A DROP IN THE BUCKET: TEN YEARS OF GOVERNMENT SPENDING ON WATER AND WASTEWATER INFRASTRUCTURE IN TEXAS COLONIAS

A Thesis

by

RICHARD EDWARD RAPIER

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

December 2009

Major Subject: Water Management and Hydrological Science

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Approved by:

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ABSTRACT

A Drop in the Bucket: Ten Years of Governement Spending on Water and Wastewater Infrastructure in Texas Colonias. (December 2009)
Richard Edward Rapier, B.A., Texas Tech University
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Since 1989, the United States Federal Government and the State of Texas have targeted water and wastewater infrastructure development spending in the *colonias* to improve access to safe, reliable and adequate water supplies and wastewater service. Prior to widespread installation of piped, treated water infrastructure, waterborne illnesses attained levels only seen in developing countries. Despite the hundreds of millions of dollars that have been spent since 1989 on water and wastewater infrastructure improvements, roughly a quarter of *colonias* still lacked basic access to water and wastewater services. Previous research and assessments of where this government spending has been targeted have not evaluated all four largest funding sources together or demonstrated the impacts of water and wastewater infrastructure spending on either public health or the local economy. This report evaluates the first of these problems by analyzing government spending of these funding sources from 1996 to 2006 in Cameron, Hidalgo, and Starr counties.

The report provides the history and context of the Texas *colonia* problem, discusses who provides water and wastewater services to the colonias, and describes the make-up of federal and state financial assistance to the *colonias* to develop their water and wastewater infrastructure. Conventional understandings of where government spending is going, for what, and to whom, are challenged by the data and analysis. Analysis results indicate greater spending on wastewater infrastructure improvements than water service in addition to greater allocation to municipal systems that extended

service into *colonia* areas historically operated by water service corporations. Further research may build on this data as well as regional economic and epidemiological data to determine outcomes of the spending in quantitative terms using various impact assessment methodologies. This report concludes with a discussion of impact assessment.

For Jessie

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This report would of not been possible without the support and advice of my graduate advisor, Ronald Kaiser, and my graduate thesis committee including Drs. Kelly Brumbelow and Rick Giardino. I would also like to thank my colleagues at the Texas Department of Rural Affairs and the Texas Water Development Board for their insight during my tenure working on *colonia* issues for the Office of Rural Community Affairs, especially Steve Mendoza and Robb Stevenson. Thank you to the Texas Water Research Institute for its financial support of this research through the Mills Scholarship Program. Finally, I want to thank my lifelong partner and wife Jessie for her constant encouragement and support.

NOMENCLATURE

AMHI	Adjusted Household Median Income
BECC	Border Environment Cooperation Commission
BEIF	Border Environment Infrastructure Fund
CCN	Certificate of Convenience and Necessity
CDBG	Community Development Block Grant
CHIPS	Colonia Health Infrastructure Platting Status
DALYs	Disability Adjusted Life Years
DPT	Diptheria and Tetanus
EDAP	Economically Distressed Areas Program
EIA	Environmental Impact Assessment
HIA	Health Impact Assessment
HUD	Housing and Urban Development
IBNET	The International Benchmarking Network for Water and Sanitation Utilities
IO	Input-Output
MMR	Measles, Mumps and Rubella
MSR	Model Subdivision Rule
OAG	Texas Office of the Attorney General
OBH	Office of Border Health (Texas Department of Health)
OCI	Office of Colonia Initiatives
TDRA	Texas Department of Rural Affairs
PUB	Public Utility Board
NADB	North American Development Bank
NAFTA	North American Free Trade Agreement
SOS	Texas Office of the Secretary of State
SUD	Special Utility District
TAMU	Texas A&M University

TCEQ	Texas Commission on Environmental Quality
TDH	Texas Department of Health
TDHCA	Texas Department of Housing and Community Affairs
TWDB	Texas Water Development Board
US	United States of America
USDA-RD	United States Department of Agriculture – Rural Development
USDA-RUS	United States Department of Agriculture – Rural Utility Service
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
WSC	Water Supply Corporation
WWSP	Water and Wastewater Service Provider

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CHAPTER I
INTRODUCTION

Approximately 15 to 20 percent of Texas' border residents live in communities called "*colonias*." The term means "settlement" or "neighborhood" in Spanish, but is commonly used to refer to unincorporated rural and peri-urban subdivisions along Texas' border with Mexico (Olmstead 2004). These communities are generally characterized by a lack of physical infrastructure such as water and wastewater, storm drainage, and paved streets (Texas A&M University 2008). Infrastructure costs are high and these communities have weak political influence, lax land development regulations and the population simply cannot afford to pay the cost of utilities (Ward 1999). The absence of critical infrastructure continues to marginalize the residents of *colonias*, ensuring the persistence of related health problems and constrain economic productivity.

Since 1989, the United States Federal Government and the State of Texas have targeted water and wastewater infrastructure development spending in the *colonias* to improve access to safe, reliable and adequate water supplies and wastewater service. *Colonias* referred to in this report are located in Texas' Lower Rio Grande Valley in the counties of Cameron, Hidalgo, and Starr. These Texas counties have the highest density of *colonias* and have experienced some of the greatest amount of government financial assistance for water and wastewater infrastructure. This report analyzes the development activities of the four largest government *colonia* water and wastewater financial assistance programs. For the first time, this report examines all four sources of funding together. It describes where government spending is going, for what, and to whom, possibly challenging conventional understandings. Finally, the report provides recommendations for why this type of financing will be needed in the future and how the government could better measure the impact of this critical infrastructure to the *colonias*.[1]

This thesis follows the style of the *Journal of Environmental Planning and Management*.

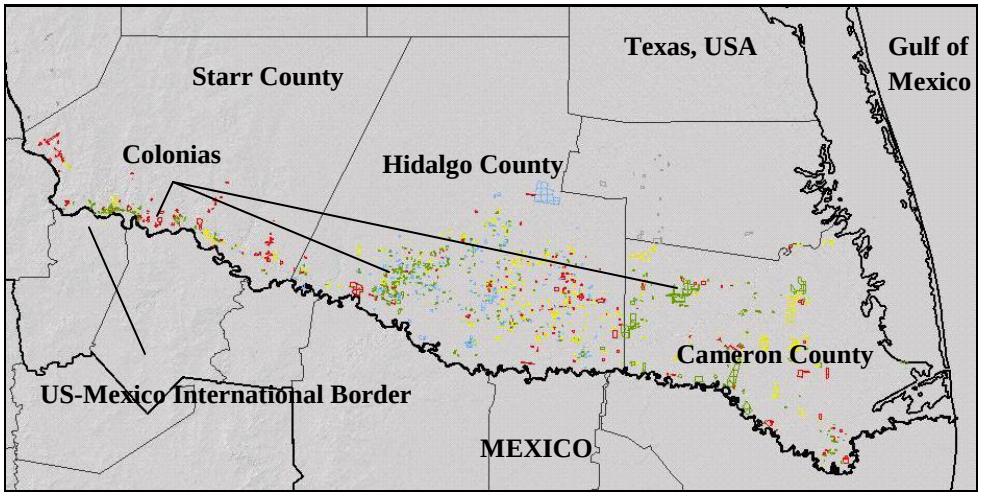

Figure 1. Map of Three County Study Area

Note: The map is courtesy of the USGS U.S. – Mexico Border Environmental Health Initiative Internet Mapping Service (USGS 2009). The identifiess the three county study area and generally identifies where colonias are distributed in the three counties. The labels are provided by the author of this report.

The Texas Colonias - History and Context

There is very little concrete data available to identify when *colonia* settlement began, but most researchers agree that some date back to at least the 1960's with the unprecedented growth in the manufacturing and agricultural sectors of the border's economy associated with the Mexican Border Industrial Program (Parcher and Humberson 2007). Thousands of people migrated to the border to work in the "maquiadoras", factories that operated on a duty- and tariff-free basis in Mexico. The *maquiadoras* imported equipment and parts from the US and assembled everything from garmets to automobiles for import back into the US. The industry grew more rapidly with the passage of the North American Free Trade Agreement (NAFTA). In addition, a large agricultural sector had grown along the Lower Rio Grande Valley where citrus, sugarcane, and other market produce dominated the landscape on the U.S. side of the border, requiring a large pool of unskilled labor. This led to a unique regional demographic interaction between the two countries with extensive cultural, political, social, and economic transborder interdependence (Peach and Williams 2003).

Colonias were said to appear almost overnight outside of the cities as land speculators sprang at the opportunity to service the demand for affordable housing by

purchasing and subdividing large tracts of cheap agriculturally-poor land. In fact, this land was often the poorest terrain with very little natural drainage, soil permeability, transportation access, or water supply. Whereas existing road networks and utilities (i.e. water, wastewater, electricity, gas) typically premeditate the rate and direction of growth in the US, this was not the case for the *colonias*, which had little or no infrastructure. Instead, *colonias* were planned to maximize the number of lots purchased from the original landowner. One example is Del Mar Heights *colonia* in Cameron county, in which a mere 300 acres of land were subdivided into 1,800 individual lots by the late 1970's (Davies and Holz 1992). In the absence of effective land-use controls, *colonias* proliferated up to 1990.

In the late 1980's, the media began to focus on the living conditions within the *colonias*. A public outcry prompted political action. From 1987 until 2005, every session of the Texas Legislature made changes to land development laws along the border to prevent and remediate future and existing *colonias* which are summarized in Table 1. In 1989, the 71st Texas Legislature passed Senate Bill 2. The landmark legislation more than any other Texas land development law restricted the future development of *colonias* in Texas. Under the new law, counties were required to adopt and enforce the Model Subdivision Rules (MSRs). MSRs dictate that new subdivisions of plots under five acres must provide water and wastewater infrastructure (OAG 2009, SOS 2009). The same bill also established the Economically Distressed Area Program (EDAP) administered by TWDB with substantial financial support for EDAP's budget from the United States Environmental Protection Agency (USEPA) (Parcher and Humberson 2007). Only counties adhering to MSRs would be eligible for this valuable source of funding (SOS 2009). A year later, the U.S. Congress also passed the Cranston-Gonzalez Affordable Housing Act. This legislation designated ten percent of all Housing and Urban Development (HUD), Community Development Block Grant (CDBG) funds obligated to the state of Texas CDBG program to be awarded to *colonia* development projects (TDRA 2009).

Table 1. Summary of Texas Laws Related to Colonia Water and Wastewater Infrastructure since 1987[1]

Legislative Session	Bill Number	Description
70th Session (1987)	Senate Bill (SB) 896	Plat recording required only city approval if the land was inside the city limits, both county and city approval for land outside the city but inside its extra-territorial jurisdiction (ETJ), and only county approval for land outside city ETJs.
	SB 408	Expanded ETJ's for cities with populations of 5,000 or more in border counties strictly for plat review and approval purposes. These cities were given five-mile ETJs. Expanded statewide prohibition against service to an unplatted lot by a WWSP owned, distributed, or controlled by affected city.
71st Session (1989)	SB 2	The first major Texas legislation directly addressing *colonias.* SB 2 set up the Texas Water Development Board's Economically Distressed Areas Program (TWDB-EDAP). Required recipients of state colonia funding to develop model subdivision rules (MSRs) to assure water and wastewater service to residential developments, and toughened platting requirements. Expanded the types of water and wastewater service providers (WWSPs) prohibited from providing services to lots in a subdivision not approved by a city. For border counties or counties receiving EDAP funds, the bill prohibited the provision of water and wastewater service to lots in a subdivision not approved by a county. The Texas Office of Attorney General gained enforcement authority over violations of the MSRs as well as new platting requirements.
72nd Session (1991)	SB 1189	Closed various loopholes in laws related to *colonias* prevention. For example, the model rules became applicable to residential developments with lots of five acres or less, rather than those with one acre or less. The law added a stipulation that a city or county could grant an exemption from the MSRs only if the city or county provided the subdivision with adequate water and wastewater service.
73rd Session (1993)	House Bill (HB) 2079	Stipulated MSRs provide criteria applicable to tracts divided into two or more parts but not properly platted before 9/1/1989**.**
74th Session (1995)	HB 1001	Revised county platting regulation in counties in the border region. Enhanced platting requirements. Limited the number of water and/or wastewater service connections per lot. Restricted the sale of all residential lots lacking water and wastewater. These applied in counties within 50 miles of the border having high unemployment and low per capita income.
75th Session (1997)	SB 1512	Created a "hardship" exception. Relaxed prohibitions against providing water and wastewater services to lots not platted or lacking water and wastewater service. Allowed a WWSP already serving one lot in a subdivision to serve other lots sold before July 1, 1995, on which home construction was begun by 5/ 1/1997.
76th Session (1999)	SB 1421	Expanded the applicability of the special county platting laws and other requirements in Subchapter B of Chapter 232 of the Local Government Code. Beginning 9/1/1999, Subchapter B applies to any subdivision of two or more residential lots located anywhere outside city limits in any of the 28 counties having some part within 50 miles of the border. Created a "hardship" exception to the general prohibition of water and/or wastewater service connections to lots not platted or lacking water and wastewater; allowing local governments to issue WWSP certificates based upon availability of water service. Gave TWDB jurisdiction over the preparing and adoption of the MSRs. Created a state "Colonia Initiatives Coordinator" to help coordinate *colonias*-related efforts of state and local governments.
77th Session (2001)	SB873	Granted broad powers to county commissioner courts to regulate subdivisions outside city limits in very populous counties and applicable to the study in Cameron and Hidalgo Counties, but not Starr County. These new county powers are similar to the controls that cities can exercise over subdivisions within their ETJs.
	SB 312 SB 649	Expanded a number of *colonia*-related programs under various state agencies**.** Required the creation of a Colonia Initiatives Advisory Committee. Created the TWDB Colonia Self-Help Program. Required training for applicants and recipients of EDAP assistance.
	SJR 37	Proposed a constitutional amendment (approved by Texas voters on 11/ 6/2001) to provide roads to connect border *colonias* with existing public roads.
78th Session (2001)	HB 1875	Allowed the rural water assistance fund to be used to provide low interest loans to rural political subdivisions for water or water related projects and for water quality enhancement projects. Allowed the rural water assistance fund to be used to enable a rural political subdivision to obtain water or wastewater service supplied by larger political subdivisions or to finance the consolidation or regionalizing of neighboring political subdivisions.

Table 1. Continued.

Legislative Session	Bill Number	Description
79th Session (2005)	SB 827	Required the Office of the Secretary of State (SOS) to establish and maintain a statewide classification system to track state-funded projects related to water/wastewater, road paving and other assistance to colonias. It will require the colonias ombudsmen, Office of Rural Community Affairs[2], the TWDB, the Transportation Commission, the Department of Housing and Community Affairs, the Department of State Health Services, and/or any other appropriate agency as determined by the SOS to report information to the SOS for the classification system and the SOS to compile and report this information to the legislature by December 1 of each even-numbered year. The classification system includes only counties within 62 miles of an international border.
	SB 1202	Increased the number of agencies involved with colonia initiatives and requires the State-designated coordinator, the SOS, to work collectively with these agencies on future colonia projects. Each agency is to designate a representative who will act as liaison between the coordinator and the agency and advise the coordinator during colonia projects. The coordinator is to also work with the colonia resident advisory committee in developing strategies and recommendations for colonia initiatives.
	SB 425	Amended the Local Government, Government and Water Codes so that a county that is located within 100 miles of an international border containing a city with a population of more than 250,000 can: a) prevent future substandard residential subdivisions from developing, b) receive the assistance of the SOS Colonia Ombudsman Program , and c) be eligible for EDAP Funds
	HB 467	Authorized any city, county or EDAP applicant in the state that applies for EDAP assistance to enforce the MSRs. Redefines "economically distressed area" and "political subdivision" by removing the requirement that the county have an average per capita income that is at least 25 percent below the state average for the most recent three consecutive years. Redefines term "affected county" to be a county that has an economically distressed area which has a median household income that is not greater than 75 percent of the median state household income.

1) The laws compiled in this table cover only those laws preceding the study period and up to the 79th Texas Legislative session since laws passed under the 80th Texas Legislative session (2007) would of come into affect after the end of the study period of this report (2006). Laws not applicable to water and wastewater infrastructure or service connections such statutory redefinition of rights and protections under contract-for-deed have been omitted. 2) The Office of Community Affairs was renamed the Texas Department of Rural Affairs in 2009. This office/department administers the Texas Community Development Block Grant Program.

Physical, Social, and Economic Characteristics

There was a fundamental yearning for single-family home ownership in the United States, which represented true success and independence for these immigrants: "the American Dream." Some *colonia* residents have even said that, "no matter how bad living conditions are in the *colonias*, it is still better than living in Mexico" (Davies and Holz 1992). Developers sold diminutive lots, typically 50' X 120' and often smaller, with only the promise of future service provision. *Colonia* residents frequently purchased these lots under "contract-for-deed" with low down payments and low monthly payments in which the developer retained the deed to the land until the debt was repaid in full. Default on such a loan typically meant a total loss of investment on the part of the resident if they missed a payment. The developer would then sell the same lot and any improvements thereon to a new buyer under the same terms (Parcher and Humberson 2007). This exploitation is particularly tragic considering the degree to which *colonia* residents invested in their property. Through "sweat equity", residents often replaced handmade shacks with mobile homes or more traditional stick-built homes when they had saved enough money. More economically successful residents expanded their homes, building solid frame brick structrues.

The *colonias* are dominated by a young population of almost 100 percent Hispanic ethnicity. *Colonia* residents are predominately considered the working poor, generating income via employment or small, self-run, businesses (Davies and Holz 1992). In the three evaluated counties, poverty rates are among the highest in Texas and, in some cases, the United States. 2000 Census poverty data illustrates this point. Of Texas' 254 counties, the three counties included in this report represent the poorest, Starr County at 36.4 percent, the third poorest, Hidalgo County at 31 percent, and the seventh poorest, Cameron County, at 29.6 percent (TDRA 2009). These poverty figures are startlingly higher than the state's average poverty rate of 16.2 percent. The 2000 Office of Border Health (OBH) survey stated that only 31 percent of *colonia* residents reported having a high school diploma and the official unemployement rate was 18 percent, not taking into account that many *colonia* residents' work is seasonal. The numbers for *non-*

colonia residents of the same counties equated to 55 percent for those with a high school diploma and an unemployment rate of 11 percent (TDH 2000).

Public Health

The increase in population and housing density during the rapid growth of the 1980s exacerbated basic infrastructure inadequacies, resulting in a growing public health crisis fomenting within the borders of the wealthiest countries in the world. Poverty, no matter where it is, moves in the same downward spiral of unmet health or safety needs often leading to decreases in daily productivity, education levels, and even life expectancy. These health risks include the same waterborne diseases that kill approximately 1.7 million people worldwide every year (Millennium Ecosystem Assessment 2005).

According to the Center for Disease Control and Prevention (CDC), infectious disease morbidity rates along the US-Mexico border region in 1997 were substantially higher when compared to non-border regions. Hepititis A, which occurs more commonly in areas with poor sanitation, had a morbidity rate three times higher in border regions. Studies have linked elevated independent risk for hepititis A infection directly with residence in colonias (Leach *et al.* 1999). Other waterborne illness such as cholera and dysentery had rates over twice as high in border regions as compared to non-border regions. The CDC also reported that childhood diseases preventable by MMR and DPT vaccines occurred at nearly twice the incidence in border states. The CDC further stated that improved santitation and public health infrastructure (i.e. water and wastewater systems) is necessary to address these problems (Doyle and Bryan 2000).

More specific survey data published in 2000 by the OBH of randomly-selected border households including *colonias* in Cameron and Hidalgo counties found significant water and sanitation-related illnesses among *colonia* residents as compared to non-residents. Tuberculosis infection was nearly twice as frequent along the border. *Colonia* residents were more likely to suffer from hepatitis A, salmonellosis, dysentery, and cholera than residents of Texas as a whole. In an environment in which people were regularly exposed to raw fecal matter, transmission rates were high. The OBH survey

found that children residing in *colonias* aged one to five were nearly twice as likely to have recently suffered from diarrhea than non-residents. Such illnesses interfered with education and had a detrimental impact on children's' growth and development, according to the report (TDH 2000).

The survey also found that while 98 percent of households (both *colonia* and *non-colonia*) reported a water connection, 41 percent of *colonia* respondents got their drinking water from other sources such as water vendors and wells. In its analysis, the OBH recommended broader assessment of the reasons why *colonia* residents did not drink the available tap water as well as the need for sanitation education about the dangers of storing water without adequate chlorination. Such water sources were a breeding ground for the bacteria and parasites responsible for higher illness rates. The OBH concludes that:

> Not only do residents of *colonias* represent a substantial proportion of the total border population (approximately 20 percent), but also due to a history of poor infrastructure and public services they were potentially at greater risk of disease and exposure to environmental contaminants (TDH 2000).

These crippling diseases are both treatable and preventable, making their prevalence that much more tragic. *Colonia* populations were under-informed about the direct link between poor sanitation and certain diseases. The shortage of primary care providers in the *colonias* meant residents were forced to travel long distances to attain healthcare. It is highly likely that actual health problems were greatly under-reported simply because many *colonia* residents, uninsured and fearful of lost wages, were unable to afford proper healthcare and therefore did not seek it out (SOS 2006).

The causal relationship between clean water and improved public health is well-established in published literature. One study found that clean water was responsible for reducing the mortality rate by half in major cities in the early 20th century. Clean water was also responsible for three quarters of infant mortality reduction and two thirds of child mortality reduction. The drastic declines in typhoid fever on a national level between 1905 and 1915 can be directly linked to water treatment technologies that introduced water filtration and chlorination. The same study calculated the saved cost

per person, per year from the availability of clean water was an estimated $500 in 2003 dollars. These cost savings from preventable annual deaths as a result of water disinfection translated to a social rate of return of approximately $160 billion (Culter and Miller 2005). Although the social rate of return based on government spending in water and wastewater infrastructure in *colonias* is not the focus of this report, the value of an econometric analysis of this type is considered at the end of the report.

The elevated preventable disease rates in the colonias combined with inadequate water and wastewater services is a reminder that, while most Americans enjoy the benefits of the well-managed infrastructure introduced more than a century ago, the health and well-being of marginalized populations continue to remain far below the greater population. It is easy to talk about household wastewater connections, pumping capacity, linear feet of pipe, and water rates without considering the *reasons* for such improvements.

Water and Wastewater Access

In 2007, the Colonia Health, Infrastructure and Platting Status or "CHIPS" tool study found that approximately 31.5 percent of Hidalgo County's *colonias* were still without either adequate potable water supplies or wastewater disposal. Starr County followed with a rate of water and wastewater inadequacy of 24.3 percent, while Cameron ranks lowest at 9.7 percent. It is not surprising that these *colonias* are located further from urban areas and their respective water and wastewater systems. The cost to extend existing systems or to construct stand alone systems is substantial (Parcher and Humberson 2007). However, densely populated *colonias* in Cameron County (i.e. Valle Hermosa and Valle Hermoso) are relatively close to large nearby systems operated by the Brownsville Public Utility Board, yet remained underserved.

Some residents of areas without access to piped water services resorted to collecting water from shallow wells despite the high occurance of groundwater contamination by pesticides, fertilizers, and fecal coliform. Still more relied on alternative water providers, paying exorbitant fees for a basic commodity. For instance, it was common for water to be hauled into *colonias* by tanker trucks then stored in

potentially contaminated 50 gallon drums. The charge for such a service in 1988 was approximately $22 per 1,000 gallons (Olmstead 2004). Currently, many residents get their drinking water from sources such as nearby Watermill Express® machines for an average price of $0.35 a gallon, while the municipal utility district prices are $11.50 for up to 3,000 gallons and $2.50 for every 1,000 gallons thereafter (City of Rio Grande City 2009). When priced out of clean drinking water, the enormous public health cost of not having access to clean drinking water is undeniable (Davies and Holz 1992).

In 1996, the Texas Water Development Board (TWDB) surveyed a sample of *colonia* residents in Cameron and Hidalgo counties and found that 94.1 and 99.9 percent of *colonia* residents were without wastewater service, respectively (Carter and Ortolano 2004). Without connection to sewerage systems, whether on-site or piped, the majority of *colonia* residents resorted to the use of cesspools, outhouses, or poorly-installed septic tanks (TDH 1988). Small lot sizes, flooding, shallow water tables, and disfunctional septic tanks contributed heavily to both groundwater and surface water contamination. In many *colonias*, piped water service was introduced, but not wastewater service. Water Supply Corporations (WSCs) in particular may have not had the legal or financial capacity to provide wastewater service despite providing water service (Carter and Ortolano 2004, Olmstead 2004). Sanitation and the significant cost to install a septic tank and drain-field was largely considered a household's responsibility. Even when wastewater systems were introduced early on, households themselves were responsible for connecting to the pubic wastewater service, which was too costly for most *colonia* households (Olmstead 2004).

Another barrier to individual connections was the stipulation that the structure to be connected be up to code. Many homes were built without indoor bathrooms or plumbing, and were therefore identified as substandard or dilapidated by housing inspectors. Residents found themselves in a "Catch-22" situation in which they could not afford to bring their homes up to code and, as a result, could not qualify for hook-up to wastewater lines, which was a code violation (SOS 2006). Rather than incur the

expense of connecting, many *colonia* residents went without any type of wastewater system or continued to use inadequate on-site septic facilities.

Note

The data in this report reflects only publically-available information from the Secretary of State, USGS CHIPS, and TDH as well as the four funding sources themselves for the years 1996 through 2006. This period of time reflects the years in which all programs were both established and relatively stable. The data on the number and population of c*olonias* used in this report comes from the 2006 CHIPS report due to unreliable census information for 1996- 2006. The reported funding is actual expenditures on completed projects during the time-period to help maintain homogeneity rather than obligated funding or funding of incomplete projects.

CHAPTER II

WATER AND WASTEWATER SERVICE PROVIDERS IN THE COLONIAS

Texas' water service is highly decentralized and complex. In general, Texas water providers can be broken into two basic categories: public and private. The public providers include municipal systems, county systems, general, and special, legislatively or TCEQ-created water districts. These providers have the authority to tax, to issue bonds, and the power of eminent domain. Municipalities regulate their own water rates, but the rates of other public providers are regulated by TCEQ. As will be discussed later in the analysis, municipalities receive a higher percentage of loans (TCEQ 2004). This is most likely due to the inherent fiscal security of a system that can issue debt on a broader revenue base, i.e. taxes (Olmstead 2004). Some of the largest public water service providers in Cameron, Hidalgo, and Starr counties that received government financing for water and wastewater infrastructure improvements from 1996 to 2006 include the cities of Harlingen, McAllen, Weslaco, and the Brownsville PUB.

Private providers include for-profit and non-profit Water Supply Corporations (WSCs). They do not have any of the authorities of public providers, they are typically member owned and their only task is to provide water and wastewater services. WSCs are able to access financing through market loans and the government, but cannot tax or issues bonds. WSCs themselves set the rates for service. While a WSC has the legal responsibility to respond requests for service connections, they are only required to calculate the cost (TCEQ 2009). If the potential customer cannot afford the rates, the WSC is not obligated to provide the service. The rates are reviewed by TCEQ only when appealed by a customer (TCEQ 2004).

A water supplier's area of service is designated when it obtains a Certificate of Convenience and Necessity (CCN) from Texas Commission on Environmental Quality (TCEQ). This CCN essentially grants the water and/or wastewater service provider (WWSP) a monopoly within that service area, though universal service coverage within that defined CCN is not required by law and not all residents live within an area covered by a CCN. Water providers, with TCEQ approval, can "trade" CCNs as well as expand

their jurisdiction if they can prove that a competing provider is not meeting the needs of the consumer (Texas Water Code Chapter 13, "Water Rates and Services" Sec. 13.246). Many *colonias* are located in areas that are not within any WWSP's CCN boundaries or in many instances *colonias* are within one WWSP's boundaries, but are not receiving services.

Past studies have shown that the vast majority of *colonias* are serviced by WSCs, but this situation is shifting rapidly as expanding municipal systems overtake service areas once exclusive to WSCs. In fact, TWDB, in some cases, assisted municipalities in the aquisition of WSC facilities (Olmstead 2004). One concern about such expansion is *colonia* residents' limited ability to effectively participate in municipal system rate-setting, since the colonias still remain outside of the city-limits. To illustrate the types of WWSPs whether private, non-profit, for-profit, or public a few examples are given to show the variation characteristics of WWSPs and the type and amounts of government assistance they received between 1996 and 2006 in the Lower Rio Grande Valley.

Although these government grants and loans have reduced the high capital costs to install new water and wastewater infrastructure, local water utilities are typically responsible for the continued operation and management of the systems. Operation and maintenance of these systems are particularly challenging to water utilities because the price of water service must remain affordable to the *colonias* residents. The limited ability to pay water bills results in low revenue and shortfalls that affect the utilities' financial, managerial and technical capacity to provide sustainable service. Setting the price of water and wastewater services for *colonia* customers is a delicate endeavor. If the cost of water is too low, the utilities don't earn enough revenue. If it's too high, it is a burden on the customer's ability to pay. This paradox is a serious concern for policymakers and WWSP managers alike and will be revisited in this report.

Characteristics of the WWSPs Evaluated

Government assistance for water and wastewater infrastructure to serve *colonias* in Cameron, Hidalgo, and Starr counties was spent on 27 individual WWSPs including 19 municipalities and 8 WSCs. In Table 2, this report highlights some select

Table 2. Water and Wastewater Service (WWSP) Characteristics

WWSP Name	County	Number of Water Connections	Estimated Population Served	Raw Water Supply Source Type	Total Production / Purchase Volume (MGD)	Average Daily Consumption (MGD)	Number of Colonia Infrastructure Projects 1996-2006	Value of Projects 1996-2006
Municipalities (19)								
Brownsville PUB	Cameron	58,074	172,437	SW/GW	40.018	20.550	2	$6,952,218
City of Alamo	Hidalgo	4,572	14,760	SW	5.000	2.195	1	$500,000
City of Donna	Hidalgo	4,200	15,000	SW	5.500	2.287	3	$9,435,516
City of Edinburg	Hidalgo	20,268	55,021	SW	10.483	9.016	2	$10,975,007
City of Harlingen	Cameron	22,569	79,000	SW	38.579	15.074	3	$8,481,097
City of La Grulla	Starr	2,231	6,693	SW	2.016	0.850	1	$112,027
City of Mercedes	Hidalgo	3,806	14,185	SW/GW	6.138	1.447	1	$2,770,975
City of McAllen	Hidalgo	47,020	141,060	SW	47.389	31.265	3	$5,835,345
City of Mission	Hidalgo	25,090	45,408	SW	19.852	13.143	1	$250,000
City of Pharr	Hidalgo	15,081	46,660	SW	13.132	5.310	2	$414,274
City of Primera[2]	Cameron	1,053	2,723	SW	1.224	0.320	1	$10,264,824
City of Rio Grande City	Starr	4,680	14,040	SW	8.208	2.949	4	$2,117,045
City of Rio Hondo	Cameron	923	2,200	SW	0.781	0.397	1	$514,916
City of Roma	Starr	5,946	17,839	SW	7.075	1.874	1	$500,000
City of San Benito	Cameron	6,200	26,000	SW	5.984	4.179	1	$2,228,396
City of San Juan	Hidalgo	4,980	30,000	GW/SW	2.135	5.004	1	$10,843,757
City of Santa Rosa	Cameron	750	2,833	SW	1.000	0.236	1	$3,200,000
City of Weslaco	Hidalgo	9,014	28,111	SW	8.159	5.580	2	$9,673,052
Town of Combes[2]	Cameron	704	2,800	SW	0.864	0.187	1	$6,610,638
Sub-Total		237,161	716,770		223.537	121.863	32	$91,679,086
WSCs (8)								
East Rio Hondo WSC	Cameron	6,332	18,996	SW	3.361	2.130	1	$1,048,800
El Jardin WSC	Cameron	3,343	10,029	SW	5.832*	1.000	3	$814,368
La Joya WSC/Agua SUD[1]	Hidalgo	13,249	39,747	SW	6.636	4.939	1	$170,670
Military Highway WSC	Cameron/Hidalgo	8,670	26,010	SW	7.740	2.750	20	$15,562,978
North Alamo WSC	Cameron/Hidalgo	31,813	94,592	SW/GW	24.353	18.959	20	$24,165,710
Olmito WSC	Cameron	1,546	5,870	SW	1.093	0.703	6	$8,496,085
Sharyland WSC/City of Alton[3]	Hidalgo	15,603	46,809	SW	14.463	8.150	8	$6,871,799
Union WSC	Starr	1,693	4,854	SW	1.500	0.603	3	$9,099,100
Sub-Total		82,249	246,907		64.978	39.234	62	$66,229,510
Total (27)		319,410	963,677		282.683	161.097	94	$157,908,595

1) The La Joya WSC converted to Agua Special Utility District after the project period in which it received government assistance. 2) The municipal systems of Primera and Combes purchase wholesale treated water and do not have their own raw water supply sources or treatment capacity. 3) Services to the City of Alton are provided by Sharyland WSC, but project funding came through the city.

characteristics of these WWSPs in terms of the number of population served, their treated water production capacity and consumption (system-wide) and the number and amount of government spending from the four major funding sources between 1996 and 2006. Although no breakdown of *colonia* versus *non-colonia* customers is available in the literature or data, loan and grant data indicates that *colonia* water and wastewater projects in municipalities outnumbered projects in WSC by a factor greater than two. Municipalities are represented by both the largest WWSPs in the three counties and by the smallest in number of connections. The same held true of the WSC recipients with WSCs like North Alamo WSC receiving the highest amount of spending in comparison with dramatically less spending in significantly smaller WSCs like El Jardin WSC. Even then, spending was often not in proportion to the size of many municipalities and WSCs.

Water Supply

A concern for all water managers is whether or not water supplies remain productive despite increased demand. There is a significant strain on availability and sufficiency of water supplies in South Texas, especially as competing demands increase and water becomes ever more scarce upstream and downstream on the Rio Grande and Nueces Rivers. Complicating matters is the transboundary nature of the Rio Grande, which WWSPs rely on for virtually all of their water supply. The Rio Grande is both transboundary in an interstate sense with the states of New Mexico and Colorado trying to satisfy their own water supply needs, but also internationally as the Rio Grande and some of its major tributaries meets the water supply needs of much of Northern Mexico.

The TWDB studied the socioeconomic impacts of unmet water needs in the Rio Grande Planning area, which covers eight border counties from Maverick County down the Rio Grande River to Cameron County including Jim Hogg and Willacy counties (Norvell and Kluge 2005). The analysis studied the demands and unmet demands based on water availability and demographic forecasts from 2010 until 2060. According to the developed impact models, the Lower Rio Grande region, including the counties evaluated in this report, had estimated population losses above 50,000 due to unmet

water needs. In addition, there were considerable impacts of this unavailability on several key economic sectors including agriculture, livestock, steam-electric, municipal, and industrial demands (Norvell and Kluge 2005).

The authors of the study state that this type of economic analysis, while good for forecasting unmet needs in large economic sectors such as the agriculture sector, are not well suited to measure the impacts on other domestic uses or household well-being, whether economic or health-related (Norvell and Kluge 2005). Although methods to better assess these impacts were not the central issue of this report, they are briefly reviewed in chapter IV.

The WWSPs discussed in this report appear to have adequate access to water supplies to be able to meet both the volume and production needs of their colonia customers assuming average consumption and usage. As population and demand continue to increase, several WWSPs will need to consider acquiring additional water supplies either through increased productivity, conservation, or direct access (purchase or right). Project level data did not detail whether water supply improvements to increase or conserve water were included, therefore this aspect was not analyzed in this report.

Federal and State Assistance to the Texas Colonias

Improving the environmental problems that impact water and wastewater along the US-Mexico border is a daunting task. In 1992, the TWDB conducted a needs survey in order to estimate the preliminary costs for introducing and improving water and wastewater services in the *colonias*. The total was calculated at $696 million in 1992 dollars. This was divided into $467.3 million for wastewater service and $147.9 million for water service (Carter and Ortolano 2004). Since 2002, construction costs have skyrocketed. As a result, many projects designed to improve the water and wastewater infrastructure in the *colonias* are substantially delayed or scaled back.

The four funding sources/programs covered in this report are the TWDB, the U.S. Department of Agriculture's Rural Development (USDA-RD), TxCDBG Program funding provided by the Texas Department of Housing and Community Affairs

(TDHCA), which now is adminsistered by the Texas Department of Rural Affairs (TDRA) formerly called the Office of Rural Community Affairs (2001-2009), and the North American Development Bank (NADB 2008). These organizations represent the largest public-sector financing source for *colonia* water and wastewater infrastructure improvements.

The Texas Water Development Board – Economically Distressed Areas Program

The TWDB's Economically Distressed Areas Program (EDAP) established in 1989 provides grants and low interest loans for the purpose of providing adequate water and wastewater services in the *colonias*. A total of $550 Million was allocated to the program. To be eligible for EDAP funding a *colonia* was required to have: inadequate water and/or wastewater systems that do not meet minimal state standards, inadequate financial resources to provide water and wastewater service to those in need, and have been established prior to the establishment of EDAP or June 1, 1989 (TWDB 2006).

Prior to 2006, EDAP funding was directed towards counties located along the Texas-Mexico border and select far southeast Texas counties.[1] Counties located in these areas must meet certain adjusted household median income (AMHI) levels to become EDAP counties. Once a county was identified as an EDAP county, EDAP funding is directed toward *colonias* or "*colonia*-like" communities without adequate water and wastewater infrastructure. In 2007, a state-wide constitutional referendum granted the EDAP program up to an additional $250 million in general obligation bonds to fund the EDAP program (TWDB 2008b). This allocation was due in part to the recognition that *colonia*-like communities were more numerous and geographically widespread than previously thought. With this allocation, the TWDB could effectively fund *colonia* water and wastewater improvements for up to another 20 years (Carter and Ortolano 2004, TWDB 2008b).

Some researchers have said that the performance of the EDAP program has been inconsistent. Before 1997, TWDB had few incentives to oversee and improve upon EDAP's performance. TWDB received lump-sum funding from the State for EDAP and was not required to provide the legislature with progress reviews (Carter and Ortolano

2004). TWDB also had no interaction and therefore little direct accountability to *colonia* residents. Another contributing factor was the fact that the public attention had shifted away from *colonias* by the mid- 1990's. EDAP was equally neglected by the USEPA, which provided only one staff member who dedicated only 10 percent of their time to *colonia* oversight (Carter and Ortolano 2004). The tide shifted in 1998 as the media turned the spotlight on the state's poor performance in responding to the needs of the *colonias*. Staff and administrative changes were made and project completion rates saw dramatic improvements. Between 1994 and 1997, nine EDAP projects were completed. From 1998 to 2002, thirty projects were completed (TWDB 2002). The 1998 establishment of the Colonia Initiatives Program gave priority to household connections for EDAP projects. By 2002, 96 percent of residents in *colonias* with completed EDAP-funded systems for water and wastewater had household connections. This success was due in great part to the negotiations that allowed use of federal funds for individual household connections to EDAP projects (Carter and Ortolano 2004).

The money didn't always target the intended recipients. Seeing an opportunity, some municipalities applied for EDAP grants in order to service projected growth corridors within their municipality and many were approved because they also coincidentally served nearby *colonias*. One example is the city of Edinburgh in Hidalgo County, which received an EDAP grant to provide water and wastewater service to 26 *colonias* while also bringing the same services to a new state prison. The prison portion of the project was completed in 18 months. The *colonia* portion took more than seven years (Carter and Ortolano, 2004). Since 2002, the EDAP program has recognized that the needs of the *colonias* far exceeded the remaining EDAP funding.

The United States Department of Agriculture – Rural Development

The United States Department of Agriculture – Rural Development (USDA-RD) provides water and waste disposal loans, guaranteed loans, and grants to communities with populations less than 10,000 and rural areas with no population limits and is administered through the Water and Environmental Program (WEP). Eligibility for this funding is restricted to organizations such as municipalities, counties, special utility

districts and non-profit water supply corporations (USDA-RUS 2003). In general, USDA-RD's terms for funding were slightly better than those offered by the EDAP program, and in the 1990s were the most generous of all governmental financial assistance available to water districts extending services to *colonias*.

Like other governmental financial assistance, USDA-RD funding can be used for construction, repairs, modifications, acquisition, engineering, and other improvements to water and wastewater systems. Grants may cover up to 75 percent of eligible facility costs and direct loans are set aside for *colonias*. This assistance includes direct funding to individual households for indoor plumbing installation and other costs associated with connecting to a water and wastewater system.

Beyond financial assistance for infrastructure, USDA-RD also provides technical assistance and training grants to improve the financial, managerial, and technical operations of water systems. These grants can also be used to prepare funding applications for water and wastewater facility construction projects (USDA-RUS 2003). According to its own assessment, USDA-RD's level of monetary assistance has benefited the most people of the four major sources of governmental financial assistance reviewed by this report (USDA-RD 2008).

Texas Community Development Block Grants Program

The Texas Community Development Block Grant Program (TxCDBG Program) was initiated when the U.S. Department of Housing and Urban Development (HUD) began giving block grants directly to the states. The Texas CDBG Program is the largest in the nation and focuses most of its funding on improvements to water and wastewater infrastructure in Texas' rural areas (TDRA 2009). As previously stated, the passage of the Cranston-Gonzalez National Affordable Housing Act into federal law required the TxCDBG Program to set aside 10 percent of its annual allocation for *colonias* in existence prior to November 28, 1990 (ORCA 2005). The TxCDBG Program provides grants under several funds for water and wastewater improvements including the Colonia Construction Fund, the Community Development Fund, and the Colonia Economically Distressed Areas Program.

In general, only counties within 150 miles of the Texas-Mexico border are eligible to apply on behalf of the *colonias* within their unincorporated jurisdictions. Some of the TxCDBG Program's grants are competitive, but others are designed to work closely with *colonia* funding agencies.

In many instances, the TxCDBG Program coordinates its *colonia* funding activities with the other major state and federal *colonia* funding agencies such as the TWDB, USDA-RD, and the North American Development Bank which, along with TDRA, fall under the umbrella of the Texas Secretary of State's Office of Colonia Initiatives *colonia* coordination group. Further, the TxCDBG retains close ties with the Texas Department of Housing and Community Affairs *colonia* programs because of pass-thru funding provided to this department by the TxCDBG Colonia Self-Help Program.

North American Development Bank

The U.S. Treasury Department created The North American Development Bank (NADB) in 1993 as a response to bi-lateral development of the Mexico-US border with the passage of the North American Free-Trade Agreement (NAFTA). Financed with equal commitments from the federal governments of the United States and Mexico, the total authorized capital of the program is $3 billion. The NADB established the Border Environment Infrastructure Fund (BEIF) to help finance the construction of water and wastewater infrastructure on both sides of the border. The USEPA provides funding to NADB's BEIF in the form of grants. These grants, combined with loans and other sources of financing, are meant to make improvements to water and wastewater infrastructure affordable for the border communities (NADB 2008).

Communities eligible for the BEIF are located within 62 miles or 100 km of the US-Mexico border. Prior to the receipt of funding, projects must be certified by the Border Environment Cooperation Commission (BECC). NADB has a unique approach to determining financial assistance need in that it assesses a community's ability to afford the cost of any proposed improvements. An affordability analysis determines project eligibility by calculating the ratio of a project's costs as a percentage of local

median household income. In some cases, communities are asked to raise their rates by reasonable margins to ensure the cost of operating and the revenues from monthly water and wastewater rate charges cover maintaining the system (with the improvements).

In order to receive funding, *colonias* must provide proof of zoning ordinance enforcement which prevents further *colonia* expansion without infrastructure. Grants are issued on a competitive basis, with priority given to projects which benefit both sides of the border. NADB also gives priority to projects which have exhausted their funding from other sources. BEIF funds, once granted, must first be used for transition assistance. Transition assistance grants help pay the system debt for up to seven years, thereby allowing user fees to rise gradually until the system becomes self-sustaining. If the user fees are unaffordable for the community, construction assistance can be applied towards the final cost of system construction including household connections. Most projects utilize a combination of transition assistance and construction assistance (NADB 2009).

Note

In 2005, the 79th Texas Legislature in House Bill 467 redefined "economically distressed area" and "political subdivision" by removing the requirement that the county have an average per capita income that is at least 25 percent below the state average for the most recent three consecutive years. Redefines term "affected county" to be a county that has an economically distressed area which has a median household income that is not greater than 75 percent of the median state household income. This change allowed counties with unincorporated areas characterized as non-colonias to apply for TWDB-EDAP funds if eligible.

CHAPTER III
OUTPUTS AND COMPARISONS OF GOVERNMENT ASSISTANCE

Cameron, Hidalgo, and Starr counties were selected for analysis. These counties have some of the highest number of *colonias* in the state (SOS 2006). The Colonia Health Infrastructure Platting Status or "CHIPS" tool was the first to comprehensively identify Texas' *colonias* in 2007. The study indicated that 178 *colonias* or 10 percent of the total number of *colonias* in the state are found in Cameron county. Starr County has a total of 236 *colonias* or 13.2 percent of State *colonias* and Hidalgo County has the highest number in the state with a total of 934 *colonias* or 52.3 percent (see Table 3). They represent not only some of the highest *colonia* populations, but also the poorest with least access to improved water and wastewater systems. The fourth source of funding, NADB, only provided financing to three projects in Cameron and Hidalgo.

Data Sources

This report covers ongoing and completed projects between 1996 and 2006. During this ten year timeframe, all four funding sources were actively financing projects. The report relies upon actual spending rather than obligated funding. Obligated funding may or may not have been spent. This targeted scope focuses on projects that fulfilled the project scope of work to improve water and wastewater infrastructure and services to *colonia* households. The data on the number and population of *colonias* used in this report comes from the 2007 CHIPS report due to unreliable or nonexistent census information for 1996 through 2006.

Data in this report is from publicly-available information at the Texas Office of the Secretary of State (SOS), USGS CHIPS, and the Department of Health (TDH) as well as the four funding agencies themselves (ORCA 2008, TWDB 2008a, USDA-RD 2008, NADB 2009). There are certain limitations inherent to this type of data collection. The information is self-reported and each agency has a vested interest in presenting positive outcomes in the literature. As previously mentioned, each organization also has a unique methodology of counting the beneficiaries of their projects, therefore it is likely that double-counting may have taken place in some circumstances. It should also be

noted that the data from TDH concerning specific health conditions reflects the entire county, not just the *colonias*.

Table 3. General Characteristics by County

	Cameron	Hidalgo	Starr
County Pop. (2000)[1]	108,874	202,572	21,644
Est. *Colonia* Pop. (2007)[1]	46,170	156,434	34,742
No. of *Colonias*[2]	178	934	236
Poverty Rate (2000)[3]	29.6%	31%	36.4%
Waterborne Disease Rates[4]	12.1	11.1	6.6
Water / Wastewater Access[2]	90.3	68.5	74.7

1) SOS 2006; 2) CHIPS, 2007; 3) Includes only unincorporated areas, U.S. Census; 4) 1992-2006 ten year average for amebiasis, campylobacteriosis, salmonellosis, shigellosis, and hepatitis A,B,C, and unspecified, CHIPS, 2007.

All data used for this report is public information that was printed out by each funding source at the request of the author. In general, this is summary project data that did not breakdown information into specific project details such as detailed budgets or specific improvements made except in the case of the CDBG data. Therefore, spending amounts in each project could not be calculated for water versus wastewater spending as well as spending attributable to specific *colonia* areas or WWSPs when multiple colonias and multiple WWSPs were included in one project. In these cases, spending was divided evenly between the multiple recipients and activities. In particular, data on the improvements in each *colonia* was highly varied with some funding sources in some years recording all the improvements made in each colonia and other funding sources that did not indicate even the names of *colonias* in which spending occured.

This report broke down data by the four government funding sources into categories representing CDBG, TWDB, USDA-RD, and NADB (ORCA 2008, TWDB 2008, USDA-RD 2008, NADB 2009). Within these categories, funding sources were analyzed based on general characteristics, the types of activities funded, and whether or not those activities included the funding of treatment improvements. This report also analyzed each funding source's spending in each of the three target counties (Cameron, Hidalgo, and Starr) as well as spending allocated to both types of water service provider receiving the funding (WSCs and municipalities).

Analysis by Funding Source

TWDB topped the funding sources in grants as well as loans and on average spent more per project and more per capita than any of the other funding sources. The most notable results of the anlaysis indicated that the TWDB spent the most (70 percent) on water and wastewater infrastructure improvements of the other three funding sources. The TWDB spending in Hidalgo was just under $68 million, which was more than three times the total spending of the other three funding sources combined. This pattern held true in Cameron County where the TWDB spent about $41 million spent and the runner-up USDA-RD spending close to $9.4 million. Interestingly, the county with the highest poverty rate received the least amount of funding from all four funding sources. It should be noted, however, that USDA-RD approached the same level of spending in Starr County as it did in Cameron County.

Other remarkable results of the analysis were the amount of spending on wastewater versus water improvements as well as the amount and location of spending on treatment improvements compared with spending on water distribution to the *colonias*. Three of the four funding sources spent significantly more on wastewater improvements than water improvements. Only the NADB spent more on water improvements. As Table 4 shows, TWDB spent far more on wastewater treatment with over $78 million or 88 percent of its total spending in municipalities.[2] In most cases municipalities have many more more water and wastewater service customers within their city limits than in the surrounding *colonias*. The significance of this level of government *colonia* funding allocation within *non-colonia* area will be discussed later in Chapter IV.

An important factor in how each community benefits from governmental financial assistance is the proportion of loan to grant amounts they recieve. The TxCDBG Program and the USDA-RD Colonia Infrastructure Program offered only grants. USDA-RD provided far larger grants than the TxCDBG Program. TWDB and NADB can provide both loans and grants, though the grants have certain restrictions.

Table 4. Characteristics of Government Assistance for Water and Wastewater Infrastructure Development in Texas Colonias 1996-2006 by Fund Source

	CDBG	TWDB	USDA-RD	NADB	Totals
General Characteristics					
Total Spending	$10,721,988	$110,450,475	$30,505,157	$6,230,975	$157,908,595
Grant Spending	$10,721,988	$89,115,975	$30,505,157	$4,356,075	$134,699,195
Loan Spending	$0	$21,334,500	$0	$1,874,900	$23,209,400
Average Spending per Project	$397,111	$4,248,095	$1,051,902	$2,076,992	
Per Capita Spending per Funding Source	$438	$1,855	$497	$241	
Percentage of Total Spending	7%	70%	19%	4%	100%
Total Number of Projects	27	26	29	3	85
Number of Beneficiaries	24,464	59,556	61,343	25,900	171,263
Average Number of Beneficiaries per Project	906	2,291	2,115	8,633	
Activity Characteristics					
Number of Projects with Water Improvements	15	15	4	2	36
Number of Projects with Wastewater Improvements	21	20	25	2	68
Spending on Water[1]	$3,779,537	$35,488,456	$6,039,657	$4,585,488	$49,893,138
Spending on Wastewater[1]	$6,942,451	$74,962,019	$24,465,500	$1,645,488	$108,015,458
Water Spending that included Water Treatment[1,2]	$0	$9,397,973	$4,513,400	$3,200,000	$17,111,373
Wastewater Spending that Included Wastewater Treatment[1,2]	$0	$48,280,573	$18,542,400	$1,645,488	$68,468,461
Percentage of Total Spending by Activity[2]					
Water	35%	32%	20%	74%	0%
Wastewater	65%	68%	80%	34%	0%
Water that included Water Treatment[3]	0%	16%	20%	66%	0%
Wastewater that included Wastewater Treatment[3]	0%	84%	80%	34%	0%
Spending by County					
Cameron County	$3,773,783	$41,426,260	$9,395,700	$3,200,000	$57,795,743
Hidalgo County	$5,384,048	$67,859,300	$12,010,357	$3,030,975	$88,284,680
Starr County	$1,564,157	$1,164,915	$9,099,100	$0	$11,828,172
Spending by District					
WSC Systems	$4,935,453	$14,495,105	$30,505,157	$0	$49,935,715
Municipal Systems	$4,457,987	$78,324,339	$0	$6,230,975	$89,013,301
WSC and Municipal Systems[4]	$1,328,548	$17,631,031	$0	$0	$18,959,579
Percentage of Total Spending by District					
WSC Systems	10%	29%	61%	0%	100%
Municipal Systems	5%	88%	0%	7%	100%
WSC and Municipal Systems[4]	7%	93%	0%	0%	100%

1) Available data did not separate spending in terms of water, wastewater, water treatment, or wastewater treatment. Therefore, project values were divided so that half was included as water spending and half was included as wastewater spending. 2) Spending in projects for water or wastewater treatment was separated out in a seperate analysis since some sources provided significant funding for treatment activities compared with water distribution activities. 4) Figures for multiple recipients (i.e. WSC and Municipalities) were separated out.

Overall, grants dominated loans over the ten year period by more than 86 percent with the TWDB accounting for nearly 70 percent of all grant funding. The greatest number of loans from all funding bodies went to municipalities while WSCs loan funding consisted of only 3 percent. However, some large WSCs received large amounts of money. The best example of this is North Alamo WSC which serves over 94,500 people today. It received and spent a little over $24 million in total government assistance with more than half of that, $14.8 million as grants. Still, municipalities received 56 percent of the overall spending and 12 percent of mixed project spending (WSC and municipalities), further confirming that the Lower Rio Grande Valley's water and wastewater service is becoming more centralized with the municipalities taking the lead role in providing services to the *colonias* with the financial backing of the federal and state governments via capital spending subsidies through the TWDB, USDA-RD, and NADB.

Analysis by Water and Wastewater Service Providers

Spending of federal and state government funds by municipal recipients was 56 percent or just over $89 million of total spending, while WSCs received just 32 percent or just under $50 million (see Table 4). These levels are followed by spending in mixed recipient projects of 12 percent or just under $19 million as shown in Table 5. Initially, this may seem surprising since earlier studies have indicated that close to 75 percent of *colonias* are served by WSCs (Olmstead 2004). Indeed, close to half of all spending was directed toward systems owned by WSCs.

Several factors may explain this spending pattern. Following the timespan covered by previous research, municipal systems have continued to expand beyond city limits to serve colonia areas. Many WSC systems converted to municipal systems or have been acquired by larger WWSPs (usually municipalities) as water and wastewater systems operated by WSCs, including colonia areas, became more interconnected and "regionalization" of services evolved. Due to this centralization of treatment operations, spending in municipalities is not totally unexpected given increasing regionalization of systems and services.

Table 5. Characteristics of Government Assistance for Water and Wastewater Infrastructure Development in Texas Colonias 1996-2006 by WWSP

	WSC	Municipality	WSC/Municipality[1]	Totals
General Characteristics				
Total Spending	$49,935,715	$89,013,301	$18,959,579	$157,908,595
Grant Spending	$48,681,715	$76,627,901	$9,389,579	$134,699,195
Loan Spending	$1,254,000	$12,385,400	$9,570,000	$23,209,400
Average Spending per Project	$979,132	$2,967,110	$4,739,895	
Per Capita Spending per Funding Source	$563	$1,176	$2,776	
Percentage of Total Spending	32%	56%	12%	100%
Total Number of Projects	51	30	4	85
Number of Beneficiaries[2]	88,719	75,713	6,831	171,263
Average Number of Beneficiaries per Project	1,740	2,524	1,708	
Number of Projects by Funding Source				
CDBG	12	12	3	27
TWDB	10	15	1	26
USDA-RD	29	0	0	29
NADB	0	3	0	3
Activity Characteristics				
Number of Projects with Water Improvements[3]	21	12	3	36
Number of Projects with Wastewater Improvements[3]	36	29	3	68
Spending on Water[3]	$17,889,210	$22,609,865	$9,394,064	$49,893,138
Spending on Wastewater[3]	$32,046,506	$66,403,437	$9,565,516	$108,015,458
Water Spending that included Water Treatment[4]	$4,513,400	$3,782,458	$8,815,516	$17,111,373
Wastewater Spending that Included Wastewater Treatment[4]	$22,104,486	$37,548,459	$8,815,516	$68,468,461
Number of Beneficiaries by Activity				
Water	32,770	39,565	6,172	78,507
Wastewater	62,157	71,313	6,519	139,989
Water with Water Treatment	9,012	6,878	5,652	21,542
Wastewater with Wastewater Treatment	16,642	51,549	5,652	73,843

1) In some cases, sources provided funding to multiple recipients (i.e. WSC and Municipalities) within a single project. These were separated out since available budget data did not separate spending by recipient. 2) Beneficiaries counts only colonia resident beneficiaires, these figures do not reflect any benefits derived by municipal residents. 3) Available data reported by all funding sources was by project - water and wastewater activities not separated out; therefore mixed activity projects counted separately. 4) Spending in projects for water or wastewater treatment was separated out in a seperate analysis since some sources provided significant funding for treatment activities compared with water distribution activities.

While the WSCs dominate the number of projects, actual spending was often small compared to the multi-million dollar grants and loans allocated to municipalities for expensive wastewater treatment plants, further illustrating the drive to regionalize services. Looking again at Table 5, we see that municipalities may have been eager to accept the sizable number of grants ($76.6 million) and below market rate loans to extend service to *colonias* since the grants to a degree subsidize their overall capital spending on treatment thereby possibly reducing the burden of these costs on a municipality's general budget (Carter and Ortolano 2004).

Regionalization of water and wastewater services provides two very important advantages compared with the establishment of new WWSPs or expansion of smaller more isolated WWSPs to serve colonias. First, regionalization of services may increase economies of scale in which the marginal cost of service decreases as the number of connections in a system increases thereby making services more affordable. Secondly, allowing larger municipal WWSPs to expand services into peri-urban colonias helps increase the likelihood that services are of high quality given the substantial financial, managerial, and technical capacities required to operate and maintain a modern water and/or wastewater system that meets current and future industry regulations.

Analysis by County

Table 6 shows that spending in Hidalgo County far surpassed spending in the other two counties as the number of projects combined in Cameron and Starr counties were still below Hidalgo's 47 projects. This meant that while average spending per project in the three counties remained relatively the same, Hidalgo had a lower per capita spending rate of only $833. Per capita spending in Cameron and Starr counties was over $1,000, but with much fewer projects and higher project costs. Government funding, simply went further in Hidalgo County which may be due to the closer proximity of Hidalgo County colonias to existing municipal networks (i.e. McAllen and Mission) and smaller average lot sizes than those in Cameron and Starr Counties. If colonias are closer to existing systems, and lot sizes are smaller, than the cost for transmission mains (or large collection mains in the case of wastewater) is lower.

Table 6. Characteristics of Government Assistance for Water and Wastewater Infrastructure Development in Texas Colonias 1996-2006 by County

	Cameron	Hidalgo	Starr	Totals
General Characteristics				
Total Spending	$57,795,743	$88,284,680	$11,828,172	$157,908,595
Grant Spending	$55,310,243	$67,733,780	$11,655,172	$134,699,195
Loan Spending	$2,485,500	$20,550,900	$173,000	$23,209,400
Average Spending per Project	$1,992,957	$1,878,397	$1,314,241	
Per Capita Spending per Funding Source	$1,070	$833	$1,051	
Percentage of Total Spending	37%	56%	7%	100%
Total Number of Projects	29	47	9	85
Number of Beneficiaries	54,037	105,975	11,251	171,263
Average Number of Beneficiaries per Project	1,863	2,255	1,250	
Number of Projects by WWSP				
WSC	20	28	3	51
Municipality	8	16	6	30
WSC and Municipality[1]	1	3	0	4
Spending by WWSP				
WSC	$19,293,655	$21,542,960	$9,099,100	$49,935,715
Municipality	$38,002,088	$48,282,141	$2,729,072	$89,013,301
WSC and Municipality[1]	$500,000	$18,459,579	$0	$18,959,579
Percentage of Total Spending by WWSP				
WSC	39%	43%	18%	100%
Municipality	43%	54%	3%	100%
WSC and Municipality[1]	3%	97%	0%	100%
Number of Beneficiaries by Funding Source				
CDBG	10,254	12,579	7,224	30,057
TWDB	31,430	49,310	4,956	85,696
USDA-RD	22,200	34,643	4,500	61,343
NADB	4,400	37,000	0	41,400
Percentage of Total Beneficiaries by Funding Source[2]				
CDBG	34%	42%	24%	100%
TWDB	37%	58%	6%	100%
USDA-RD	36%	56%	7%	100%
NADB	11%	89%	0%	100%

1) In some cases, sources provided funding to multiple recipients (i.e. WSC and Municipalities) within a single project. These were separated out since available data did not seperate spending by recipient. 2) For example, benficiaries of TWDB projects in Hidalgo County accounted for 23 percent of all beneficiaries regardless of county, district, funding agency, or activity.

The analysis of the number and relative percentage of beneficiaries in each county based on the funding source had a predictable outcome. Each funding source reached the most beneficiares in Hidalgo County, followed by Cameron, and then Starr counties. In terms of spending in each county, USDA funds appear to be more equitably distributed among the three counties, while NADB reached the most beneficiaries in Hidalgo County and no beneficiaries in Starr County, which reflects its limited number of projects and their locations.

Finally, a comparison of the beneficiary counts and spending based on WWSP in each county is somewhat contrary to assumptions based on the analysis of spending by WWSPs in the previous section. Spending in Hidalgo and Cameron still largely follow previous patterns whereby spending was higher in municipalities than with WSCs. Starr County, however, breaks this mold with spending and beneficiary counts in WSCs surpassing spending and beneficiary counts in projects involving municipalities by almost a factor of three and almost two, respectively, despite projects with municipalities numbering double the number of projects with WSCs. Starr County also attracted the highest percentage of grant funding primarily due to its high rate of poverty. This variance in the data may be attributed to USDA-RD's wastewater projects with Union WSC, where an estimated nine colonias were connected to a virtually new wastewater system that included wastewater treatment.

Analysis by Type of Activity

Despite the attention improved water access and service draws from the media and policymakers, government financing for wastewater service overrode water service assistance by more than two to one margin. Spending on wastewater projects accounted for 68 percent of government assistance with spending on 68 completed wastewater projects by 2006.[3] There may be possible explainations for why colonias received more assistance for wastewater improvements than water improvements from 1996 to 2006.

Water services to the colonias may have been provided prior to the study period. Government funding helped communities comply with increasingly stringent wastewater

treatment regulations designed to protect public health. Water improvements preceded wastewater improvements and were often times provided by the local WWSP, especially WSCs, because *colonia* residents were much more willing to pay for a connection and regular service rates for water from a centralized water system.. Wells require more regular maintenance and an electric pump uses a significant amout of electricity (on average 400 kWh per household) and water from other vendors is unreliable and expensive (USDE 2009). Due to simple supply and demand, WSCs have historically provided water service in rural areas but not wastewater service, leaving a need for government to step in.

USDA-RD concentrated the most heavily on wastewater projects, with 82 percent of its WSC projects focused on wastewater. CDBG funding was evenly split with half of its spending going towards water and half of it going towards wastewater improvements. Unlike other funding sources, CDBG did not spend any of its colonia funding from 1996 to 2006 on municipalities, which is due to its own program restrictions preventing colonia funding distribution to municipalities unless the colonias have been recently annexed. TWDB and NADB spent the most on treatment upgrades with the largest percentage spent on wastewater treatment. As Table 7 shows, NADB's ratio of spending on wastewater treatment to water treatment was 85 and 15 percent respectively. Considering that areas outside the corporate limits of a city are not citizens of that city and therefore cannot vote or be represented by members of the city council, social researchers may seek to study issues of equity in municipal water and wastewater service governance, rates, and fees. It is possible that rates or operation decisions may have a bias for citizens of the city rather than outside customers, especially the historically marginalized colonia residents. Rates rates that may be affordable to a municipal customer may be too financially burdensome for a colonia customer, who has no legal standing to voice an objection to proposed rates and fees in the rate-setting process beyond protesting to TCEQ or a County Commissioner.

Table 7. Characteristics of Government Assistance for Water and Wastewater Infrastructure Development in the Texas Colonias 1996-2006 by Activity

	Water	Wastewater	Totals	Water with Treatment	Wastewater with Treatment	Treatment Totals
General Characteristics						
Total Spending	$49,893,138	$108,015,458	$157,908,595	$17,111,373	$68,468,461	$85,579,834
Grant Spending	$67,948,612	$118,987,432	$186,936,044	$16,766,346	$69,479,216	$86,245,562
Loan Spending	$14,978,900	$22,062,400	$37,041,300	$9,743,000	$19,885,900	$29,628,900
Average Spending per Project	$1,385,920	$1,588,463		$3,422,275	$4,027,557	
Per Capita Spending per Funding Source	$636	$772		$794	$927	
Percentage of Total Spending	32%	68%	100%	20%	80%	100%
Total Number of Projects	36	68	104	5	17	22
Number of Beneficiaries	78,507	139,989	218,496	21,542	73,843	95,385
Average Number of Beneficiaries per Project	2,181	2,059		4,308	4,344	
Number of Projects by County[1]						
Cameron County	15	22	37	2	6	8
Hidalgo County	17	37	54	2	7	9
Starr County	4	9	13	1	4	5
Spending by County[2]						
Cameron County	$21,819,694	$35,976,049	$57,795,743	$4,450,000	$13,243,495	$17,693,495
Hidalgo County	$26,994,973	$61,289,708	$88,284,680	$12,078,916	$45,543,408	$57,622,324
Starr County	$1,078,471	$10,749,701	$11,828,172	$582,458	$9,681,558	$10,264,015
Number of Beneficiaries by County						
Cameron County	34,957	33,327	68,284	12,364	19,461	31,825
Hidalgo County	38,121	95,411	133,532	6,700	47,404	54,104
Starr County	5,429	11,251	16,680	2,478	6,978	9,456
Percentage of Total Spending by County[2]						
Cameron County	51%	49%	100%	39%	61%	100%
Hidalgo County	29%	71%	100%	12%	88%	100%
Starr County	33%	67%	100%	26%	74%	100%
Percentage of Total Spending by Funding Source[2]						
CDBG	50%	50%	100%	0%	0%	0%
TWDB	38%	62%	100%	19%	81%	100%
USDA-RD	18%	82%	100%	42%	58%	100%
NADB	48%	52%	100%	15%	85%	100%

1) Available data reported by all funding sources was by project - water and wastewater activities not separated out; therefore mixed activity projects counted separately. 2) For example, benficiaries of Wastewater projects in Hidalgo County accounted for 44 percent of all spending regardless of county, district, funding agency, or activity.

Notes

1. CHIPS "identified" *colonias* based on *Colonia* Survey forms provided by the four agencies. This process implicitly relies on each agency's definition of what a *colonia* is, as well as its delineated boundaries based on each agency's statutory and internal *colonia* characteristics guidelines.
2. Funding source data is broken down by project, therefore in many cases funding was provided to both a municipality and a WSC within the same project. In these cases, funding source data was not broken down by number and type of WWSP and the spending total for each project was divided evenly between the WWSPs. WWSPs participating in any project numbered no more than two with the majority of projects dedicated to one WWSP.
3. Twenty-four projects consisted of both water and wastewater activities, available data did not separate out the dollar values of these projects.

CHAPTER IV
EVALUATING THE IMPACT OF GOVERNMENT ASSISTANCE PROGRAMS IN THE FUTURE

One major barrier to programmatic success is the lack of a harmonized system of metrics that could evaluate project results across all four major government funding agencies. Each of the four agencies have substantially different methodologies of determining project outputs and outcomes. Until recently, the even basic definition and characteristics of a *colonia* varied markedly. With this in mind, providing a reliable quantitative comparison of each agency's efforts is challenging at best. However, the Texas Legislature took note of this and in 2005 passed Senate Bill 827 mandating the creation of a system to identify *colonias* and track state-funded infrastructure improvement projects.

In 2007 the U.S. Geological Survey, in cooperation with the U.S. Department of Housing and Urban Development (HUD), the Texas Water Development Board (TWDB), the Offices of the Texas Attorney General, and Texas Office of the Secretary of State, developed the Colonia Health Infrastructure Platting Status or "CHIPS" tool (Parcher and Humberson 2007). This vital collection of information in this report, not only identifies *colonias* using GIS, but it also classifies the *colonias* according to the degree of health risk they present due to lack of infrastructure and other environmental factors.

An important next step is a renewed interest in the further development of the CHIPS tool. In Hidalgo County alone, 261 *colonias* or 28 percent of the total *colonias* in the county are categorized as "unknown", meaning that they lack the most basic information about platting, road and environmental conditions, and water and wastewater services. But the idea of a comprehensive database remains the single best chance of accurately tracking and distributing funding to the *colonias*. CHIPS had been designed with this in mind, with infrastructure financing data linked directly to each *colonia*. Although funding for the continued development and use of the CHIPS tool dried up soon after it was introduced, new and ongoing state and federal initiatives have

the opportunity to sufficiently monitor and evaluate government *colonia* financing at a macro scale if funding is renewed.

Coordination and harmonization with organizations currently working toward the same goals of better public health and improved living condition would be beneficial for everyone. The Office of Border Health and the Border Health Commission are just two examples of federally-funded organizations that are actively working on exactly those issues. Partnership and standardization of data could effectively close the information gap. This would make it easier to identify communities in need, address those needs, and communicate the results to the lawmakers who are understandably reluctant to continue funding projects that cannot accurately report outcomes.

Given the enormous strain on America's aging infrastructure and the high cost of heavy construction, local governments and officials will need to do more to retain or attract the government spending levels needed to construct and maintain adequate water and wastewater infrastructure and services for the *colonias*. To this end, justifying the impacts of past and present inverventions as well as the benefit of continuing future interventions can be improved. Traditional cost-benefit analysis, aggregate output models (social rate of return), and input-output (IO models) economic impact models are limited in their ability to fully measure impacts of water and wastewater infrastructure improvements at the domestic level. Therefore, this area of research would benefit from impact assessments that can integrate the multiple benefits to regional economies, environment, and public health (Canning and Bennathan 2000, and Norvell and Kluge 2005).

One type of impact assessment that could be effective is a quantitative health impact assessment (HIA). HIAs are not meant to replace other assessment tools such as environment impact assessments (EIAs) or appropriately designed benefits and cost analysis (BCA), but to supplement them. Quantitative HIAs can be broken down into two phases: exposure impact to assess the determinents of unsafe water and an outcome of water and wastewater infrastructure assessment (Veerman *et al*. 2005). Standardized data collection is essential for a quantitative HIA. This has already begun with the

collection of colonia data for the colonia identification survey and CHIPS as part of an exposure impact. However, comprehensive epidemiological data collection is necessary to accurately gauge the outcomes of water and wastewater improvements.

A particularly relevant health indicator that federal, state, and local officials may use to measure improved health and well-being in terms of morbidity and mortality longitudinally is the disability adjusted life year or "DALY." DALYs are able to bundle life years lost and time spent with disease, adjusted for the severity of disease to measure the overall burden of disease on *colonia* residents (Fehr *et al.* 2003, Veerman *et al*. 2005, WHO 2009). Researchers can then calculate the costs of inadequate water and wastewater infrastructure and management to quantify losses not only on average to a group of *colonia* residents, but the economic impacts of the rise in DALYs of that population.

Government financial assistance has greatly assisted the *colonias* because they have reduced the high capital costs to install new water and wastewater infrastructure, but the managers who must then manage these systems know that this is only the tip of the iceberg. Once the infrastructure is in place and functional, the utilities themselves are typically responsible for the continued safe operation and management of the systems. Policy-makers and water managers would be prudent to concern themselves with the sustainability of providing services based on the sophistication of the infrastructure the government financed and the proper management of these systems. In the US and abroad, the focus on sustainability is growing as evidenced by the number of national and international organizations and government agencies seeking to improve financial, managerial, and technical operations (USEPA 2008, USEPA 2009, IBNET 2009). Systematically revisiting those *colonia* areas and their WWSPs five, ten, and perhaps twenty years in the future will help governments and citizens improve best practices to infrastructure development in low-income areas. Most importantly, evaluating the results of these projects will help us better understand the value of critical infrastructure to *colonia* resident health and well-being, as well as the environment, local and regional economies.

CHAPTER V
CONCLUSION

The state and federal governments have made a concerted effort to deliver water and wastewater access to Texas' *colonias*. Without it, blight and public health problems would persist and likely worsen. Traditionally, more interest, emphasis, and funding has been directed toward clean water access. However, this report shows that from 1996 to 2006, government assistance largely financed wastewater improvements. Municipalities as opposed to WSCs took the greatest share of government assistance for this infrastructure, despite *colonias* existing in unincorporated peri-urban and rural areas. Taken together, it is clear that the state's regionalization policies are strongly influencing the centralization of large municipal water and wastewater systems and expanding outward to *colonia* areas, where water and wastewater service, if available, has traditionally been provided by WSCs.

The actual the impact of this governmental financial assistance to WWSPs serving the *colonias*, which has amounted to $157,908,595 over the five years, is unclear. A recent report by OCI reviewed the funding devoted to water and wastewater development in the *colonias* in broad measures. The report concluded that even though hundreds of millions have been spent since 1989 for water and wastewater, roughly a quarter of the original 1,786 *colonias* without adequate access to water and wastewater service still lacked those basic utilities. The water and wastewater access status of an additional 312 *colonias* where there are nearly 50,000 estimated residents, is completely unknown (SOS 2006).

This report for the first time attempted to examine all four major government *colonia* water and wastewater infrastructure financing sources together. Comparitive analysis proved difficult due to the lack of complete and interpretable data as well as the apparent differences in the measurement of outputs and results. In the future it may be possible to better analyze results if data is more clearly presented and methodologies standardized. The state of Texas' efforts thus far represent significant progress, especially with the creation of a tool such as CHIPS. Much more progress can be made

with its continued use and development as well as the introduction of quantitative HIA tools and the implementation of clear, definitive, and standardized data. In the end, government assistance is likely making a demonstrable impact on the health and economic livilihoods of *colonia* residents. *Colonias* are finally experiencing rational development, service provision, and greater inclusion into more formal regional economic sectors.

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VITA

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