000	335,704		
Total	13,543	9,405			863,948	1,037,804	176,580	350,436		
Other	-	-								
Irrigated	4,700	4,559	213.20	42.64	1,196,412	1,458,880	-	262,468	88	230,972
Nonirrigated	-	-			-	-	-	-		
Total	4,700	4,559			1,196,412	1,458,880	-	262,468		
Total	-	-								
Irrigated	44,500	43,198			$ 12,797,471	18,563,806	$ 533,582	$ 6,299,917		$ 4,947,144
Nonirrigated	88,837	68,100			8,197,749	10,214,635	543,142	2,560,028		
Total	133,337	111,298			20,995,220	28,778,441	1,076,724	8,859,946		

Source: BBC Research & Consulting.

EXHIBIT VIII-12.
Farm Operating Costs and Income in Medina County
100% Edwards Irrigation Reduction

Crop	Acres Planted	Acres Harvested	Variable Preharvest Costs per Planted Acre	Variable Harvest Costs per Harvested Acre	Total Variable Production Costs	Total Gross Crop Value	Government Farm Payments	Total Farm Operating Income
Corn								
Irrigated	3,390	3,322	$ 197.76	$ 37.40	$ 794,657	$ 1,136,192	$ 49,434	$ 390,970
Nonirrigated	25,558	23,257	89.20	30.26	2,983,368	4,069,568	219,549	1,305,748
Total	28,948	26,580			3,778,025	5,205,760	268,984	1,696,718
Cotton								
Irrigated	-	-	318.13	211.79	-	-	-	-
Nonirrigated	1,473	1,384	84.36	77.94	232,137	383,242	24,226	175,332
Total	1,473	1,384			232,137	383,242	24,226	175,332
Hay								
Irrigated	3,666	3,629	136.09	227.44	1,324,347	1,566,423	-	242,076
Nonirrigated	19,996	17,997	39.24	102.78	2,634,345	2,987,459	-	353,115
Total	23,662	21,626			3,958,692	4,553,883	-	595,191
Oats								
Irrigated	40	8	105.90	24.75	4,434	4,721	96	383
Nonirrigated	22,150	6,645	38.30	20.75	986,177	1,249,738	39,870	303,431
Total	22,190	6,653			990,611	1,254,459	39,966	303,814
Peanuts								
Irrigated	1,600	1,600	434.02	59.81	790,120	1,106,080	-	315,960
Nonirrigated	-	-	130.27	15.70	-	-	-	-
Total	1,600	1,600			790,120	1,106,080	-	315,960
Sorghum								
Irrigated	374	363	144.28	42.50	69,379	67,952	4,535	3,107
Nonirrigated	35,750	32,533	70.87	27.00	3,411,988	4,109,645	243,994	941,651
Total	36,124	32,895			3,481,367	4,177,596	248,529	944,759
Vegetables								
Irrigated	680	673	401.89	-	273,285	640,886	-	367,601
Nonirrigated	-	-	-	-	-	-	-	-
Total	680	673			273,285	640,886	-	367,601
Wheat								
Irrigated	40	32	115.49	27.50	5,511	5,523	1,166	1,179
Nonirrigated	18,057	12,459	45.43	22.50	1,100,660	1,341,130	224,267	464,737
Total	18,097	12,492			1,106,171	1,346,653	225,434	465,915
Other								
Irrigated	564	547	213.20	42.64	143,569	175,066	-	31,496
Nonirrigated	-	-	-	-	-	-	-	-
Total	564	547			143,569	175,066	-	31,496
Total								
Irrigated	10,354	10,175			$ 3,405,302	$ 4,702,843	$ 55,231	$ 1,352,773
Nonirrigated	122,983	94,275			11,348,675	14,140,782	751,907	3,544,013
Total	133,337	104,450			14,753,977	18,843,625	807,138	4,896,786

Source: BBC Research & Consulting.

EXHIBIT VIII-13.
Baseline Farm Operating Costs and Income in Uvalde County

Crop	Acres Planted	Acres Harvested	Variable Preharvest Costs per Planted Acre	Variable Harvest Costs per Harvested Acre	Total Variable Production Costs	Total Gross Crop Value	Government Farm Payments	Total Farm Operating Income	Acres Irrigated by Edwards Wells	Edwards Irrigated Farm Operating Income
Corn										
Irrigated	14,500	13,485	$ 197.76	$ 37.40	$ 3,371,859	$ 4,611,870	$ 200,657	$ 1,440,668	88 %	$ 1,267,788
Nonirrigated	1,515	1,000	89.20	30.26	165,404	159,380	9,440	3,416		
Total	16,015	14,485			3,537,263	4,771,250	210,097	1,444,084		
Cotton										
Irrigated	5,600	5,488	318.13	211.79	2,943,861	3,166,038	246,960	469,137	86	403,458
Nonirrigated	-	-	84.36	77.94	-	-	-	-		
Total	5,600	5,488			2,943,861	3,166,038	246,960	469,137		
Hay										
Irrigated	900	891	136.09	227.44	325,126	384,556	-	59,430	90	53,487
Nonirrigated	10,000	9,000	39.24	102.78	1,317,411	1,494,000	-	176,589		
Total	10,900	9,891			1,642,537	1,878,556	-	236,019		
Oats										
Irrigated	4,800	960	105.90	24.75	532,061	566,554	11,520	46,013	90	41,412
Nonirrigated	6,667	2,000	38.30	20.75	296,820	376,147	12,000	91,327		
Total	11,467	2,960			828,881	942,700	23,520	137,339		
Peanuts										
Irrigated	-	-	434.02	59.81	-	-	-	-	-	-
Nonirrigated	-	-	130.27	15.70	-	-	-	-		
Total	-	-			-	-	-	-		
Sorghum										
Irrigated	11,700	10,881	144.28	42.50	2,150,519	2,089,805	136,013	75,299	88	66,263
Nonirrigated	9,783	9,000	70.87	27.00	936,293	983,664	67,500	114,871		
Total	21,483	19,881			3,086,812	3,073,469	203,513	190,169		
Vegetables										
Irrigated	6,000	5,940	401.89	-	2,411,341	5,654,880	-	3,243,539	90	2,919,185
Nonirrigated	-	-	-	-	-	-	-	-		
Total	6,000	5,940			2,411,341	5,654,880	-	3,243,539		
Wheat										
Irrigated	6,800	5,168	115.49	27.50	927,452	862,120	186,048	120,716	90	108,645
Nonirrigated	12,903	8,000	45.43	22.50	766,194	751,201	144,000	129,007		
Total	19,703	13,168			1,693,646	1,613,321	330,048	249,724		
Other										
Irrigated	8,900	8,633	163.70	22.32	1,649,658	1,761,132	-	111,474	87	96,983
Nonirrigated	-	-	-	-	-	-	-	-		
Total	8,900	8,633			1,649,658	1,761,132	-	111,474		
Total										
Irrigated	59,200	51,446			$ 14,311,876	$ 19,096,955	$ 781,197	$ 5,566,276		$ 4,957,219
Nonirrigated	40,868	29,000			3,482,122	3,764,392	232,940	515,210		
Total	100,068	80,446			17,793,998	22,861,346	1,014,137	6,081,486		

Source: BBC Research & Consulting.

EXHIBIT VIII-14.
Farm Operating Costs and Income in Uvalde County
100% Edwards Irrigation Reduction

Crop	Acres Planted	Acres Harvested	Variable Preharvest Costs per Planted Acre	Variable Harvest Costs per Harvested Acre	Total Variable Production Costs	Total Gross Crop Value	Government Farm Payments	Total Farm Operating Income
Corn								
Irrigated	1,740	1,618	$ 197.76	$ 37.40	$ 404,623	$ 553,424	$ 24,079	$ 172,880
Nonirrigated	3,453	2,279	89.20	30.26	376,936	363,209	21,513	7,785
Total	5,193	3,897			781,560	916,633	45,591	180,665
Cotton	-	-						
Irrigated	784	768	318.13	211.79	412,141	443,245	34,574	65,679
Nonirrigated	-	-	84.36	77.94	-	-	-	-
Total	784	768			412,141	443,245	34,574	65,679
Hay	-	-						
Irrigated	90	89	136.09	227.44	32,513	38,456	-	5,943
Nonirrigated	22,789	20,510	39.24	102.78	3,002,227	3,404,653	-	402,426
Total	22,879	20,599			3,034,739	3,443,109	-	408,369
Oats	-	-						
Irrigated	480	96	105.90	24.75	53,206	56,655	1,152	4,601
Nonirrigated	15,193	4,558	38.30	20.75	676,418	857,195	27,347	208,123
Total	15,673	4,654			729,625	913,850	28,499	212,724
Peanuts	-	-						
Irrigated	-	-	434.02	59.81	-	-	-	-
Nonirrigated	-	-	130.27	15.70	-	-	-	-
Total	-	-			-	-	-	-
Sorghum	-	-						
Irrigated	1,404	1,306	144.28	42.50	258,062	250,777	16,322	9,036
Nonirrigated	22,293	20,510	70.87	27.00	2,133,705	2,241,656	153,825	261,777
Total	23,697	21,816			2,391,767	2,492,433	170,146	270,812
Vegetables	-	-						
Irrigated	600	594	401.89	-	241,134	565,488	-	324,354
Nonirrigated	-	-	-	-	-	-	-	-
Total	600	594			241,134	565,488	-	324,354
Wheat	-	-						
Irrigated	680	517	115.49	27.50	92,745	86,212	18,605	12,072
Nonirrigated	29,405	18,231	45.43	22.50	1,746,066	1,711,900	328,159	293,993
Total	30,085	18,748			1,838,812	1,798,112	346,764	306,065
Other	-	-						
Irrigated	1,157	1,122	163.70	22.32	214,455	228,947	-	14,492
Nonirrigated	-	-	-	-	-	-	-	-
Total	1,157	1,122			214,455	228,947	-	14,492
Total	-	-						
Irrigated	6,935	6,110			$ 1,708,879	$ 2,223,204	$ 94,732	$ 609,057
Nonirrigated	93,133	66,088			7,935,353	8,578,613	530,843	1,174,104
Total	100,068	72,198			9,644,232	10,801,818	625,575	1,783,161

Source: BBC Research & Consulting.

EXHIBIT VIII-15.
Farm Operating Costs and Income in Medina County, 50% Edwards Irrigation Reduction

Crop	Acres Planted	Acres Harvested	Variable Preharvest Costs per Planted Acre	Variable Harvest Costs per Harvested Acre	Total Variable Production Costs	Total Gross Crop Value	Government Farm Payments	Total Farm Operating Income
Corn								
Irrigated	12,995	12,735	$ 197.76	$ 37.40	$ 3,046,184	$ 4,355,404	$ 189,498	$ 1,498,719
Nonirrigated	22,010	20,029	89.20	30.26	2,569,207	3,504,616	189,071	1,124,480
Total	35,005	32,764			5,615,391	7,860,020	378,569	2,623,198
Cotton								
Irrigated	1,650	1,634	318.13	211.79	870,882	1,121,055	73,508	323,680
Nonirrigated	1,268	1,192	84.36	77.94	199,911	330,039	20,863	150,991
Total	2,918	2,826			1,070,793	1,451,094	94,371	474,672
Hay								
Irrigated	3,783	3,745	136.09	227.44	1,366,613	1,616,415	-	249,802
Nonirrigated	17,220	15,498	39.24	102.78	2,268,636	2,572,730	-	304,094
Total	21,003	19,244			3,635,249	4,189,145	-	553,896
Oats								
Irrigated	270	54	105.90	24.75	29,928	31,869	648	2,588
Nonirrigated	19,075	5,722	38.30	20.75	849,273	1,076,245	34,335	261,307
Total	19,345	5,776			879,201	1,108,114	34,983	263,896
Peanuts								
Irrigated	1,600	1,600	434.02	59.81	790,120	1,106,080	-	315,960
Nonirrigated	-	-	130.27	15.70	-	-	-	-
Total	1,600	1,600			790,120	1,106,080	-	315,960
Sorghum								
Irrigated	1,887	1,830	144.28	42.50	350,048	342,847	22,880	15,679
Nonirrigated	30,787	28,016	70.87	27.00	2,938,324	3,539,129	210,122	810,928
Total	32,674	29,847			3,288,371	3,881,976	233,002	826,607
Vegetables								
Irrigated	2,340	2,317	401.89	-	940,423	2,205,403	-	1,264,980
Nonirrigated	-	-	-	-	-	-	-	-
Total	2,340	2,317			940,423	2,205,403	-	1,264,980
Wheat								
Irrigated	270	219	115.49	27.50	37,197	37,279	7,873	7,956
Nonirrigated	15,550	10,730	45.43	22.50	947,863	1,154,950	193,134	400,220
Total	15,820	10,948			985,059	1,192,228	201,007	408,176
Other								
Irrigated	2,632	2,553	213.20	42.64	669,991	816,973	-	146,982
Nonirrigated	-	-	-	-	-	-	-	-
Total	2,632	2,553			669,991	816,973	-	146,982
Total								
Irrigated	27,427	26,687			$ 8,101,386	$ 11,633,325	$ 294,407	$ 3,826,345
Nonirrigated	105,910	81,188			9,773,212	12,177,709	647,524	3,052,021
Total	133,337	107,874			17,874,598	23,811,033	941,931	6,878,366

Source: BBC Research & Consulting.

EXHIBIT VIII-16.
Farm Operating Costs and Income in Uvalde County
50% Edwards Irrigation Reduction

Crop	Acres Planted	Acres Harvested	Variable Preharvest Costs per Planted Acre	Variable Harvest Costs per Harvested Acre	Total Variable Production Costs	Total Gross Crop Value	Government Farm Payments	Total Farm Operating Income
Corn								
Irrigated	8,120	7,552	$ 197.76	$ 37.40	$ 1,888,241	$ 2,582,647	$ 112,368	$ 806,774
Nonirrigated	2,484	1,639	89.20	30.26	271,170	261,294	15,476	5,600
Total	10,604	9,191			2,159,411	2,843,941	127,844	812,374
Cotton	-	-						
Irrigated	3,192	3,128	318.13	211.79	1,678,001	1,804,642	140,767	267,408
Nonirrigated	-	-	84.36	77.94	-	-	-	-
Total	3,192	3,128			1,678,001	1,804,642	140,767	267,408
Hay	-	-						
Irrigated	495	490	136.09	227.44	178,819	211,506	-	32,686
Nonirrigated	16,394	14,755	39.24	102.78	2,159,819	2,449,327	-	289,508
Total	16,889	15,245			2,338,638	2,660,832	-	322,194
Oats	-	-						
Irrigated	2,640	528	105.90	24.75	292,633	311,604	6,336	25,307
Nonirrigated	10,930	3,279	38.30	20.75	486,619	616,671	19,673	149,725
Total	13,570	3,807			779,253	928,275	26,009	175,032
Peanuts	-	-						
Irrigated	-	-	434.02	59.81	-	-	-	-
Nonirrigated	-	-	130.27	15.70	-	-	-	-
Total	-	-			-	-	-	-
Sorghum	-	-						
Irrigated	6,552	6,093	144.28	42.50	1,204,290	1,170,291	76,167	42,167
Nonirrigated	16,038	14,755	70.87	27.00	1,534,999	1,612,660	110,662	188,324
Total	22,590	20,848			2,739,289	2,782,951	186,829	230,491
Vegetables	-	-						
Irrigated	3,300	3,267	401.89	-	1,326,238	3,110,184	-	1,783,946
Nonirrigated	-	-	-	-	-	-	-	-
Total	3,300	3,267			1,326,238	3,110,184	-	1,783,946
Wheat	-	-						
Irrigated	3,740	2,842	115.49	27.50	510,099	474,166	102,326	66,394
Nonirrigated	21,154	13,116	45.43	22.50	1,256,130	1,231,551	236,080	211,500
Total	24,894	15,958			1,766,229	1,705,717	338,406	277,894
Other	-	-						
Irrigated	5,029	4,878	163.70	22.32	932,057	995,040	-	62,983
Nonirrigated	-	-	-	-	-	-	-	-
Total	5,029	4,878			932,057	995,040	-	62,983
Total	-	-						
Irrigated	33,068	28,778			$ 8,010,378	$ 10,660,079	$ 437,964	$ 3,087,666
Nonirrigated	67,000	47,544			5,708,737	6,171,502	381,892	844,657
Total	100,068	76,322			13,719,115	16,831,582	819,856	3,932,323

Source: BBC Research & Consulting.

EXHIBIT VIII-17.
Farm Operating Costs and Income in Medina County, 50% Edwards Irrigation Reduction, All Vegetables Remain in Production

Crop	Acres Planted	Acres Harvested	Variable Preharvest Costs per Planted Acre	Variable Harvest Costs per Harvested Acre	Total Variable Production Costs	Total Gross Crop Value	Government Farm Payments	Total Farm Operating Income
Corn								
Irrigated	11,938	11,700	$ 197.76	$ 37.40	$ 2,798,516	$ 4,001,291	$ 174,091	$ 1,376,866
Nonirrigated	22,017	20,035	89.20	30.26	2,570,066	3,505,788	189,134	1,124,856
Total	33,955	31,735			5,368,582	7,507,079	363,225	2,501,722
Cotton								
Irrigated	1,469	1,454	318.13	211.79	775,085	997,739	65,422	288,075
Nonirrigated	1,269	1,193	84.36	77.94	199,978	330,149	20,870	151,042
Total	2,737	2,646			975,063	1,327,888	86,292	439,117
Hay								
Irrigated	3,770	3,732	136.09	227.44	1,361,964	1,610,916	-	248,952
Nonirrigated	17,226	15,504	39.24	102.78	2,269,395	2,573,590	-	304,196
Total	20,996	19,236			3,631,358	4,184,507	-	553,148
Oats	-	-				-		
Irrigated	245	49	105.90	24.75	27,124	28,882	587	2,346
Nonirrigated	19,081	5,724	38.30	20.75	849,557	1,076,605	34,346	261,395
Total	19,326	5,773			876,681	1,105,488	34,934	263,740
Peanuts	-	-				-		
Irrigated	1,600	1,600	434.02	59.81	790,120	1,106,080	-	315,960
Nonirrigated	-	-	130.27	15.70	-	-	-	-
Total	1,600	1,600			790,120	1,106,080	-	315,960
Sorghum								
Irrigated	1,721	1,669	144.28	42.50	319,174	312,608	20,862	14,296
Nonirrigated	30,797	28,026	70.87	27.00	2,939,307	3,540,313	210,192	811,199
Total	32,518	29,695			3,258,481	3,852,922	231,054	825,495
Vegetables								
Irrigated	4,000	3,960	401.89	-	1,607,561	3,769,920	-	2,162,359
Nonirrigated	-	-	-	-	-	-	-	-
Total	4,000	3,960			1,607,561	3,769,920	-	2,162,359
Wheat								
Irrigated	245	198	115.49	27.50	33,711	33,786	7,135	7,210
Nonirrigated	15,555	10,733	45.43	22.50	948,180	1,155,336	193,198	400,354
Total	15,800	10,931			981,891	1,189,122	200,334	407,564
Other								
Irrigated	2,405	2,332	213.20	42.64	612,085	746,363	-	134,278
Nonirrigated	-	-	-	-	-	-	-	-
Total	2,405	2,332			612,085	746,363	-	134,278
Total								
Irrigated	27,392	26,694			$ 8,325,340	$ 12,607,585	$ 268,098	$ 4,550,343
Nonirrigated	105,946	81,215			9,776,482	12,181,782	647,741	3,053,042
Total	133,337	107,909			18,101,821	24,789,368	915,839	7,603,385

Source: BBC Research & Consulting.

EXHIBIT VIII-18.
Farm Operating Costs and Income in Uvalde County, 50% Edwards Irrigation Reduction, All Vegetables Remain in Production

Crop	Acres Planted	Acres Harvested	Variable Preharvest Costs per Planted Acre	Variable Harvest Costs per Harvested Acre	Total Variable Production Costs	Total Gross Crop Value	Government Farm Payments	Total Farm Operating Income
Corn								
Irrigated	7,418	6,899	$ 197.76	$ 37.40	$ 1,725,043	$ 2,359,433	$ 102,656	$ 737,046
Nonirrigated	2,479	1,636	89.20	30.26	270,675	260,817	15,448	5,590
Total	9,898	8,535			1,995,718	2,620,250	118,104	742,636
Cotton	-	-						
Irrigated	2,927	2,869	318.13	211.79	1,538,756	1,654,888	129,086	245,218
Nonirrigated	-	-	84.36	77.94	-	-	-	-
Total	2,927	2,869			1,538,756	1,654,888	129,086	245,218
Hay	-	-						
Irrigated	450	446	136.09	227.44	162,726	192,470	-	29,744
Nonirrigated	16,364	14,728	39.24	102.78	2,155,872	2,444,851	-	288,979
Total	16,815	15,174			2,318,598	2,637,321	-	318,723
Oats	-	-						
Irrigated	2,402	480	105.90	24.75	266,296	283,560	5,766	23,029
Nonirrigated	10,910	3,273	38.30	20.75	485,730	615,544	19,637	149,451
Total	13,312	3,753			752,026	899,104	25,403	172,481
Peanuts	-	-						
Irrigated	-	-	434.02	59.81	-	-	-	-
Nonirrigated	-	-	130.27	15.70	-	-	-	-
Total	-	-			-	-	-	-
Sorghum	-	-						
Irrigated	5,986	5,567	144.28	42.50	1,100,205	1,069,144	69,584	38,523
Nonirrigated	16,009	14,728	70.87	27.00	1,532,194	1,609,714	110,460	187,979
Total	21,994	20,295			2,632,399	2,678,858	180,044	226,502
Vegetables	-	-						
Irrigated	6,000	5,940	401.89	-	2,411,341	5,654,880	-	3,243,539
Nonirrigated	-	-	-	-	-	-	-	-
Total	6,000	5,940			2,411,341	5,654,880	-	3,243,539
Wheat	-	-						
Irrigated	3,403	2,587	115.49	27.50	464,190	431,491	93,117	60,419
Nonirrigated	21,115	13,092	45.43	22.50	1,253,835	1,229,300	235,648	211,114
Total	24,519	15,678			1,718,024	1,660,792	328,765	271,532
Other	-	-						
Irrigated	4,603	4,465	163.70	22.32	853,120	910,769	-	57,649
Nonirrigated	-	-	-	-	-	-	-	-
Total	4,603	4,465			853,120	910,769	-	57,649
Total	-	-						
Irrigated	33,190	29,252			$ 8,521,678	$ 12,556,636	$ 400,209	$ 4,435,167
Nonirrigated	66,878	47,457			5,698,306	6,160,226	381,194	843,114
Total	100,068	76,709			14,219,984	18,716,861	781,403	5,278,280

Source: BBC Research & Consulting.

Changes in Total Returns to Farmers

If farmers were compensated for transferring their irrigation supplies, the financial impacts on former irrigators would be much different than described under "Changes in Farm Net Income."

Proceeds from irrigation sales. Under the assumption that owners of irrigated land would receive $1,000 for each acre no longer irrigated and assuming 75,350 acres of Edwards irrigated land would be transferred under the 100 percent scenario, owners of irrigated land would receive a one-time pre-tax payment of $75 million dollars. Under the 50 percent transfer scenario, land owners would receive $38 million before taxes.

In addition to the possible direct compensation for irrigation supplies, certain irrigators may also be able to recoup some of the value of their irrigation equipment. An increasing proportion of irrigation in Medina and Uvalde Counties is by center pivot. We estimate that about 35 percent of irrigated acreage is now in center pivot systems. Based upon local interviews, new center pivot equipment costs about $400 to $500 per acre, and salvage value might be 20 percent of the initial cost, or about $100 per acre. Most of these sales might be to Mexico. There would be little salvage value for furrow or drip irrigation systems. Under the 100 percent transfer scenarios (with or without compensation), about 26,000 acres irrigated with center pivot systems would go out of irrigation, and at $100 salvage value per acre, an additional $3 million in proceeds would go to farmers selling their center pivot systems. This increases the one-time pre-tax payment under the 100 percent, compensation scenario to $78 million. Under the 100 percent transfer, no compensation scenario, the $3 million salvage value would be the only proceeds from the transfer. (Some farmers may have outstanding debt on the center pivot systems, some of which is from a District loan program. Repayment of these loans is discussed later in this section.)

One tends to see center pivot in the larger, more advanced, and profitable farm operations. Therefore, under the 50 percent transfer scenarios, we assumed that none of the acres in center pivot irrigation would come out of production. Under these scenarios, there would be no extra return to farmers from the salvage sale of center pivot equipment.

Use of the proceeds. The study team examined several possible uses of the proceeds from irrigation sales.

Taxable nature of the proceeds. The first demand on the compensation proceeds from water transfers would probably be to pay federal income taxes. Farmers would likely pay capital gains taxes on the proceeds from the sale, less the basis in the property relating to the value of the water. (Farmers now face this tax issue when they sell off a portion of their land holdings and need to separate their basis in the land from their basis in the improvements.)

For example, if a farmer sold irrigation supplies for land that he bought for $1,200 per acre, he would pay taxes on the difference between the proceeds and the basis in the property pertaining to irrigation. If one-third of the value of the land was related to irrigation, then the capital gain would be $600 per acre ($1,000 less $400 basis for the irrigation). At the current top tax rate for capital gains — 28 percent — this farmer would pay taxes of $168 per acre. The after-tax proceeds would be $832 per acre. (The sale would push most farmers currently in the 15 percent tax bracket into the higher tax bracket where a 28 percent capital gains rate would apply.)

The above example would be relevant for some land owners, but not all. For example:

- Capital gains would be much higher for farmers that bought land 30 to 40 years ago when land prices were low.
- Farmers that bought land 10 years ago when prices were high could have an irrigation basis in the land much closer to the amount of proceeds from the sale of irrigation supplies. Therefore, capital gains would be lower for these farmers.
- Individuals recently inheriting land might have little or no capital gains since the basis in the land is adjusted to market value at the time of inheritance.
- Some of the "irrigation basis" in the land might be related to irrigation equipment, which may have been partially or fully depreciated by the farmer. Any sale in which the farmer recaptured this depreciation would add to the taxes owed.
- Some farmers might face tax rates of only 15 percent on the capital gain.
- For farmers showing operating losses, some of the proceeds would simply offset losses and not be taxed.
- It might be possible for farmers to have a tax free exchange if they purchased additional irrigated land with the proceeds from the sale of the irrigation supplies. (However, purchases of nonirrigated land might not be eligible for this special tax treatment because such land may not be considered "like property.")

The above examples illustrate the complexity of analyzing taxability of proceeds from a water transfer. Not only are there a diversity of tax positions among local farmers, but the lack of precedent makes this a somewhat uncertain area of tax law. Therefore, the study team incorporated a very simple approach to the issue of tax implications from proceeds of the sale. We assumed that farmers on average have $200 basis in the irrigation supplies for each acre of irrigated land. (This relatively low basis is used because of the large number of long-time land owners in the area.) With this assumption, an average of $800 per acre would be a taxable gain. Assuming a 28 percent tax rate, $224 in taxes would need to be paid, and the after-tax proceeds would be $776. While this may be a reasonable assumption for this impact analysis, it might not represent the characteristics of individual land owners.

We also considered tax implications from salvage sale of center pivot irrigation equipment. Because the equipment is a depreciable asset, and some or all of the initial investment would be depreciated at the time of any salvage sale, the difference between the pre-tax proceeds and after-tax proceeds is not clear. For simplicity, we assume that after-tax proceeds from sale of center pivot irrigation equipment equal the pre-tax proceeds.

Continuation in farming. The discussion of changes in farm income in the previous pages is based upon the premise that currently irrigated land would remain in production on a dryland basis if each land owner sold his or her irrigation supplies. However, this assumption does not necessarily mean that the former irrigator would stay in farming. The land owner might retire from farming altogether, selling or leasing the land to another farmer. Some irrigators might sell their property and move out of the area. Others might sell most of their land and use the combined proceeds to pay off debts and invest in new businesses or retire. Some may buy more dryland acreage with the proceeds from the sale of irrigation. Even with the proceeds from the transfer, some farm operations may still fail. There would probably be as many responses to a sale of irrigation supplies as there are irrigators. However, for purposes of quantifying the economic effects of irrigation sales, we assume that land owners would stay in the area. (If after receiving the proceeds of the sale, former irrigators left the area, total impacts on the local economy would be greater than estimated in this study.)

Investment of the proceeds. One way of analyzing the impact of the proceeds from any sale of irrigation supplies is to assume that farmers would invest the proceeds and earn annual investment income that would augment the returns from dryland farming. Assuming a conservative investment such as one year Treasury bills, farmers might obtain a yield of about 6 percent interest (pre-tax). This would return about $47 per acre if farmers invested all of the proceeds after paying capital gains taxes (using the assumptions outlined above). Therefore, if all of the proceeds from the sale were invested, farmers would annually receive about $3.5 million in investment income under the 100 percent transfer scenario and about $1.8 million under the 50 percent transfer scenario. Adding annual returns from investing the salvage value of center pivot irrigation equipment, farmers would receive about $3.7 million under the compensated 100 percent transfer scenario, and $0.2 million under the uncompensated 100 percent transfer scenario.

Most irrigators are in the 15 percent or 28 percent federal income tax brackets, presumably self-employment taxes would not apply since investment returns would be outside the business. Therefore, marginal tax rates of 15 to 28 percent are typical for all but the most profitable (and least profitable) irrigators. Using the 28 percent marginal tax rate, a $47 per acre income before taxes translates into $34 per acre after taxes. Total after-tax returns from the proceeds of the sale would be $2.6 million under the 100 percent transfer scenario and $1.3 million under the 50 percent transfer scenario.

Adding in the returns on proceeds from the sale of center pivot irrigation equipment (under the 100 percent transfer scenarios only), annual after-tax returns from the compensated 100 percent transfer scenario would be $2.7 million, and after-tax returns from the uncompensated 100 percent transfer scenario would be $0.1 million.

The economic stimulus resulting from local spending of a portion of the annual investment return from transfer proceeds was incorporated in subsequent impact analyses in this report (Section IX, etc.) It is also conceivable that a portion of the transfer proceeds might be reinvested locally, providing funding for the creation of new local businesses or the expansion of existing local companies.

In his retrospective analysis of the impacts of water transfers in Colorado's Arkansas Valley, Kenneth Weber specifically sought evidence of local reinvestment of water transfer proceeds and found little or none. Although the potential for local reinvestment of transfer proceeds would vary from place to place, this potential stimulus was not incorporated in the subsequent impact evaluations for the Edwards case study.

Payment of debts. It is very likely that much of the proceeds from sales of irrigation supplies would go toward payment of outstanding debts. Many land owners that would transfer irrigation supplies have mortgages on their land. Those financial institutions holding the mortgages would be expected to require land owners to repay a portion of the outstanding principal if they sold their irrigation supplies. (Most of the mortgages are held by federal land banks, not private commercial banks.) If so, this would reduce the net proceeds to the land owner, but also reduce the land owner's debt service on the mortgage. Interest rates on these outstanding mortgages typically range from 5 to 9 percent (rates at the time of this report were around 8 percent). Assuming an average of about 7 percent, the net financial effect on land owners would be roughly equivalent if they paid off outstanding debts compared to investing all of the proceeds. This is true for returns before and after taxes since interest on land is a tax deductible expense. (This analysis also holds for sale of irrigation equipment, although interest rates on equipment loans might be somewhat higher.)

Net financial impacts on irrigators. Under the 100 percent transfer, compensation scenario, the nearly $4 million pre-tax annual income from investment of the proceeds from water transfers would not fully offset the $8 million per year pre-tax reductions in net income from farming (before fixed costs). Accounting for certain fixed costs of farming might make the difference in returns smaller. Also, the per acre income from the proceeds from the water transfers would more than offset the per acre reductions in returns from farming for all crops except vegetables.

Under the 50 percent transfer, compensation scenario, the $1.8 million in pre-tax annual income from investment of the water transfer proceeds would not equal the $4 million reduction in pre-tax net income from farming before fixed costs. Again, net returns might be closer to balanced after accounting for fixed farm operating costs.

Under the no compensation scenarios, there would be no offsetting returns from proceeds from the sale except for minimal income from center pivot irrigation equipment salvage.[1] The impacts would be nearly equal to those previously discussed under "Changes in Farm Income" in this section of the report. Exhibit VIII-19 summarizes the net change in annual returns to study area farmers under each scenario.

EXHIBIT VIII-19.
Net Change in Total Annual Returns to Study Area Farmers
(Computed with Baseline Conditions in Millions)

Compensation	100% Transfer	50% Transfer - A	50% Transfer - B
With compensation	($4)	($2)	$0
Without compensation	($8)	($4)	($2)

50 percent transfer A assumes 50 percent of Edwards irrigated vegetables remain in production.
50 percent transfer B assumes all Edwards irrigated vegetables remain in production.
Source: BBC Research & Consulting.

Summary of Impacts on Farmers

Impacts on land owners under the "with compensation" scenarios. Under the transfer scenarios in which owners of irrigated land would receive compensation, sale of irrigation supplies would be voluntary and only take place if a land owner found it in his or her best interest to forego irrigation in exchange for the one-time cash payment. By definition, all selling land owners would benefit. Those that would not benefit at the offered price would not sell. (The net loss shown in Exhibit VIII-19 for the 100 percent transfer, compensation scenario shows a net loss primarily because fixed costs of farming were not considered, and the price of $1,000 per acre might not fully compensate all vegetable farmers.)

Impacts on land owners under the "no compensation" scenarios. Farmers' circumstances would be substantially different if they were not compensated for transfer of

[1] The study team examined whether land owners would be able to show losses on their tax returns if irrigation rights were transferred without compensation. It is unclear whether losses could be taken at the time of the transfer of the property, or whether land owners would have to wait until they disposed of the property. Even if losses could be taken at the time of transfer, many farmers would have no net income to offset with the losses. Because of these uncertainties, no tax benefits resulting from an uncompensated transfer of irrigation supplies were incorporated into this analysis.

irrigation supplies. Under the 50 percent scenario, an owner of 1,000 acres irrigated by Edwards wells would face a loss of value of about $500 per acre for one half of his acres, or $250,000. Farmers with substantial debt may not be able to maintain profitable operations and would need to restructure the debt, sell the farm or go bankrupt. Impacts would be more severe under the 100 percent transfer, no compensation scenario. Farmers could lose up to one-half the value of their formerly irrigated land. The owner of 1,000 Edwards irrigated acres in the above example could lose $500,000 of the value of his land under this scenario. For many, the remaining value of the land would be less than the outstanding mortgages on the land. Farmers with less outstanding debt might still be affected by reluctance of lenders to provide new loans. Because of the high variability of income in dryland farming, even financially secure farmers might go bankrupt during a multi-year drought.

While it was not possible to develop precise estimates of the number of farmers that would lose their farms if their irrigation supplies were removed without compensation, a third or more of the present irrigators might be vulnerable to foreclosure. Including both irrigators and dryland farmers in Medina County, and only including farms with sales over $10,000, 35 percent reported net losses in 1992 based upon statistics from the U.S. Census of Agriculture. About 47 percent of these farms reported net losses for 1992 in Uvalde County. Our analyses suggest that other farmers would purchase the land of farmers that went bankrupt as a result of the water transfers, and they would continue farming the land on a dryland basis, somewhat mitigating the effects on the regional economy. Even so, the study team concludes that the 100 percent transfer, no compensation scenario would have profound financial effects on existing owners of land irrigated by Edwards wells. For many, such a transfer would permanently put them out of the farming business.

Impacts on farmers leasing irrigated land. Some farmers primarily farm leased land, not land they own. This is especially true in Uvalde County. The 1992 Census of Agriculture reports that about one-quarter of all harvested crop acreage in Uvalde County was leased in 1992 (including both dryland and irrigated acreage). In Medina County, only 13 percent of crop acreage was leased.

Farmers leasing land would face potential losses of operating income, but would not receive any compensation for the irrigation supplies or be affected by loss of land values. Those able to shift operations to other irrigated land within or outside the study area might be able to replace the income previously earned by farming Edwards irrigated land. Those unable to locate lands that could be leased (or purchased if the renter had sufficient capital) would no longer be able to farm. In sum, under the with compensation transfer scenarios, farmers primarily farming leased land would be more severely impacted than farmers owning land. Under the no compensation scenarios, farmers working leased lands would be less severely affected than farmers owning land.

SECTION IX.
Secondary Economic Impacts of Potential Edwards Aquifer Water Transfers

In the previous section of the report, we described the direct effects that potential transfers of Edwards Aquifer water supplies might have on farmers in Medina County and Uvalde County. These changes in farm activities — the types of crops grown, levels of crop production, farm revenues and net farm incomes — could be expected to lead to a range of secondary economic effects throughout the study area. Types of potential secondary economic impacts were identified in Section VI. This step of the impact analysis provides quantitative estimates of the magnitude of secondary economic impacts under each of the transfer scenarios developed previously. Other potential impacts, on fiscal conditions of local governments and on demographic and social conditions in the study area, are described in subsequent sections of this report.

How the Study Team Projected Economic Impacts of the Transfer Scenarios

To estimate the potential secondary economic effects of water transfers on the local economy, the study team examined the relationships between crop production and a range of other economic activities in Medina County and Uvalde County. Key components of this research included review of crop budgets; interviews with a variety of businesses with ties to local agricultural activity; and analysis of the quantitative relationships among agriculture, farm related businesses and other economic activities using an input-output model of the local economy.

Crop budgets. Crop budgets for irrigated and non-irrigated production of the crops grown in the study area were obtained from local agricultural extension agents. These budgets, compiled from interviews with local farmers, provide a means of identifying the quantities and costs of various inputs required to grow an acre of each type of crop found in the study area. By applying the budgets for each type of irrigated and non-irrigated crop to the projected changes in crop selection and production identified in Section VIII, the study team was able to estimate the effects that these changes in farm activities would have on purchases of farm chemicals, agricultural services, fuel and electricity, farm labor and other inputs.

Interviews. The study team conducted personal or telephone interviews with a range of businesses throughout Medina County and Uvalde County. Interviews were conducted with area agricultural extension agents, farmers, bankers, crop shippers and processors, grain elevator and cotton gin operators, seed and chemical suppliers, and other business managers. These interviews served a number of purposes, including:

- identification of the extent to which each type of farm input is purchased locally versus from out-of-area suppliers,
- assessment of the potential responses of different types of agriculture-related businesses to changes in business volume, and
- identification of the relationships between crop production and "forward-linked" businesses involved in shipping and processing crops.

The interviews were also used to modify some of the relationships implied in the input-output model to more closely reflect local circumstances.

Input-output models. To quantify the "multiplier effects" that would result as changes in crop producing activity ripple throughout the local economy, BBC employed the Implan input-output model originally designed by the United States Forest Service. Input-output models such as Implan are designed to estimate the total economic effects resulting from a specific change in the level of activity in one or more sectors — in this case, changes in the levels of production of various local crops.

Although the Implan model is customized for the study area through the use and interpretation of local data for Medina and Uvalde Counties, the model still contains a number of relationships that are based on national averages for each industry. For the key crops and related businesses most affected by the water transfer scenarios, the Implan baseline activity levels and relationships were modified where necessary to better reflect local conditions identified from the crop budgets and interviews.

A more thorough discussion of input-output models and the use of the Implan model is presented in Part A of this report, the impact framework.

Local Economic Relationships Leading to Secondary Impacts

A large portion of the secondary economic impacts that might result from water transfers stems from relationships between crop production, sales of farm inputs, and crop processing and shipping operations within the study area economy.

Changes in farm expenditures. Conversion from irrigated to dryland crop production and corresponding changes in the types and quantities of crops grown in the study area would not only affect farm production, revenues and net income as described in Section VIII, but would also affect farmers' purchases of labor, agricultural services, chemicals, fuel and other inputs. Exhibit IX-1 summarizes estimated farm input purchases under baseline conditions and the 100 percent and 50 percent transfer scenarios. These estimates are based upon crop budgets and the cropping activity profiles presented in Section VIII.

EXHIBIT IX-1.
Study Area Farm Input Expenditures

Inputs	Total Baseline Input Purchases ($000s)	Change in Purchases ($000s) 100% Transfer	50% Transfer - A	50% Transfer - B
Seed	3,211	(1,216)	(608)	(301)
Fertilizer	5,427	(1,666)	(833)	(796)
Chemicals	3,992	(2,344)	(1,171)	(916)
Chemical Application	1,171	(682)	(341)	(291)
Fuel, Lube and Repairs	8,934	(5,127)	(2,564)	(2,586)
Preharvest Labor	6,485	(2,325)	(1,162)	(842)
Harvest	6,308	153	76	(41)
Hauling	2,346	(429)	(214)	(274)
Other	915	(755)	(378)	(420)
Total	38,789	(14,391)	(7,195)	(6,467)

Source: BBC Research & Consulting.

Under baseline conditions, crop producers in Medina County and Uvalde County purchase approximately $39 million per year in hired labor, agricultural services and farm inputs. Under the 100 percent transfer scenario, these input purchases would drop to less than $25 million per year, a decline of over $14 million per year. Under the 50 percent transfer scenario, input expenditures would decline by slightly more than $7 million per year to approximately $32 million. These changes in input purchasing reflect lower input usage per acre in dryland crop production than in irrigated crop production. If vegetable crops were to remain in production, annual farm input purchases would decline by about $6.5 million.

Some input categories are affected more than others. Expenditures for harvest services, for example, are projected to actually increase under the 100 percent transfer scenario, reflecting the conversion of more acres into hay production. Changes in expenditures for vegetable harvesting and hauling are not reflected in Exhibit IX-1 since these costs are normally incurred by the processors and shippers under "forward contracting" arrangements rather than by the farmers.

In Medina and Uvalde Counties, farm inputs are predominantly purchased from local suppliers. Interviews with farmers and local supply businesses indicated that more than 70 percent of farm chemicals and fertilizers are purchased locally. Virtually all seed purchases are local.

The changes in purchases of inputs, services and labor from local suppliers would lead to impacts beyond the farm workers and the agricultural support sector. Other businesses that supply goods and services to this sector as well as businesses supported by the purchases of farm and agribusiness workers, would also be affected. These additional rounds of economic effects are reflected in the estimates of total economic impacts discussed later in this section.

Changes in crop processing and shipping activities. Within the Medina County and Uvalde County study area, crop production is linked to a range of agricultural processing and shipping activities. Processors and shippers, primarily working with locally grown vegetables and corn for food, are important sources of local employment, particularly in Uvalde County. These businesses are a significant component of the local economy because they add substantially to the value (price) of the crops and they are relatively large employers. Although employment levels vary considerably by season for many of these operations, based upon interviews with processors and shippers, we estimate that full-time equivalent employment of these operations encompasses more than 700 local jobs.

Our interviews with local processors and shippers suggested that many of these operations would continue to operate, albeit on a somewhat diminished scale, under the 50 percent transfer scenario. Under the 100 percent transfer scenario, the viability of most of the processing and shipping operations would be threatened. Due to the added cost of transporting crops to the study area for further shipping and processing, as well as the greatly increased risk of spoilage, most local shippers and processors would relocate or shut down under the 100 percent transfer scenarios.

As in the case of the farm input suppliers, impacts upon shippers and processors would have ripple effects throughout the local economy. These additional impacts are also reflected in the overall economic impact projections discussed later in this section. (While incorporating the impacts resulting from these forward linkages, the study team was careful not to double count impacts on the agricultural production sector and farm input suppliers which had been included previously.)

Overall Economic Impact Projections

Overall economic impacts of each water transfer scenario were estimated using the Implan model, adjusted to closely reflect the baseline agricultural profile of the area, the direct impacts identified in Section VIII, and the information gained from analysis of the crop budgets and through local interviews. These impacts reflect:

- effects of the transfer on crop producers (direct impacts),
- effects on crop shippers and processors (forward linkages),
- impacts on businesses that supply goods and services to farmers and shippers/processors (indirect impacts), and
- more widespread impacts on the range of business activity supported by the personal consumption spending of employees and owners of farms and farm-related businesses (induced impacts).

The impact estimates under the 100 percent transfer scenarios also incorporate the relatively modest return that some farmers could receive from the salvage value of their center pivot equipment, as described in the previous section.

Uncompensated transfer scenarios. Exhibits IX-2 through IX-5 depict the projected overall economic impacts of uncompensated water transfers on the Medina County/Uvalde County study area. These impact projections assume that the farmers would not be compensated for ceasing use of Edwards Aquifer water supplies to irrigate some (50 percent) or all (100 percent) of the acres currently under Edwards irrigation.

100 percent transfer uncompensated scenario. Economic impacts can be measured in terms of diminished sales/output, or in terms of declines in "value added." While impacts on sales/output measure changes in the total sales of firms within the region, impacts on value added reflect changes in the productivity of the region — the contribution that local manufacturing, processing, marketing and services make to the value of products ultimately sold to consumers. This contribution is reflected in the earnings of local business owners, the wages and salaries of employees, and the taxes paid by local businesses.

Economic impacts of the 100 percent transfer uncompensated scenario on regional sales and value added are shown in Exhibit IX-2. Under this scenario, regional output would decline by more than $125 million per year. Regional value added would decline by nearly $50 million per year. The difference between the impact on sales and the impact on local value added reflects the non-local component of sales. For example, a car dealership may have relatively large total sales value, but only a small portion of the value of each sale is local value added. The largest portion of the sales price of a new car is the wholesale cost of the car to the local dealer — which is not part of local value added.

Under the 100 percent transfer uncompensated scenario, we estimate that nearly 1,600 study area jobs would ultimately be eliminated as a direct or indirect result of the water transfer. As depicted in Exhibit IX-2, this job loss would include about 310 farm jobs, more than 500 jobs in processing and shipping crops, and over 700 jobs in other sectors of the local economy that are supported by the purchases of farms and crop processors or by purchases of the employees of these agricultural activities.

EXHIBIT IX-2.
Projected Annual Economic Impacts of the 100 Percent Transfer Scenario, Without Compensation to Farmers

Sector	Output/Sales ($ millions)	Value Added* ($ millions)	Projected Job Loss
Crop production	$22.0	$12.2	310
Crop processing/shipping	44.0	14.5	530
Other businesses	60.1	22.1	720
Total	$126.1	$48.8	1,560

* Value added includes employee compensation, ownership earnings and business taxes.
Source: BBC Research & Consulting.

Exhibit IX-3 depicts the distribution of the employment impacts of the 100 percent transfer uncompensated scenario by sector. The sectors listed in the exhibit reflect the Standard Industrial Code (SIC) classification of economic activity used by the federal government. This classification scheme combines farm jobs with agricultural services employment and employment in forestry and fisheries (although we are unaware of any fishery or forestry employment in the local economy).

Large employment impacts would occur in the agriculture, forestry and fisheries sector. The manufacturing sector, which includes crop processing activities, would also be substantially impacted under this scenario. Impacts on the trade sector would include effects on wholesale trade (primarily on farm input suppliers and crop shippers) as well as retail trade (largely related to diminished consumer spending within the study area). The loss of more than 200 jobs in the services sector, like the impacts on retail trade, would primarily result from diminished consumer spending capability within the study area.

The potential bankruptcy of some former irrigators would not likely threaten local commercial banks, which tend to hold limited assets in direct operating loans to these farmers. The impacts on bank employment would more likely be caused by reduced lending activity in related agricultural businesses and reduced business activity in other sectors.

EXHIBIT IX-3.
Projected Employment Impacts by Sector:
100 Percent Transfer Scenario, Without Compensation to Farmers

Sector	Projected Job Loss	Percent of 1993 Jobs in Sector
Agriculture, forestry and fisheries	450	12.7%
Mining	0	0.0
Construction	30	1.7
Manufacturing	320	21.3
Transportation, communications, public utilities	30	4.1
Trade	480	11.3
Finance, insurance, real estate	40	4.8
Services	220	4.8
Government	0	0.0
Total	1,560	7.2%

Source: BBC Research & Consulting.

50 percent transfer uncompensated scenario. As shown in Exhibit IX-4, water transfers under the 50 percent uncompensated transfer scenario would reduce study area output/sales by about $70 million per year. The reduction in local value added would be more than $25 million per year. These impacts are slightly greater than one-half the magnitude of the impacts under the 100 percent transfer uncompensated scenario, reflecting the assumption that a major food processor would cease local operations. We estimate that about 900 local jobs would be lost under this scenario.

EXHIBIT IX-4.
Projected Annual Economic Impacts of the 50 Percent Transfer Scenario, Without Compensation to Farmers

Sector	Output/Sales ($ millions)	Value Added* ($ millions)	Projected Job Loss
Crop production	$11.0	$6.1	160
Crop processing/shipping	23.9	7.2	330
Other businesses	34.0	12.4	400
Total	$68.9	$25.7	890

* Value added includes employee compensation, ownership earnings and business taxes.
Source: BBC Research & Consulting.

Exhibit IX-5 depicts the distribution of employment impacts by sector under the 50 percent transfer uncompensated scenario. In comparison to the broad distribution of job losses under the 100 percent transfer uncompensated scenario, employment effects are somewhat more concentrated in the agriculture, fisheries and forestry sector and the manufacturing (processing) sector under the 50 percent transfer uncompensated scenario.

EXHIBIT IX-5.
Projected Employment Impacts by Sector:
50 Percent Transfer Scenario, Without Compensation to Farmers

Sector	Projected Job Loss	Percent of 1993 Jobs in Sector
Agriculture, forestry and fisheries	220	6.2%
Mining	0	0.0
Construction	20	1.1
Manufacturing	310	20.7
Transportation, communications, public utilities	20	2.7
Trade	180	4.2
Finance, insurance, real estate	20	2.4
Services	120	2.7
Government	0	0.0
Total	890	4.1%

Source: BBC Research & Consulting.

As described in the previous section's discussion of direct impacts, if production of the highest valued irrigated crops (vegetables) is not affected by transfers, the economic impact of the 50 percent scenario on the crop producers would be significantly reduced. Because much of the crop processing and shipping business in the study area is associated with the production of vegetables and food corn that is much less affected under this scenario, impacts on these businesses would also be much less under the 50 percent transfer scenario-B, which assumes all vegetables remain in production. Exhibit IX-6 summarizes the estimated impacts of this scenario.

EXHIBIT IX-6.
Projected Annual Economic Impacts of the 50 Percent
Transfer Scenario - B, Without Compensation to Farmers

Sector	Output/Sales ($ millions)	Value Added* ($ millions)	Projected Job Loss
Crop production	$8.1	$3.3	120
Crop processing/shipping	1.0	0.5	10
Other businesses	15.4	6.0	200
Total	$24.5	$9.7	330

* Value added includes employee compensation, ownership earnings and business taxes.
Source: BBC Research & Consulting.

The projected impacts of the 50 percent transfer scenario-B are about one-fifth of the magnitude of the impacts under the 100 percent transfer scenarios, and less than one-half the magnitude of 50 percent transfer scenario-A. This result follows from the assumption that vegetable production would not be affected under the 50 percent scenario-B. Therefore, local shippers and processors dependent upon vegetables would not be impacted. The distribution of impacts in this scenario is more narrow, as illustrated in Exhibit IX-7.

EXHIBIT IX-7.
Projected Employment Impacts by Sector:
50 Percent Transfer Scenario - B, Without Compensation to Farmers

Sector	Projected Job Loss	Percent of 1993 Jobs in Sector
Agriculture, forestry and fisheries	180	5.1%
Mining	0	0.0
Construction	10	0.6
Manufacturing	10	0.7
Transportation, communications, public utilities	10	1.4
Trade	70	1.7
Finance, insurance, real estate	10	1.2
Services	40	0.9
Government	0	0.0
Total	330	1.5%

Source: BBC Research & Consulting.

Compensated transfer scenarios. In the previous section of this report, we estimated that — under a 100 percent transfer scenario — study area farmers might receive $2.6 million in annual earnings, after taxes, if they were paid $1,000 per Edwards-irrigated acre to cease irrigation from Edwards wells. Comparable annual earnings from transfer compensation under a 50 percent transfer scenario would be $1.3 million.

Estimates of the economic impacts of the compensated transfer scenarios were developed by combining projections of the local economic stimulus resulting from spending of farmer compensation earnings with the estimated impacts of the uncompensated scenarios.

100 percent transfer scenario with compensation. Projected overall economic impacts of the 100 percent transfer scenario with compensation are presented in Exhibit IX-8 and Exhibit IX-9. As shown in Exhibit IX-8, water transfers under this scenario would reduce study area output/sales by more than $120 million per year. The reduction in local value added would exceed $45 million per year. About 1,520 local jobs would be lost under the 100 percent transfer compensated scenario. These impacts are not greatly different from the impacts under the 100 percent transfer scenario without compensation.

EXHIBIT IX-8.
Projected Annual Economic Impacts of the 100 Percent Transfer Scenario, With Compensation to Farmers

Sector	Output/Sales ($ millions)	Value Added* ($ millions)	Projected Job Loss
Crop production	$22.0	$12.2	310
Crop processing/shipping	44.0	14.5	530
Other businesses	56.6	20.9	680
Total	$122.6	$47.6	1,520

* Value added includes employee compensation, ownership earnings and business taxes.
Source: BBC Research & Consulting.

Exhibit IX-9 depicts the distribution of employment impacts by sector under the 100 percent transfer compensated scenario. As under the 100 percent transfer uncompensated scenario, a number of sectors apart from agriculture would be substantially impacted. Impacts on the trade sector; the service sector; and the transportation, communication and public utilities sector are slightly smaller if farmers are compensated for the water transfers because of local spending of compensation proceeds.

EXHIBIT IX-9.
Projected Employment Impacts by Sector: 100 Percent Transfer Scenario, With Compensation to Farmers

Sector	Projected Job Loss	Percent of 1993 Jobs in Sector
Agriculture, forestry and fisheries	450	12.7%
Mining	0	0.0
Construction	30	1.7
Manufacturing	320	21.3
Transportation, communications, public utilities	30	4.1
Trade	470	11.1
Finance, insurance, real estate	30	3.6
Services	190	4.3
Government	0	0.0
Total	1,520	7.0%

Source: BBC Research & Consulting.

50 percent transfer scenario with compensation. As shown in Exhibit IX-10, water transfers under this scenario would reduce study area output/sales by nearly $67 million per year. Local value added would decline by $25 million per year. We estimate that about 870 local jobs would be lost under this scenario. These impacts are roughly 3 percent smaller than the projected impacts of the 50 percent transfer uncompensated scenario.

EXHIBIT IX-10.
Projected Annual Economic Impacts of the 50 Percent Transfer Scenario, With Compensation to Farmers

Sector	Output/Sales ($ millions)	Value Added* ($ millions)	Projected Job Loss
Crop production	$11.0	$6.1	160
Crop processing/shipping	23.9	7.2	330
Other businesses	32.1	11.8	380
Total	$67.0	$25.0	870

* Value added includes employee compensation, ownership earnings and business taxes.
Source: BBC Research & Consulting.

Exhibit IX-11 depicts the distribution of employment impacts by sector under the 50 percent transfer scenario with compensation. As under the 50 percent transfer uncompensated scenario, employment effects are most heavily concentrated in the agriculture, fisheries and forestry sector and the manufacturing (processing) sector. Compensation to farmers, and subsequent local spending, slightly reduces impacts on the trade; services; and transportation, communication, and public utilities sectors.

EXHIBIT IX-11.
Projected Employment Impacts by Sector: 50 Percent Transfer Scenario, With Compensation to Farmers

Sector	Projected Job Loss	Percent of 1993 Jobs in Sector
Agriculture, forestry and fisheries	220	6.2%
Mining	0	0.0
Construction	20	1.1
Manufacturing	310	20.7
Transportation, communications, public utilities	20	2.7
Trade	170	4.0
Finance, insurance, real estate	20	2.4
Services	110	2.5
Government	0	0.0
Total	870	4.0%

Source: BBC Research & Consulting.

If vegetable production were to remain at baseline levels and farmers were compensated in the 50 percent water transfer scenario, the expected economic impacts might be similar to those in Exhibit IX-12. Like the uncompensated scenario, regional economic impacts would be considerably smaller than in the 50 percent scenario-A in which vegetable production declines. Like the 100 percent scenarios, compensating the farmers has little effect on the total regional impacts of the 50 percent transfer.

EXHIBIT IX-12.
Projected Annual Economic Impacts of the 50 Percent Transfer Scenario - B, With Compensation to Farmers

Sector	Output/Sales ($ millions)	Value Added* ($ millions)	Projected Job Loss
Crop production	$8.1	$3.3	120
Crop processing/shipping	1.0	0.5	10
Other businesses	13.6	5.3	180
Total	$22.7	$9.1	310

* Value added includes employee compensation, ownership earnings and business taxes.
Source: BBC Research & Consulting.

Changes in employment caused by the compensated 50 percent transfer scenario-B would be very similar to the case in which farmers were not compensated. Total job loss in the two-county area would be about 1.5 percent as shown in Exhibit IX-13.

EXHIBIT IX-13.
Projected Employment Impacts by Sector: 50 Percent Transfer Scenario - B, With Compensation to Farmers

Sector	Projected Job Loss	Percent of 1993 Jobs in Sector
Agriculture, forestry and fisheries	180	5.1%
Mining	0	0.0
Construction	10	0.6
Manufacturing	5	0.3
Transportation, communications, public utilities	10	1.4
Trade	60	1.4
Finance, insurance, real estate	10	1.2
Services	35	0.8
Government	0	0.0
Total	310	1.4%

Source: BBC Research & Consulting.

The output and value added impacts of the different water transfer scenarios discussed above are summarized in comparative form in Exhibit IX-14 (on the following page).

EXHIBIT IX-14.
Output and Value Added Under Baseline and Water Transfer Scenarios — Medina and Uvalde Counties

Uncompensated

	Output/Sales ($ millions)				Value Added* ($ millions)			
Sector	Base-line	100% Transfer	50% Transfer A	50% Transfer B	Base-line	100% Transfer	50% Transfer A	50% Transfer B
Crop production	$51.6	$29.6	$40.6	$43.5	$22.4	$10.2	$16.3	$19.1
Crop processing/ shipping	50.0	6.0	$26.1	49.0	16.7	2.2	$9.5	16.2
Other	1,436.4	1,376.3	$1,402.4	1,421.0	594.1	572.0	$581.7	588.1
Total	$1,538.0	$1,411.9	$1,469.1	$1,513.5	$633.2	$584.4	$607.5	$623.4

Compensated

	Output/Sales ($ millions)				Value Added* ($ millions)			
Sector	Base-line	100% Transfer	50% Transfer A	50% Transfer B	Base-line	100% Transfer	50% Transfer A	50% Transfer B
Crop production	$51.6	$29.6	$40.6	$43.5	$22.4	$10.2	$16.3	$19.1
Crop processing/ shipping	50.0	6.0	26.1	49.0	16.7	2.2	9.5	16.2
Other	1,436.4	1,379.8	1,404.3	1,422.8	594.1	573.2	582.3	588.8
Total	$1,538.0	$1,415.4	$1,471.0	$1,515.3	$633.2	$585.6	$608.1	$624.1

* Value added includes employee compensation, ownership earnings and business taxes.

(A) 50 percent transfer - A assumes 50 percent reduction in all Edwards irrigated crops.

(B) 50 percent transfer - B assumes 50 percent reduction in total Edwards irrigated crops, but irrigated vegetables stay in production.

Source: BBC Research & Consulting.

Observations. The projected economic impacts of the 100 percent transfer scenarios, including the elimination of nearly 1,600 local jobs, indicate that irrigated agriculture is an important component of the local economic base in Medina County and Uvalde County. The magnitude of the job losses projected under either 100 percent transfer scenario could raise the local unemployment rate for the two-county area from around 6 percent to around 14 percent if unemployed residents remained in the area. As is currently the case, the unemployment rate in Medina County would likely be lower than the two-county average, while the rate in Uvalde County could be considerably higher.

As noted in Section VII which described baseline economic conditions in the study area, a substantial share of the income of Medina County residents comes from jobs that many residents commute to in San Antonio. Since this source of income into the local economy would presumably be unaffected by water transfers, the total income of Medina County residents after transfers would likely decline by a smaller proportion than the reduction in employment located within the study area.

Comparing projected economic impacts under both compensation scenarios with impacts under both uncompensated scenarios indicates that compensation of irrigators (at the levels assumed in this study) would do relatively little to reduce economic impacts in the study area. Under the 100 percent compensated transfer scenario, we project nearly 1,560 jobs would be lost — about 40 fewer jobs lost than under the comparable uncompensated scenario. Impacts on total output/sales in the study area under the 100 percent transfer compensated scenario are $123 million — a reduction from about $126 million in the comparable uncompensated scenario. Economic impacts under the 50 percent transfer scenario are also only slightly reduced by compensating the farmers.

Although paying farmers $1,000 per acre to cease Edwards irrigation would offset most of the impact of water transfers on net farm income, as demonstrated in Section VIII, this level of compensation has relatively little effect on regional economic impacts for several reasons. Compensation based on losses in net farm income only offsets the economic impacts that would result from declines in farm household spending. Declines in farm expenditures for inputs and labor, and in the expenditures of farm workers and agribusiness employees, are not mitigated. Impacts on crop processors and shippers would also be unaffected by compensation paid to farmers on a net income loss basis.

Transition and other impacts. The projected impacts on the local economy represent the long-run effects of water transfers, assuming formerly irrigated lands are successfully and completely converted to dryland farming. Short-term impacts could be greater if certain agricultural lands are allowed to go out of production during the transition.

By nature, dryland farming is considerably riskier than irrigated crop production due to variable climate conditions. If Medina and Uvalde Counties were entirely dependent upon dryland crop production, economic impacts of the water transfers in dry years would be considerably greater than estimated in this analysis. The risks associated with complete reliance on dryland farming could impact the long-term viability of agricultural support business as well as farms. A full scale evaluation of the impacts of this change in agricultural risk, however, is a complex undertaking beyond the scope of this study.

SECTION X.
Demographic Impacts of Edwards Aquifer Water Transfers

In the previous section of this report, the study team projected the number of jobs that might be lost under six potential Edwards Aquifer water transfer scenarios. In this section, we present related estimates of the aggregate demographic impacts of the scenarios on the population and households of Medina County and Uvalde County. More detailed analysis of the socioeconomic characteristics of impacted workers and their households is presented in Section XII, Social Impacts of Edwards Aquifer Water Transfers.

Approach

In general, the impacts identified up to this point in the analysis represent long-term effects of water transfers. Staying consistent with this viewpoint, we have adopted an approach to projecting demographic impacts that relates impacted jobs to population and households using a simple ratio approach. We project the potential long-term difference in the number of people and households that would live in the study area if transfers occurred. This approach assumes that impacts on employment opportunities not only affect the number of working age people living in the local area but also the number of dependents and ultimately the number of retired persons.

In 1994 there were about 55,000 residents in the combined Medina County/Uvalde County study area. At the same time, there were about 22,000 jobs in the two counties.[1] Comparison of these figures indicates that, on average, each local job supports approximately 2.5 residents.[2]

Based on 1990 Census data, which provides the last reliable count of households in the study area, the average local household includes 3 residents. Although more detailed data available from the Public Use Microdata Sample indicates that farm households tend to be larger than others in the area, we used the area-wide average household size to avoid

[1] Population based on U.S. Bureau of Census, 1994 population estimates. Employment estimated by BBC based on 1993 data from the U.S. Bureau of Economic Analysis, Regional Economic Information System and recent growth trends.

[2] Note that this ratio approach assumes that the relationships among the number of local jobs, employed residents and the number of retired persons remain unchanged.

uncertain assumptions regarding the behavior of specific types of households. Farm households also tend to include a larger number of employed persons, so their larger size is largely offset by a lower population to employment ratio for this sector.

Projected Demographic Impacts of Water Transfers

Exhibit X-1 depicts the study team's projections of the impacts on the number of local residents and households under each of the six water transfer scenarios. Under the 100 percent transfer with compensation scenario, it is possible that the study area population would be reduced by 3,800 people. Without Edwards irrigation supplies, Medina and Uvalde Counties might only support a population of 51,000, almost 8 percent less than current population. The number of study area households could decline by up to 1,300. These impact estimates assume that most individuals unable to find work in the two counties would relocate. Given job growth in the area, early retirement and potential outcommuting to San Antonio jobs, declines in population and households would probably not be this large.

EXHIBIT X-1.
Projected Impacts of Water Transfers on Medina County/Uvalde County Residents and Households

Scenario	Projected Job Losses	Potential Change in Population	Potential Change in Households
100 Percent Transfer Compensated	1,520	3,800	1,270
100 Percent Transfer Uncompensated	1,560	3,900	1,300
50 Percent Transfer Compensated (A)	870	2,180	730
50 Percent Transfer Uncompensated (A)	890	2,230	740
50 Percent Transfer Compensated (B)	310	780	260
50 Percent Transfer Uncompensated (B)	330	830	280

(A) 50 percent transfers assuming proportional cutbacks in vegetables along with other crops.
(B) 50 percent transfers assuming all vegetables remain in production.
Source: BBC Research & Consulting, 1996.

SECTION XI.
Fiscal Impacts

This portion of the impact analysis reviews the potential financial impacts water transfers and resulting changes in local economic activity would have on local governments in Medina and Uvalde Counties. Changes in tax rates on remaining businesses and residents of the two counties are reviewed at a gross level of detail. A detailed fiscal impact analysis for each county, municipality, school district and other local governmental entity was beyond the scope of this study.

The analysis of impacts in this section of the report is broadened to include impacts on other utilities. Specifically, fiscal impacts on the local electrical cooperative and its ratepayers are considered at the end of this section.

Impacts on County Governments

Medina and Uvalde Counties rely upon property tax revenues from irrigated farms and other property potentially impacted by water transfers. For Medina County, 60 percent of the $5.4 million in budgeted revenues for 1995-1996 are property taxes. About one-half of the approximately $3 million in budgeted Uvalde County revenues are property taxes. County sales tax revenues could also be affected (sales taxes comprise one-sixth of the Uvalde County General Fund budget and one-tenth of the Medina County budget). The net fiscal impacts on the counties also depend upon changes in demand for county services under the transfer scenarios.

Impact on tax revenues from shifts to dry land farming. Both Medina and Uvalde Counties assess nonirrigated farmland at a lower value than irrigated land. Water transfers would result in lower property tax revenues for each county.

Medina County impacts. The Medina County Appraisal District assesses each property on an individual basis based upon market value. Comparing typical assessed values for irrigated and nonirrigated cropland, irrigated land is typically valued at about $500 more per acre than comparable nonirrigated land. This incremental value of irrigated land over nonirrigated land of course would vary property by property.

Medina County has a property tax rate of $0.46 per $100 assessed value. Assuming an incremental assessed value of irrigation of $500 per acre, Medina County would lose about $2.30 per acre transferred from irrigation into dryland farming. Under the 100 percent transfer scenarios, Medina County property tax revenues from farmland would decrease by about $74,000. This potential loss of tax revenue would represent a 2 percent decline in current property taxes collected by Medina County. The 50 percent transfer scenarios would reduce Medina County property tax revenues by about $37,000 per year, 1 percent of total County property taxes. Exhibit XI-1 outlines our estimates of how both counties would be affected by shifts of land from irrigation to dryland farming.

Uvalde County impacts. Unlike Medina County, Uvalde County has a standard schedule of agricultural use values it assigns to lands in agricultural production. In 1995, Uvalde County assigned a use value for deep well irrigated lands with high quality soils of $294 per acre. Nonirrigated farmland with high quality soils was assigned a value of $138 per acre. Using these values, each acre shifted from Edwards irrigation to dryland farming could reduce Uvalde County assessed valuation by $156. Applying Uvalde County's 1995-1996 tax rate of $0.32 per $100 in assessed valuation, the County would lose about $0.50 per year in property tax revenues for every acre shifted from irrigation to dryland production. Under the 100 percent transfer scenario, Uvalde County property taxes would decline by about $22,000 per year, or about 1 percent of current property tax collections. About $11,000 in property tax revenues from farms would be lost under the 50 percent transfer scenario. Exhibit XI-1 summarizes these impacts.

EXHIBIT XI-1.
Impacts of Changes in Land Use on County Property Tax Revenues

	Uvalde County		Medina County	
	100% Transfer Scenarios	50% Transfer Scenarios	100% Transfer Scenarios	50% Transfer Scenarios
Acres affected (thousands)	44	22	31	16
Average change in assessed valuation practice	$156	$156	$500	$500
Change in total assessed valuation (millions)	$7	$3	$16	$8
Tax rate (per $100 assessed valuation)	$0.32	$0.32	$0.46	$0.46
Change in property taxes (thousands)	$22	$11	$74	$37
Percent change in total property taxes	1 %	1 %	2 %	1 %

Source: BBC Research & Consulting from Medina and Uvalde County 1995-1996 Budgets and interviews with County officials.

The 50% scenarios with vegetable cutbacks (A) and the 50% scenarios assuming all vegetable stay in production (B) involve the same number of acres and would have the same effects on property tax revenues.

Other impacts on property taxes. The impact analysis above only considers the direct effects of shifting irrigated land into a lower value land use. Impacts are projected to be relatively small. However, both counties may receive significant property tax revenues from businesses linked to irrigated agriculture that might go out of business or leave the region if Edwards irrigation rights were transferred. For example, Uvalde County might receive more in property tax revenues from large crop processing operations than it gets from taxes on irrigated land. Further, any reductions in overall business activity and resident population could result in further decreases in Uvalde and Medina County assessed valuation. Including these effects, it is possible that each county would lose property tax revenues more in proportion to projected decreases in total economic activity in the study area. For example, the secondary impact analysis indicated that study area value added, one key measure of economic activity, could decline by 8 percent under the 100 percent transfer scenarios. Under the 50 percent transfer scenarios, study area value added would decline by about 4 percent (assuming vegetable production was proportionally reduced).

Impact on sales taxes. Sales taxes are the second largest source of revenues for both Medina and Uvalde Counties. Medina County budgeted $464,000 in sales taxes for 1995-1996. Uvalde County included $500,000 in sales tax revenues in its 1995-1996 budget. Uvalde County also collects sales taxes in support of public health in the form of a health district assessment. The revenues collected from this tax, usually distributed to the county hospital, might also be impacted by water transfers but are not included in this discussion.

Farm production itself, as well as most farm inputs and processed agricultural products, is usually not subject to sales taxes. However, retail sales would decline in Medina and Uvalde Counties under either set of transfer scenarios. Our projections of secondary impacts suggests a 6 percent decline in combined Medina and Uvalde County retail sales under the 100 percent transfer, uncompensated scenario. Under the 50 percent transfer scenarios, retail sales would decline by about 3 percent (assuming cutbacks in vegetable production), or by 1 percent (if all vegetables stay in production). As shown in Exhibit XI-2, the transfer scenarios could lead to reductions in sales tax revenues of $10,000 to $58,000 per year for the two counties combined. For purposes of assessing impacts on the individual counties, it is reasonable to assume that impacts on sales taxes would be equally divided between the two counties.

EXHIBIT XI-2.
Impacts of Water Transfers on County Sales Tax Revenues

	Change in County Sales Taxes	
	Percentage Change	Change in Total County Sales Taxes (Thousands)
100% Transfer		
Compensated	6 %	$58
Uncompensated	5	48
Compensated	3	30
Uncompensated	3	30
Compensated	1	10
Uncompensated	1	10

(A) 50 percent reduction in all irrigated crops including vegetables.
(B) 50 percent reduction in irrigated crops, but all vegetables remain in production.
Source: BBC Research & Consulting from Medina and Uvalde County 1995-1996 Budgets and Interviews with County Officials.

Summary of impacts on county revenues. Adding the impacts on property taxes and sales taxes, Medina County would lose a minimum of $50,000 in revenues under the any of the transfer scenarios. Uvalde County would lose a minimum of $50,000 in annual revenues.

Impact on county expenditures. Most of Medina and Uvalde County expenditures go towards law enforcement and different types of social services. If transfer of irrigation rights ultimately results in fewer county residents, these expenditures could be reduced. However, in the short term, higher unemployment and lost wages for a portion of the population least able to absorb economic dislocation might result in even higher law enforcement and social services costs. Therefore, it is difficult to project whether there would be any reductions in demand for county services, and when any reductions would occur.

Conclusions. Our assessment of the aggregate net fiscal impacts on Medina and Uvalde County governments is summarized below.

Medina County. Adding the property tax impacts from a shift of irrigated land to dryland farming to the sales tax impacts, Medina County might see a reduction of tax revenues of at least $103,000 under the uncompensated 100 percent transfer scenario. Additional losses of property values due to indirect and induced economic effects of the water transfers could add to this impact. Other types of fees and charges would also decline if there were fewer businesses and residents within the county.

It is unclear whether the County would see much reduction in demand for county services. Assuming no net decrease in county expenditures and assuming that about $100,000 is representative of the reduction in annual revenues, the net fiscal impact on Medina County under the 100 percent transfer scenarios would be about 2 percent of its current budget. (See Exhibit XI-3.) This provides one perspective on the potential increase in Medina County tax rates and other charges that could be required as a result of water transfers. It is possible that fiscal impacts could be double this amount or more if there were major losses in property tax values within the county beyond those quantified here.

EXHIBIT XI-3.
Summary of Fiscal Impacts on County Budgets
($Thousands)

	100% Transfer		50% Transfer (A)		50% Transfer (B)	
	Compensated	Uncompensated	Compensated	Uncompensated	Compensated	Uncompensated
Medina County						
Changes in Property Taxes						
Shifts to dryland farming	($74)	($74)	($37)	($37)	($37)	($37)
Other	unknown	unknown	unknown	unknown	unknown	unknown
Changes in Sales Tax Revenues	($24)	($29)	($15)	($15)	($5)	($5)
Changes in Expenditures	Possibly $0	Possibly $0	Possibly $0	Possibly $0	Possibly $0	Possibly $0
Net Fiscal Impact (known items only)	($98)	($103)	($52)	($52)	($42)	($42)
Percentage of County budget	2%	2%	1%	1%	1%	1%
Uvalde County						
Changes in Property Taxes						
Shifts to dryland farming	($22)	($22)	($11)	($11)	($11)	($11)
Other	unknown	unknown	unknown	unknown	unknown	unknown
Changes in Sales Tax Revenues	(24)	(29)	(15)	(15)	(5)	(5)
Changes in Expenditures	Possibly $0	Possibly $0	Possibly $0	Possibly $0	Possibly $0	Possibly $0
Net Fiscal Impact (known items only)	($46)	($51)	($26)	($26)	($16)	($16)
Percentage of County budget	2%	2%	1%	1%	1%	1%

Source: BBC Research & Consulting from Medina and Uvalde County 1995-1996 Budgets and interviews with County officials.

Under the 50 percent transfer scenarios, net fiscal impacts on Medina County might be at least $50,000 per year (1 percent of the County budget).

Uvalde County. The study team's assessment of the range of potential aggregate fiscal impacts on the Uvalde County budget is comparable to the fiscal impacts reported above for Medina County. Adding the property tax impacts from a reduction in the value of agricultural land and the losses in sales tax revenues, Uvalde County revenues might be $51,000 lower under the no compensation, 100 percent transfer scenario. As discussed previously, there might be no corresponding reduction in demand for Uvalde County services, at least not immediately. Therefore, Uvalde County tax rates and other charges might need to increase by 2 percent to offset these revenue losses. Net impacts on the county budget could be at least double this amount if major businesses left the area. Under the 50 percent transfer scenarios, impacts might represent 1 percent of the county budget.

Impacts on Municipal Governments

Although the study team did not complete a detailed examination of fiscal impacts on municipalities within Medina and Uvalde Counties, a general assessment is presented below. The relative impact on municipal sales tax revenues would be much the same as seen for the counties. Even though little irrigated farmland is within municipal boundaries, the impacts on economic activity within the counties would affect property values and tax revenues within the municipalities.

Study area municipality general funds are more dependent upon sales taxes and less dependent upon property taxes than the two county governments. For example, over 40 percent of the City of Castroville's 1996 General Fund budget is comprised of sales tax revenues. Therefore, the potential 6 percent decrease in study area retail sales under the 100 percent transfer scenario could have a greater relative impact on municipalities than the counties.

Municipalities would see little impact from a decrease in assessed valuation for farmland since little irrigated farmland is within municipal boundaries. However, the impacts on total economic activity within the study area could affect property values within study area municipalities. As with the impact analysis for the counties, it was not possible to develop estimates of these indirect property tax impacts within the scope of this study.

While county expenditures are focused on law enforcement and social services, when enterprise funds are included, most municipal expenditures are for utilities such as water, sewer and electricity. If the number of businesses and residents within municipalities is affected by water transfers, demand for these types of services and corresponding revenues would decline. High fixed costs inherent in municipal utilities usually mean that, in the short run, reductions in demand for services result in revenue losses exceeding any expenditures savings.

Impacts on School Districts

School districts are the local governmental units potentially most affected by changes in property values. However, the Texas school district funding equalization system would reduce or eliminate these fiscal impacts on local school districts.

School districts in Medina and Uvalde Counties. There are seven school districts wholly within Medina and Uvalde Counties and several additional districts that include a portion of one of these counties. We focused our analysis on the following school districts:

- D'Hanis
- Devine
- Hondo
- Medina Valley
- Natalia
- Knippa
- Sabinal
- Utopia
- Uvalde Consolidated.

Background on the equalization system. Methods of financing public education in Texas have undergone considerable turmoil during the past decade. The financing system was revamped in 1989 in response to litigation concerning school finance equity. The new system, however, was subsequently declared unconstitutional by the Texas Supreme Court. Two subsequent attempts by the Senate to rectify perceived inequities in the system were also declared unconstitutional by the courts.

Since 1993, Texas school finance has been administered under the system devised in Senate Bill 7. This new system has been found constitutional by both a district court and the Texas Supreme Court and remains in effect as of the date of this study.

Under the current equalization system, school districts in Texas are limited to a maximum wealth of $280,000 in property value per student. Districts with wealth above this amount must select one of several remedies to reduce their effective wealth to the cap. In effect, revenues above the cap are "recaptured" by the State. For these wealthy districts, a decrease in local property value would have no impact on their revenues as long as they remained above the maximum wealth level.

Districts with wealth below $205,500 per student receive additional revenues under the State's equalization program. For these districts, the State makes up the difference between the taxes applied against their actual wealth and the revenue they would receive if their wealth were $205,500 per student. For this group of districts, any decrease in property value would be offset by additional state equalization funds.[1]

The only school districts which would sustain a long-term revenue impact from a decline in local property values would be districts that have wealth per student greater than $205,500 and less than $280,000. For these districts, any decrease in local property values would result in lower property taxes.

As shown in Exhibit XI-4, none of the Medina and Uvalde County school districts has wealth that falls within the ranges of $205,500 and $280,000 which could make them vulnerable to long-term fiscal impacts from reduced property values. For all of the districts within the study area except for the Utopia District in Uvalde County, a decline in local

[1] However, any school district could sustain a one year impact from reductions in local property values due to lags between local collections and state equalization

property values would be made up by an increase in state equalization aid. In the case of the Utopia District, a decline in local property value would allow the district to retain a greater portion of local revenues — again offsetting any revenue impacts. For all of these districts, the same level of local tax effort would produce the same amount of revenue before and after potential transfers.

EXHIBIT XI-4.
Potential Impacts on School Districts in Medina and Uvalde Counties

County/District	Taxable Property Value per Student	Effect of Decline in Local Property Value
Medina County		
D'Hanis	$145,863	Offsetting Increase in State Equalization
Devine	75,126	Offsetting Increase in State Equalization
Hondo	90,340	Offsetting Increase in State Equalization
Medina Valley	113,481	Offsetting Increase in State Equalization
Natalia	50,012	Offsetting Increase in State Equalization
Uvalde County		
Knippa	$97,481	Offsetting Increase in State Equalization
Sabinal	133,171	Offsetting Increase in State Equalization
Utopia	361,634	Offsetting Decrease in State Recapture
Uvalde Consolidated	72,369	Offsetting Increase in State Equalization

Source: BBC Research & Consulting from Texas Education Agency, Snapshot '95: 1994-95 School District Profiles.

District property value per student changes from year to year both as a result of changes in local property values and changes in the number of students in the district. Even though none of the districts in Uvalde County and Medina County would currently sustain an impact on revenues from water transfers, future changes in property value per student could place some of the districts at risk.

Impacts on Power Rates

Most farmers and many businesses and residents of Medina and Uvalde Counties receive their power from the Medina Electric Cooperative, Inc. If water transfers result in reduced demand for power to operate irrigation wells, the power company and its rate payers could be negatively affected.

Background. Medina Electric serves farmers, industry and residences in all or parts of 17 counties in South Texas. Medina Electric's long range financial forecast projects 1996 revenues of about $28 million. About 12 percent of 1996 revenues are expected to come from irrigation sales. Small commercial and residential customers account for 85 percent of power revenues. The company has an extensive transmission and distribution system and its own power generation.

Impact on power sales from reduced pumping demand. Medina Electric reports that one-third of its irrigation revenues come from Edwards irrigators. Therefore, we estimate that Medina Electric Cooperative revenues could decline by 4 percent, or about $1 million per year, under the 100 percent transfer scenarios. This figure is consistent with the reduction in power sales projected from crop budget figures.

Impact on costs from reduced pumping demand. If water transfers reduced or eliminated the power used by Edwards irrigators, Medina Electric would save some energy generation costs and possibly some transmission system maintenance. Demand for Medina Electric power is growing, so reducing or eliminating Edwards irrigation demand could help the power company meet the growth in demand from other customers. Also, Medina Electric might save some costs by shaving peak summer demand. However, because many irrigators currently participate in a voluntary load management program in which they avoid irrigating at peak times of the day, it is not clear how much peak-shaving would materialize.

Impact on rates from reduced pumping demand. While Medina Electric would lose $1 million of revenues per year from elimination of Edwards irrigation, its costs would probably be reduced by almost as much or possibly more. Assuming costs could only be reduced by $0.5 million per year, the increase in other customers' rates to achieve necessary revenue requirements would be in the range of 2 percent.

Other impacts. Medina Electric would also be affected by changes in demand from linked industries affected by the water transfers. About 40 percent of the power company revenues come from commercial customers. Some of those customers would scale back operations or shut down if Edwards irrigation supplies were transferred. Also, residential demand could be slightly impacted from fewer people living in Medina and Uvalde Counties. However, because some of the commercial customers potentially most affected by the transfers, such as Dean Foods, purchase their power from other power suppliers; effects on Medina Electric would be small relative to its total rate base.

Conclusions. Because of Medina Electric's large service area, loss of power demand from Edwards irrigators would amount to a relatively small reduction in its total power sales. Reduced demand from other customers affected by the transfers would add to this impact, but probably still would account for a small portion of total power sales that could be replaced by other growth in demand. Impacts on Medina Electric rate payers would be minimal.

SECTION XII.
Social Impacts of Edwards Aquifer Water Transfers

Previous sections of this report outlined baseline socioeconomic conditions in the study area (Section VII), and projected economic and demographic impacts of the water transfer scenarios (Sections VII-X). This section of the report evaluates the social impacts of water transfers within the study area. In this step of the impact analysis, we present a more detailed examination of the particular groups of local households potentially most affected by transfers.

Background

As reported in Section IX, we estimated that nearly 1,600 jobs in Medina and Uvalde Counties might be eliminated if all of the Edwards Aquifer water currently used for crop irrigation were transferred out of the area. If 50 percent of Edwards Aquifer supplies were transferred, employment losses might be as few as 300 jobs or as many as 900 jobs, depending on whether vegetable crops and vegetable processors are effected.

While these projected economic impacts would be felt throughout the local economy, the impacts would not fall evenly on all segments of the population. The concentration of impacts within certain economic sectors is presented in the Section IX. Although all economic sectors would experience some job losses, farm owners/managers and farm workers, as well as employees in agricultural services and farm-related trade and manufacturing activities ("directly linked industries"), would bear the brunt of the impact. Of course, under the scenarios in which compensation is paid to the farmers in exchange for ceasing Edwards irrigation, the financial impacts on farm owners would be mitigated (although impacts on their lifestyles could still occur).

Individuals and their households may respond to job losses in a number of ways. The following list suggests some of the most likely responses:

- seek alternative employment in the area,
- commute to work outside the two-county area,
- remain unemployed and rely on financial support from family or community support networks,
- retire, or
- relocate.

The following discussion describes the segments of the population that might be most affected by water transfers, and considers how each groups might respond to impacts from the transfers. Other social issues related to transfers are also discussed. We begin by reviewing key data sources.

Research Methods

To more closely examine the socioeconomic characteristics of the most affected segments of the population, the study team analyzed the Public Use Microdata Samples files from the 1990 Census of Population. While these files are now several years old, they provide extraordinarily detailed demographic and economic information on all segments of the population that is generally unavailable from any other published source.

It should be noted, however, that because of concerns regarding non-disclosure of the individual responses in the PUMS data, the PUMS sample containing Medina and Uvalde Counties also includes records for a number of other nearby rural counties. The study team determined that data on the affected population in the PUMS files were representative of the characteristics of these groups in the smaller Uvalde County and Medina County study area.

Other sources of information on the characteristics of potentially affected groups and possible responses to job losses were also consulted. These information sources included interviews with managers of agricultural processing and shipping operations, agricultural extension agents, agricultural input sellers, school and hospital administrators, staff of local civic organizations and other local sources. Data on Medina County and Uvalde County farmers from the 1992 Census of Agriculture were also examined.

Responses of Farm Owners to Impacts of Transfers

Owners and managers of irrigated farms in Medina and Uvalde Counties comprise the group most directly impacted by water transfers. Their responses to transfers, and corresponding effects upon the local community would depend on whether they were compensated for ceasing to irrigate with Edwards Aquifer wells.

Responses under compensated transfer scenarios. Under the compensated transfer scenarios in which water transfers are assumed to occur through voluntary market transactions, financial impacts on farm owners would be largely mitigated. Only those farmers finding it financially beneficial to sell their water supplies would participate in the transfers. Farmers who sold their water supplies would have a number of options to respond to their new conditions.

Some of the existing farmers in the area might convert from irrigated to dryland farming and continue to work the same lands. Fundamental differences between irrigated farming and dryland farming in terms of the risks involved, the use of credit and capital, and other factors suggest this conversion is not as simple as it might appear. In Medina and Uvalde Counties, irrigated farming and dryland farming are distinctly different types of operations. Further, local sources consider irrigated farmers and dryland farmers to be different types of individuals. Irrigated farming is much more capital and labor intensive, usually much more profitable, and is much less risky than dryland farming. Dryland farming in this region is sometimes described as rolling the dice: one year can be great, and the next year you won't make a crop. This type of farming requires a different mindset than some irrigated farmers might now have.

Those farmers selling their water supplies that wish to continue in irrigated farming might seek to sell their lands and combine the proceeds from the water transfer and land sale to purchase irrigated farmlands in other areas. We suspect, however, that agricultural land market conditions and the characteristics of local farmers may make this option relatively unattractive. Demand for nonirrigated agricultural land in Medina County and Uvalde County is not extremely great at present, and land values have not appreciated materially in recent years. These market conditions would make it more difficult for farmers to receive enough compensation for their lands to pay off their existing debts and purchase new lands elsewhere.

Perhaps more importantly, local farmers tend to be older than the workforce as a whole and to have long-standing ties to the local area. As depicted in Exhibit XII-1, the average age of farm owners/managers is 50, and more than forty percent of these individuals are older than 55 In fact, if paid farm managers are excluded and only farm owners are considered, the average age of this group is 57 years of age. The average farm owner (again excluding paid managers) has worked his landholdings for 17 years. [1] Many farmers might choose to retire if their financial circumstances, coupled with the investment earnings on transfer compensation, provided them with sufficient security to choose this option. As noted in the Arkansas Valley, Colorado transfer case study, retirement while remaining in the area has been a common response to other transfers of irrigation supplies.

EXHIBIT XII-1.
Comparison of Selected Characteristics of Local Farm Owners/Managers with the Overall Population

	Farm Owners/ Managers	Overall Population
Average Age	50	39*
Proportion Aged 55+	44%	17%
Proportion Living in Home for More than 10 years	55%	38%

* Characteristics of <u>workers</u> in the overall population only.

Source: BBC analysis based on Public Use Microdata Samples; Bureau of Census, 1990.

Many farm owners earn most of their income from a job off the farm. The 1992 Census of Agriculture indicated that two-thirds of farm owners with revenues over $10,000 had farming as their principal occupation. Further, about forty percent of farms with

[1] Bureau of Census, 1992 Census of Agriculture, data for Medina County and Uvalde County.

revenues over $10,000 posted losses in 1992. We project that these farmers would be among the first to sell their water supplies if they were to be compensated for these transfers. Many of these farmers would be in a much better financial position, and face very little negative change in lifestyle, if they sold their water supplies.

Responses under uncompensated scenarios. Under the uncompensated scenarios, water transfers are assumed to occur without any payments to the farm owner. Farm owners stand to lose both income and wealth — in the form of reduced land values. As discussed in Section VII, uncompensated transfers could place these farm owners in a very difficult financial position. Faced with devalued land assets, continuing mortgage obligations, substantially reduced farm income, and much more year-to-year uncertainty in the returns from farming, many of these farm owners would immediately or eventually go bankrupt. Those farmers in the best financial position to weather these impacts would be the older farmers that are debt-free and have built up their non-farm assets. However, these same farmers may be considering retirement, and water transfers could largely wipe out the very assets they were counting on to be able to comfortably retire.

These outcomes would be particularly difficult for local farmers because of their demographic situations. Eighty percent of local farm owner/managers are the heads of their own households. While about one-half of these households include another worker, the farmer is typically the major economic contributor to the household.[2] Except under certain corporate farming conditions uncommon in Medina County and Uvalde County, farmers are not eligible to receive unemployment benefits like workers who have been laid off in other industries.

Responses of Farm Workers and Employees in Directly Related Occupations

If Edwards crop irrigation ceased altogether, as envisioned in the 100 percent transfer scenarios, the number of farm workers and employees in directly linked industries that would lose their jobs would considerably exceed the number of farm owners and managers affected by the transfers. The socioeconomic characteristics of these segments of the population suggest that, in many respects, the relative social and economic impacts on these households would be as or more severe than the impacts on the farmers.

Socioeconomic profile of crop farm workers and employees in directly linked occupations. Evaluation of the social consequences of substantial job losses among local farm workers and employees in closely linked occupations requires a closer look at the socioeconomic characteristics of these workers. As shown in Exhibit XII-2, in contrast to the approximately equal balance between Hispanic and non-Hispanic residents in the combined Medina County and Uvalde County study area, about 8 out of ten crop farm workers and workers in closely linked industries are Hispanic. Most crop farm workers are male, while employees of closely linked industries are evenly balanced between men and women. The average age of these workers is similar to the average age of the workforce in the study area as a whole.

[2] BBC analyses based on the Public Use Microdata Samples; Bureau of Census, 1990.

EXHIBIT XII-2.
Selected Demographic Characteristics of Crop Farm Workers and Employees in Closely Linked Industries

	Crop Farm Workers	Linked Industry Workers*
Hispanic	82%	79%
Male	68%	52%
Female	32%	48%
Average Age	38	40

* Includes employees of wholesale trade businesses supplying farm inputs and shipping crops from the area and employees of agricultural processors.

Source: BBC analysis based on Public Use Microdata Samples; Bureau of Census, 1990.

In contrast to the owners/managers of crop farms in the two counties, who typically have household incomes above local averages, crop farm workers and employees in directly linked industries are among the lowest income households within the study area. Census data indicate that these individuals had average annual personal incomes of $9,114 (crop farm workers) and $8,710 (directly linked industries) in 1989. In contrast, the average personal income of all workers living in the area was slightly more than $16,100, while crop farm owners/managers had an average personal income of nearly $21,000.[3]

Despite often including more workers than average within the household, those households headed by crop farm workers and employees in directly linked industries have combined household incomes which are much lower than average for the area. Households headed by crop farm workers and employees in directly linked industries had an average household income of less than $17,500 in 1989, compared to about $31,600 for households headed by farm owners and managers and the $29,700 average for all working households in the area.[4]

How might the individuals in these potentially impacted groups and their households respond to job losses resulting from water transfers? As an initial observation, it is important to remember that these individuals would not receive compensation for their economic hardships arising from water transfers, even under the scenarios envisioning voluntary transfers in exchange for payments to farm owners.

Potential to find work in other local sectors. Workers who lost their jobs as a result of water transfers might seek similar jobs in other areas, or attempt to move into different types of employment. As in other places, the majority of new jobs in Medina County and Uvalde County over the next few years will likely be in the service and retail trade sectors. Although strong English language skills may be less important in South Texas than in other places, English facility is still clearly an asset for job seekers. In general, greater educational background also improves the potential for workers to move into new occupational areas.

Exhibit XII-3 portrays the English speaking capability and educational background of the workers likely to be most affected by water transfers and compares these attributes with the overall workforce in the area. While only nine percent of the local workforce

[3] BBC analyses based on the Public Use Microdata Samples; Bureau of Census, 1990.

[4] BBC analyses based on the Public Use Microdata Samples; Bureau of Census, 1990.

indicated that they spoke English "not well" or not at all in the 1990 Census, about one fourth of the crop farm workers and employees in directly impacted industries reported limited English capabilities.

EXHIBIT XII-3.
Characteristics of Farm Workers and Employees in Directly Linked Industries Affecting Employability in Other Sectors

	Crop Farm Workers	Directly Impacted Industries	Overall Workforce
Language Capability			
Speak English "Not Well" or Not at All	28%	24%	9%
Speak English "Well" or Better	72%	76%	91%
Educational Attainment			
No High School	44%	42%	16%
Some High School, no Diploma	30%	25%	17%
At Least a High School Diploma	26%	33%	66%

Source: BBC analysis based on Public Use Microdata Samples; Bureau of Census, 1990.

About two-thirds of the employees in the overall workforce have at least a high school degree. Only one-third of all employees in directly linked industries, and less than one-third of crop farm workers have a high school degree. A substantial proportion of the these workers have no high school educational background whatsoever. The limited formal education of most crop farm workers and employees in linked industries, and the limited English skills of some of these workers, could make it difficult for these individuals to obtain newly created jobs in retail trade or services.

Some of the skills which these workers have might be applicable to work in certain construction or manufacturing occupations. Exhibit VII-4, presented earlier in the baseline economic profile of the study area depicts the number of jobs in each local economic sector in 1980 and in 1993. Neither construction nor manufacturing appears to be growing sufficiently to absorb large numbers of displaced farm workers and employees of linked businesses. Interviews with economic development officials in the area indicated that new manufacturing jobs attracted to the area, in aerospace and other light industry, may demand technical skills not commonly found among the farm workforce.

Some local school districts in Medina County and Uvalde County offer programs designed to assist adults who have not completed their high school degrees. Interviews with representatives of the Hondo school district indicated that these programs are currently undersubscribed and currently serve few, if any, farm workers. The Hondo school district does not charge tuition for these programs, although adults seeking their GED are required to pay for the costs of testing.

Some vocational training is available through both continuing education programs at the local school districts and through the Southwest Texas Junior College, located in Uvalde. The public school district programs generally charge a minimal tuition and may be available to assist individuals who have not obtained a high school diploma. The College programs may be inaccessible to much of the farm worker population because of cost and entry requirements.

Support systems. Crop farm workers and employees in closely linked industries tend to live in larger households, often with more wage earners, than other local residents.

As shown in Exhibit XII-4, the average size of households headed by crop farm workers and employees in directly linked industries is considerably larger than the typical household size throughout the area. About twice as many households headed by these potentially impacted workers include at least three workers as found in the overall study area.

EXHIBIT XII-4.
Selected Household Characteristics of Potentially Impacted Employees

	Average # of Residents	Porportion of Household with at Least 3 Wage Earners	Average Household Income (1989)
Crop Farm Workers	3.96	26%	$17,300
Employees in Linked Industries*	3.95	24%	$16,900
Overal Area Households	2.95	13%**	$29,699 **

* Includes employees of wholesale trade businesses supplying farm inputs and shipping crops from the area and employees of agricultural processions.

** Excludes non-working households headed by retirees.

Source: BBC analysis based on Public Use Microdata Samples; Bureau of Census, 1990.

The fact that farm worker households and households of workers in directly linked industries tend to include more wage earners than average for the area might appear to lessen some of the potential impacts on these households. However, given low combined household incomes to begin with, it may be extremely difficult for these households to cope with one less income for any extended period of time. Further, the PUMS data suggest that many of these households would have more than one worker losing their jobs because the water transfers. Of local households that include a farm worker (or an employee in a directly linked industry) and at least one other employed person, about 25 to 30 percent have more than one of the household members working in one of these likely impacted occupations.

In some instances, farm worker households might suffer additional impacts because of special living arrangements tied to their jobs. As shown in Exhibit XII-5, about one in seven households headed by crop farm workers live in homes which are "rented without cash payment," typically according to some type of sharecropping arrangement. These households might not only lose their monetary incomes, but also their homes as a result of transfers.

Any farm workers who lose their special housing arrangements with farm owners will confront a difficult local housing market. Due to difficulty in obtaining interim financing to develop new homes, very few new units have been added to the local supply in recent years, despite growth in local population. Affordable housing is scarce, although farm workers with children do receive assistance from the county governments in obtaining places to live. Farm workers without children would be in a particularly difficult housing situation if they lose their current living arrangements.

EXHIBIT XII-5.
Tenure of Households Headed by Farm Workers

	Crop Farm Workers	All Local Households
Owned – Free and Clear	46%	44%
Owned – Mortgage	16%	27%
Rented for Cash	25%	24%
Rented, No Cash Payment	14%	5%

Source: BBC analysis based on Public Use Microdata Samples: Bureau of Census, 1990.

Apart from support from other members of their households, impacted employees could also seek assistance from governmental sources.

Mobility of the farm worker/impacted employee population. If there are few suitable possibilities for local employment in other sectors, many impacted workers could be forced to either commute to work in other locations or move out of the area altogether.

Medina and Uvalde County crop farm workers and employees of directly linked industries are not necessarily more mobile than the local population as a whole. As shown in Exhibit XII-6, more than sixty percent of the potentially impacted workers lived in the same house at the time of the 1990 Census that they had lived in five years before — a slightly greater proportion of non-movers than found in the general population of the area.

EXHIBIT XII-6.
Mobility of Potentially Impacted Workers

	Lived in Same House 5 Years Ago	
	Yes	No
Crop Farm Workers	62%	38%
Employees in Directly Linked Industries	63%	37%
Overall Population	60%	40%

Source: BBC analysis based on Public Use Microdata Samples; Bureau of Census, 1990.

Given the seasonal variability common in crop farm employment and in many of the directly linked occupations, a substantial portion of this workforce is accustomed to working on a number of different farms, or for a number of different agricultural businesses, throughout the year. With a reduction in the amount of suitable work available in the study area, many of these workers might commute to seasonal jobs more frequently and over greater distances. Greater travel time to work and more time away from the home could place additional stresses on both the workers and their families.

Broader Community Impacts

Beyond the question of how individuals who lose their jobs as a direct result of water transfers might cope with this hardship, water transfers could have a range of additional social impacts on the community as a whole.

Unemployment, crime, and other social impacts. The job losses projected under the 100 percent transfer scenarios could raise the local unemployment rate from current levels of around six percent to nearly 15 percent. High unemployment could lead to greater social problems such as crime, substance abuse and greater instability of family structures. These factors could create perceptions of a local community in a state of decline.

Impacts on religious institutions and community organizations. The social impacts discussed above would place stresses on community support systems including religious institutions, social service organizations, government agencies and informal support mechanisms including extended families. For example, Medina Community Hospital is a publicly owned not-for-profit hospital that is required to provide catastrophic medical care to individuals without insurance or other resources. Although this requirement already places a fiscal strain on the hospital, the costs of caring for uninsured farm workers are often paid for by the farm owners. Following water transfers, this source of support could be reduced, adding to the fiscal challenges facing the hospital.

The need for additional support would come at a time when the traditional sources of funding for these institutions could also be reduced because of the transfers. Because of lower incomes and job losses, water transfers may result in a fall in contributions to local churches and community organizations.

In addition to reduced funding, religious, social and civic organizations might find that longstanding members would leave the community as a result of diminished agricultural activity. The relative stability of the agricultural population — as evidenced by the long average tenure of farm operators and high concentration of local residents among farm workers — might be disrupted by changes in the local economy resulting from transfers. Potential turnover among these residents might remove considerable resources such as experience, clout and effort from these non-business entities.

Impacts on long term economic development prospects. Our assumptions concerning the nature of the water transfers are such that water would still be available for new industrial, commercial and residential development in both counties. However, long term economic development prospects in Medina County and Uvalde County might be affected by a lasting perception of a community in decline. These perceptions could make it more difficult for Medina County and Uvalde County to attract new businesses.

Impacts on sense of community. Much of Medina County is already well along in diversification from an agriculturally-based economy. Many households include at least one worker that commutes to the San Antonio area. Transfers of Edwards irrigation supplies could well accelerate the rate at which Medina County becomes integrated into the San Antonio economy. This may have both positive and negative effects. Employment opportunities are greater in San Antonio, and salaries and wages are higher for most San Antonio jobs. This brings in substantial income to Medina County, which is then circulated within the local economy. However, longer commuting times and a greater "San Antonio focus" may make it harder to families to maintain the types of rural lifestyles that many desire. The sense of community may suffer. The social impacts would be what one would find in many small rural communities that have converted to bedroom communities of urban areas. Of course, this may occur in Medina County with or without water transfers. Water transfers may only hasten the process and, for many local residents, give a sense that this economic future for the county was forced upon them.

While Medina County is well within the commuting shed of San Antonio; to date, Uvalde County has not been a functional part of the San Antonio economy. Uvalde County may be too distant from San Antonio jobs to for out-commuting to replace the economic stimulus now provided by irrigated crop farming. While Medina County can regain the lost jobs resulting from any transfers of irrigation supplies, it would be much more difficult for Uvalde County to rebound from these job losses. Therefore, the long term social and economic impacts on Uvalde County could be much more pronounced in Uvalde County than in Medina County.

Impacts on religious institutions and community organizations. The social impacts discussed above would place stresses on community support systems including religious institutions, social service organizations, government agencies and informal support mechanisms including extended families.

Impacts on long-term economic development prospects. Our assumptions concerning the nature of the water transfers are such that water would still be available for new industrial, commercial and residential development in both counties. However, long-term economic development prospects in Medina County and Uvalde County might be affected by a lasting perception of a community in decline.

Impacts on sense of community. Transfers of Edwards irrigation supplies could well accelerate the rate at which Medina County becomes integrated into the San Antonio economy. This might have both positive and negative effects. Longer commuting times and a greater "San Antonio focus" might make it harder for families to maintain the types of rural lifestyles that many desire. The sense of community might suffer.

While Medina County is well within the commuting shed of San Antonio, to date, Uvalde County has not been well integrated into the San Antonio economy. Uvalde County may be too distant from San Antonio jobs for out-commuting to replace the economic stimulus now provided by irrigated crop farming. While Medina County could regain the lost jobs resulting from any transfers of irrigation supplies, it would be much more difficult for Uvalde County to rebound from these job losses. Therefore, the long term social and economic impacts in Uvalde County could be much more pronounced than in Medina County.

Key Observations Based on Findings

Substantial impacts on the local community would occur even if farmers were compensated for transferring their supplies. This research demonstrates that the local communities would be substantially impacted if all of the Edwards irrigation supplies were transferred:

- study area output would decrease by $123 million,
- over 1,500 jobs would be lost in the two counties, and
- study area population could decrease by up to 3,800 people.

Large impacts on the local economy would occur regardless of whether or not irrigators were compensated for their irrigation supplies. There are little differences in the study team's estimates of community-wide economic, demographic, fiscal and social impacts between the compensated and the uncompensated transfer scenarios. Similarly, paying irrigators $2,000 or more per acre (as opposed to the study's assumed $1,000 per acre compensation) for their irrigation supplies would not substantially lessen the total impacts on the two-county region.

For example, even though transfers without compensation would bankrupt many of the farmers losing the irrigation supplies, local banks could probably weather these losses (federal land banks hold most of the land mortgages; local banks primarily make equipment and operating loans). Shutting down the local crop processing and shipping operations would have an even greater impact on the local economy than bankruptcy of local irrigators.

Impacts on the two-county region would still be substantial if only 50 percent of the water supplies were transferred. This study also shows that impacts on the local communities would still be significant if only 50 percent of the water supplies were transferred. The following compares the impacts if 50 percent of the Edwards irrigation supplies were transferred:

- study area output would decrease by $67 million,
- 900 jobs would be lost in the two counties, and
- population could decrease by up to 2,200 people.

(These impact estimates assume farmers are compensated for their supplies and that vegetables are affected the same as other irrigated crops.)

Impacts would be far less if the highest value crops stayed in production. The study team also examined economic impacts assuming 50 percent of the water supplies were transferred, but that irrigation of vegetables would be unchanged (and irrigators were compensated). This would keep local vegetable processors and shippers in business, a major source of income and employment within the study area. To keep vegetables in production, the transfer scheme would need to allow irrigators the flexibility to shift remaining water supplies or crop production between farms or encourage an active market for leasing remaining irrigated land. Under this scenario:

- study area output would decrease by $23 million,
- over 300 jobs would be lost, and
- study area population could decrease by up to 800 people.

There would still be hardships for those workers displaced from farm work and other local jobs under this 50 percent scenario. Many of the farm workers, and perhaps other displaced workers, might not have the education and skills for new jobs created within the local economy. However, the smaller magnitude of these job losses would make it more likely that displaced workers could find new jobs in the local area. Also, the smaller magnitude would likely be less overwhelming for local support networks that could aid these workers and their families.

Impacts on economic and demographic conditions during the first few years following transfers could be more severe than the long-run impact estimates quantified in this study. Some proportion of the lands which were formerly irrigated might remain out of production altogether during this transition phase.

SECTION XIII.
Summary and Conclusions

Transfers of irrigation supplies could have major impacts on Medina County and Uvalde County businesses, employees and residents that extend far beyond the farmers involved in the transfers.

Economic Impacts

Transfer of all of the Edwards Aquifer irrigation supplies from Medina and Uvalde Counties would have major impacts on the local economy, even if farmers were compensated for the transferred irrigation supplies. The following summarizes the impacts under this 100 percent transfer, with compensation scenario.

Impacts on output. Economic output from study area businesses would fall by about $125 million if all of the Edwards irrigation supplies were transferred (including impacts on crop production). This represents 8 percent of total economic output from businesses in Medina and Uvalde Counties.

Impacts would be widely felt among different sectors of the local economy. Only one-sixth of the impacts on output would be in the crop production sector. Effects on crop processing and shipping would be much greater. Nearly one-half of the reduction in economic activity would be in support sectors such as trade and services.

Impacts on employment. If all of the irrigation supplies were transferred, over 1,500 jobs would be lost in Medina and Uvalde Counties, about 7 percent of total jobs located in these two counties. Over one-fifth of the local manufacturing jobs would be lost, primarily due to closure of major food processors. About 13 percent of local agricultural jobs would be lost. The number of jobs in wholesale and retail trade would be reduced by 11 percent.

Transition impacts. The projected impacts on the local economy represent the long-run effects of water transfers, assuming formerly irrigated lands are successfully and completely converted to dryland farming. Short-term impacts could be greater if certain agricultural lands go out of production during the transition.

Demographic Impacts

Based upon the estimates of job losses noted above, the combined population of Medina and Uvalde Counties could be reduced by about 3,800 people (about 1,300 households) if 100 percent of the Edwards irrigation were transferred.

Fiscal Impacts on Local Governments

Because of the funding mechanisms of local governmental units, fiscal impacts on the counties, municipalities and school districts would be relatively minor. Combined, Medina and Uvalde Counties might lose about $150,000 per year in property and sales tax revenues as a result of the water transfers. Tax rates might need to increase by 2 percent to recover these lost revenues.

The Texas school district funding equalization system would eliminate fiscal impacts on local school districts. The study team's assessment of impacts on the local power cooperative suggests that impacts on rate payers would be minimal.

Social Impacts

Farm owners and operators. Water transfers would create some dislocation of farm owners and operators, even if irrigators were compensated for the transfers. Because of the differences between irrigation and dryland crop operations — particularly the lower yields, different crop types and high risk of dryland farming — not every former irrigator would want to continue in crop production. Because many irrigators in these two counties are older, water transfers might hasten farmers' retirement. Many local farm owners work off the farm, so sale of irrigation supplies might have little effect on their lifestyles. Farmers that primarily lease irrigated land would need to convert to dryland farming, find new employment, or relocate their operations outside the counties.

Even with certain dislocations among former irrigators, the economics of farming in the area suggest that most formerly irrigated land would convert to dryland production. It might be that different farmers would be working the land, however.

Farm workers and employees in directly related occupations. Assuming irrigators were compensated for the transfers, impacts would fall hardest on farm workers and employees in directly related occupations, the majority of whom are of Hispanic descent. More than one-third of the jobs on crop farms would be eliminated. Many of these potentially displaced workers have little formal education and limited English skills. It might be difficult for these employees to find other jobs in the area. San Antonio jobs might be difficult to obtain as well, and the long commuting distance limits this option for Uvalde County residents.

Unemployment, crime, and other social impacts. The job losses projected under the 100 percent transfer scenarios could raise the local unemployment rate from recent levels of around 6 percent (for the combined county area) to nearly 14 percent. High unemployment could lead to greater social problems such as crime, substance abuse and greater instability of family structures. These factors could create perceptions of a local community in a state of decline.