10-1-2009

Binational Water Management: Perspectives of Local Texas Officials in the U.S.-Mexico Border Region

Olivia N. Thompson
Texas State University-San Marcos, Dept. of Political Science, Public Administration Program, olivia.thompson@gmail.com

Binational Water Management: Perspectives of Local Texas Officials in the U.S.–Mexico Border Region

By

Olivia Thompson

An Applied Research Project
(Political Science 5397)
Submitted to the Department of Political Science
Texas State University
In Partial Fulfillment for the Requirements for the Degree of
Masters of Public Administration
Fall 2009

Faculty Approval:

_____
Dr. Patricia M. Shields

_____
Dr. Chris Brown

_____
Charles E. Zech, J.D., MPA

Abstract

Purpose: The purpose of this Applied Research Project is to assess the attitudes and opinions of local Texas government officials that manage water resources in the U.S.–Mexico border region. Previous research on binational water management in Texas has not included the attitudes and opinions of local Texas officials in the border area. Although negotiations on binational water management take place at the level of the U.S. Department of State, the administration of binational water management strategies takes place at the local level. The inclusion of local Texas officials' attitudes and opinions will make a valuable contribution to any future debates of binational water management strategies and will be important to finding the management strategies with the most potential for success.

Method: To satisfy the research purpose, this Applied Research Project used survey research. The issues identified in the scholarly literature were used to develop two conceptual frameworks that served as the basis for the survey instrument. One hundred and seventy-two local Texas government officials that manage water resources in the U.S.-Mexico border region were administered the survey either electronically or by mail. Descriptive statistics were used to analyze the results.

Findings: The results of this survey show strong support for making changes to the treaty that governs binational management of the Rio Grande. Additionally, there was support for some water conservation techniques. Further, local officials indicated that specific barriers kept them from cooperating fully with their Mexican counterparts. Lastly, local officials indicated that they use several modes of communication to educate the public on water issues and to invite the public to water policy discussions.

About the Author

Olivia Thompson was born and raised in rural Ohio. She graduated from The Ohio State University with a bachelor's degree in art. Shortly after graduating from Ohio State, she moved to Austin, Texas. After moving to Austin, Olivia became familiar with Texas' water scarcity issues, a problem she had not experienced in Ohio. This led to an interest in environmental law, and more specifically water law. While taking an environmental law class as part of the Texas State MPA program, she began to explore water law in the Texas-Mexico border region. A research paper completed for the environmental law class led to the development of this applied research project.

Olivia currently works for The University of Texas at Austin in external relations. Olivia can be contacted by email at olivia.thompson@gmail.com.

Table of Contents

List of Tables

Table of Figures

Chapter 1: Introduction

> Water is *the* defining issue that this region faces. Economy, immigration, and environment are important issues all, but they pale in comparison with water. Water is fundamental and non-negotiable. In the decades ahead, water may become the most daunting challenge Texas has faced since European settlement. This is not something we can finesse, spin, or rationalize away: the future of Texas depends on how we respond to this test of our collective character and ingenuity.[1]

In 2008, national and local American newspapers contained headlines describing a "water war" or "water fight" between Texas and Mexico. A disagreement over the terms of an international treaty affecting communities along the Rio Grande had erupted into a legal battle that would be reconciled by a Canadian court (Michaels 2008; Sherman 2008). A group of Texas farmers, ranchers, and irrigation districts elevated a dispute over Rio Grande water allocations to an international tribunal in the case of *Bayview Irrigation District #11 v. United Mexican States*.[2] Federal, state, and local officials in Texas were incensed when the U.S. Department of State filed a submission with the international tribunal siding with Mexico in the case (Michaels 2008). The Texas farmers, ranchers, and irrigation districts (hereinafter *Bayview*) ultimately lost this case, but the controversy continues. Ambiguities in the international treaty that governs the use of the Rio Grande and issues of water resource sustainability in the region continue to cause tension between the two nations.

[1] Norwine, Giardino, and Krishnamurthy 2005, xi. Norwine, Giardino, and Krishnamurthy are editors of *Water for Texas*, a collection of white papers by experts on Texas water, law and policy, published by the Texas A&M University System.

[2] *Bayview Irrigation District #11 v. United Mexican States*, 2008 CanLII 22120 (ON S.C.). The lawsuit was filed under the North America Free Trade Agreement (NAFTA). Per NAFTA rules, the neutral country (in this case Canada) presides over the case.

Binational Water Management in Texas

Texas faces significant water supply issues both within the state and along its international border.[3] The U.S. Federal Government defines the U.S.-Mexico border area as 100 kilometers from the political boundary of the United States and the United Mexican States (Environmental Protection Agency 2006). This area is demarcated by the dotted line on either side of the Rio Grande in figure 1.1, below.[4] The border area includes 32 counties in Texas, 14 of which are entirely within the federal definition of the U.S.-Mexico border area. Binational

Figure 1.1. Texas region of the U.S.-Mexico border.

Source: Texas Commission on Environmental Quality.

[3] For examples of other Texas State Applied Research Projects (ARPs) that deal with Texas' water issues, see Albright 2006, Barron 2006, Billingsley 2002, Cantu 2004, Gillfillan 2008, Helmle 2005, and Wilson 2009.

[4] See Appendix D for a larger map of the Texas – Mexico border region.

water management[5] has become an important political and economic issue for the state, as diminishing water supply from the Rio Grande has affected economic interests along the border.

Binational water management is a worldwide political issue. A total of 263 binational watersheds have been identified across the world. These watersheds affect approximately 40 percent of the world's population and supply nearly 60 percent of the world's fresh water (Jarvis, et al. 2005). The need for improved binational water management strategies cannot be overstated in the context of a rapidly growing population and increased political uncertainty caused by climate change. Recently, the United Nations declared that every person on earth is entitled to "sufficient, safe, acceptable, physically accessible and affordable water for personal and domestic uses" (Ward and Pulido-Velázquez 2007, 25). If a limited natural resource like water is to be accessible, affordable, and meet minimum standards of safety, nations that share these water resources must make it a top priority to agree on a management strategy. Although international in scope, this management strategy will be administered by local officials in conjunction with citizens, nongovernmental organizations, and other levels of government. Binational agreement and cooperation is critical because water does not recognize political boundaries and must endure multiple and often conflicting demands from all users (Wolf 1998). For this reason, binational water management is of particular importance in Texas as the Rio Grande serves as both international political boundary between Texas and Mexico, and is the major source of fresh water for both Texan and Mexican residents in the region.

Norwine, et al. (2005, xi) have identified five locational characteristics that increase the likelihood that "water wars" will occur. These characteristics are limited water supplies,

[5]For the purposes of this paper "binational water" refers to both surface and groundwater systems that are intersected by an international boundary. Thus, "binational water management" refers to policies and strategies that seek to regulate the use of binational water. Both "binational" and "transboundary" are used interchangeably throughout the literature and this paper.

increasing population and water demand, a growing divide between the "water-rich" and the "water-poor," transnational water disputes, and sensitivity to climate change. According to Norwine, et al. (2005), Texas is the region with the highest potential for water conflict in North America. In addition to this high potential for conflict, a complex political and legal framework relating to water management has evolved throughout the history of the United States (Helmle 2005). This complexity extends to Texas' shared water resource management relationship with Mexico. A sixty-five-year-old treaty between the United States and Mexico currently guides the management of the Rio Grande. Although the population and economy of the region have changed substantially, this binational water management framework is still being used today. The treaty may require sweeping changes if current and future water demand is to be met and water wars are to be avoided.

Research Purpose

The purpose of this research is to assess the attitudes and opinions of local Texas government officials that manage water resources in the U.S.-Mexico border region toward binational water management. The first purpose of this research is to describe the attitudes and opinions of local Texas government officials that manage water resources toward six prominent issues in binational water management under the treaty between the United States of America and Mexico, known as *Relating to the Utilization of the Waters of the Colorado and Tijuana Rivers and of the Rio Grande of 1944* (hereinafter "*1944 Treaty*" or "*Treaty*") as these issues relate to the Texas-Mexico border region. The second purpose of this research is to explore opinions of local Texas government officials that manage water resources toward (1) a willingness to support water conservation techniques, (2) international communication and cooperation, and (3) community involvement.

Previous research on binational water management in Texas has not included the attitudes and opinions of local Texas officials in the border area. Although negotiations on binational water management take place at the level of the U.S. Department of State, the administration of binational water management strategies takes place at the local level. The inclusion of local Texas officials' attitudes and opinions will provide a valuable contribution to any future debates of binational water management strategies and will be important to finding management strategies with the greatest potential for success.

Chapter Organization

This paper is divided into seven chapters. The next chapter, Chapter 2, discusses the geography of Texas along the Rio Grande, water law, and the history of Rio Grande water management, including the *1944 Treaty*. Chapter 3 describes the key issues with the *1944 Treaty* that should be considered in binational water management. Chapter 4 explores water conservation techniques, international communication and cooperation, and community involvement in binational water management. Chapter 5 describes the methodology used in this study including the research technique, strengths and weaknesses of the research method, the population used for this research, statistics, and human subject research issues. Chapter 6 shares the results of the survey and provides an analysis of the data. Chapter 7 summarizes the research purpose, results, and provides policy recommendations and directions for future research.

Chapter 2: Setting

Chapter Purpose

The purpose of this chapter is three-fold. First, this chapter describes the geography of Texas, which has a significant influence on weather patterns that affect water and population distribution throughout the state. The chapter also discusses state, federal and international water law, as it applies to Texas. Finally, it provides a brief history of the management of the Rio Grande.

Geography of Texas along the Rio Grande

The Rio Grande River begins as a snow-fed mountain stream in the Rio Grande National Forest in the San Juan Mountains of Colorado (Metz 2008). It flows south through the state of New Mexico, and into the state of Texas 32 kilometers northwest of the city of El Paso, Texas. The Rio Grande forms the official political boundary between Texas and Mexico, beginning in El Paso, Texas, and traveling approximately 2,012-kilometers to the Gulf of Mexico (Eaton and Hurlbut 1992; Moore, et al. 2002). The Rio Grande is one of the longest rivers in North America (Metz 2008; Moore, et al. 2002).

Figure 2.1. Hand-drawn ferry across the Rio Grande River at Los Ebanos, Texas.
Photograph courtesy of the author.

Several climate regions characterize the Texas-Mexico border region. Ranging from subtropical arid in the far western corner, and including mountain, subtropical steppe, and subtropical subhumid moving eastward to the Gulf of Mexico. The differences in climate are attributed to the flow of moisture from the Gulf of Mexico northward, resulting in decreased precipitation from east to west (Office of the State Climatologist). Precipitation is irregular and heavy, making both flood and drought common (Legates 2005). Additionally, high average air temperatures cause water evaporation to exceed precipitation in most of the state, particularly along the international border in West Texas and the Rio Grande Valley (Texas Comptroller of Public Accounts 2008).

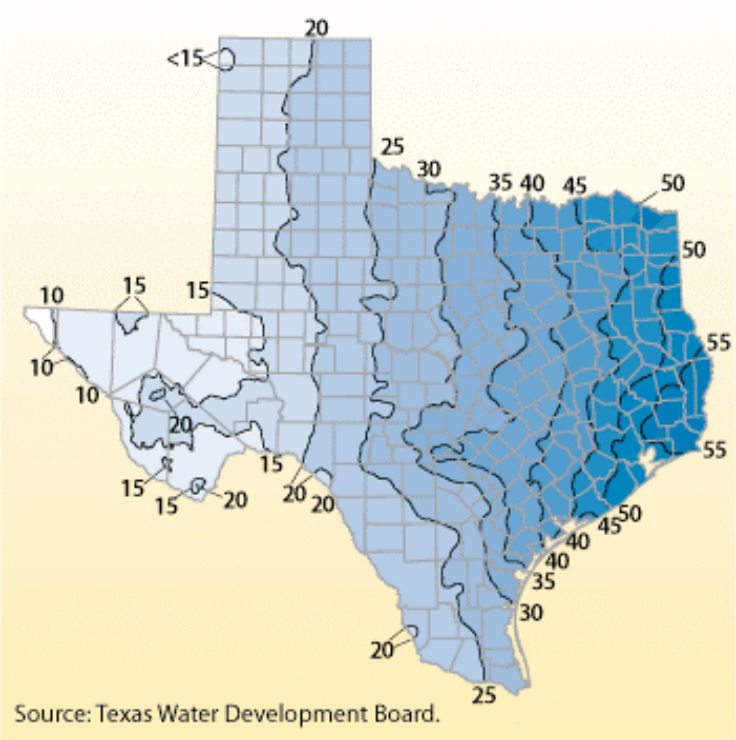


Figure 2.2. Texas' average annual precipitation in inches, 1971-2000.
Source: Texas Water Development Board.

Varying climate regions and rainfall cause both population and industry to cluster in key areas of the border region. The population of the West Texas border region is concentrated in El

Paso County with 96 percent of the region's residents, and the largest economic sectors include agriculture, agribusiness, and manufacturing (Texas Water Development Board 2009).[6] Moving eastward to the mid-basin region (also known as the Plateau region), the population diminishes as land use changes to support vegetation for grazing and livestock (Texas Water Development Board 2009). The lower basin regions, known as the Rio Grande and Coastal Bend regions include five cities (Brownsville, McAllen, Laredo, Harlingen, and Eagle Pass) with expected high increases in growth (Texas State Data Center 2009). This area relies heavily on agriculture, trade, services and manufacturing for economic stability (Texas Water Development Board 2009).

Figure 2.3. Lake Amistad Reservoir at the Rio Grande River (near Del Rio, Texas).

Photograph courtesy of Texas Department of Transportation.

[6] Although rainfall in the West Texas border region is low, high average temperatures and historically abundant groundwater resources have supported both agriculture and population growth.

Water Law

The legal framework for water rights and usage in Mexico differs from that in the United States. The respective national laws in each country indicate the attitude of both cultures toward water; these attitudes underlie present and past conflict.

The Mexican Constitution of 1917 defines water as "national water," therefore it is fully subject to federal control. The National Water Law, passed in 1992, further reinforced the Mexican government's control by establishing that water can only be used by permission of the federal government for municipal, agricultural, hydropower, and other productive activities (Arnold 2007). In contrast, water law in the United States is tiered, with individual states retaining much of the control over the disposition of water.[7] Yet, several federal laws do apply to the waters of the United States, including the waters of the Texas-Mexico border area:

(1) The federal reserved water rights doctrine, or Winters Doctrine, established by the U.S. Supreme Court case *Winters v. United States*,[8] reserves a quantity of water necessary to continue the "primary purposes" of the federally reserved land. Big Bend National Park, a national park along the Texas-Mexico border, could seek to enforce this doctrine if necessary (Brock, et al. 2001).

(2) The Endangered Species Act mandates that sufficient water flow must be maintained for endangered species that inhabit rivers, lakes, streams, and other bodies of water in the border region (Brock et al. 2001).

(3) The American Heritage River Designation, Executive Order 13061, seeks to promote economic revitalization, natural resource and environmental protection, historic and cultural

[7] The Tenth Amendment to the U.S. Constitution grants powers not delegated to the federal government to the states. Because each state has differing water laws, and the scope of this paper is limited to the Texas region of the United States–Mexico border, only Texas laws will be explored in any depth.
[8] *Winters v. U.S.*, 207 U.S. 564, 28 S.Ct. 207 U.S. (1908).

preservation through federal assistance. The Rio Grande from El Paso to Laredo has been designated as an American Heritage River under this order (Brock et al. 2001; EPA 2006).

(4) The National Wild and Scenic Rivers Act stipulates that any designated rivers must be preserved in a free-flowing condition for the benefit of preserving scenic, recreational, geologic, fish, wildlife and other values. Hydropower and water resource development projects are prohibited on any designated rivers. A 196-mile stretch of the Rio Grande is preserved under this act (Brock et al. 2001).

(5) The Clean Water Act directly addresses the discharge of pollutants into waterways, manages polluted runoff water, and aids in the financing of wastewater treatment infrastructure. The Clean Water Act only applies to quality standards for surface waters (EPA 2009).[9]

(6) The Safe Drinking Water Act sets minimum standards for drinking water quality. The EPA oversees the implementation of these standards.

The responsibility for compliance with these federal laws, particularly the Safe Drinking Water Act, falls to state and local officials (EPA 2009). Increasingly, it is the responsibility of state and local officials to not only ensure compliance standards are met, but also to locate funding for programs meant to guarantee compliance (Tresner 2009).

Because individual states retain most of the power to govern water rights, each state has enacted various laws that reflect cultural and economic importance to the region. It is also important to note that the United States' legal system creates a distinction between surface water and groundwater, and that individual states are responsible for promulgating rules that address each type of water. The Texas Water Code defines *groundwater* as "water percolating below the

[9] The U.S. legal system considers surface water and groundwater as two separate types of water. Each state is responsible for making rules that address these two types of water.

surface of the earth".[10] *Surface water*, as defined by the Texas Water Code, is "water found in lakes, bays, ponds, impounding reservoirs, springs, rivers, streams, creeks, estuaries, marshes, inlets, canals, the Gulf of Mexico inside the territorial limits of the state, and all other bodies of surface water, natural or artificial, inland or coastal, fresh or salt, navigable or nonnavigable, and including the beds and banks of all watercourses and bodies of surface water, that are wholly or partially inside or bordering the state or inside the jurisdiction of the state".[11] In Texas, water rights laws are based on two main philosophies, the *public trust doctrine*, which concerns surface waters, and the *rule of capture*, which applies to groundwater.

The public trust doctrine, established by English common law, considers surface water as property of the state that is held in trust for the benefit of the state's citizens. This right predates and supersedes the rights of private users. The Texas Commission on Environmental Quality (TCEQ) is charged with regulating Texas' surface water, including granting permits to municipalities to operate drinking and wastewater systems and issuing surface water rights permits (TCEQ 2009).

Groundwater is considered the private property of the landowner, based on the Texas Supreme Court case *Houston & T.C. Ry. Co. v. East.*[12] In this case, the Court adopted the English common law rule of capture, which acknowledges that, except in cases of "malice or waste":[13]

> An owner of soil may divert percolating water, consume or cut it off, with impunity. It is the same as land, and cannot be distinguished in law from land. So the owner of land is the absolute owner of the soil and of percolating water, which is a part of, and not different from, the soil. No action lies against the owner for interfering with or destroying percolating or circulating water under the earth's surface.[14]

---

[10] Texas Water Code § 26.001 (5).
[11] Ibid.
[12] *Houston & T.C. Ry. Co. v. East*, 98 Tex. 146, 150 (1904), 81 S.W. 279, 281.
[13] *City of Corpus Christi v. City of Pleasanton*, 154 Tex. 289, 276 S.W.2d 801 (1955).
[14] *Houston & T.C. Ry. Co. v. East*, 98 Tex. 146, 150 (1904), 81 S.W. 279, 281. (citing *Pixley v. Clark*, 35 N.Y. 520, 91 Am. Dec. 72).

Of particular importance, the *East* opinion cited the English case Acton v. Blundell, which holds that if the landowner "intercepts or drains off the water collected from the underground springs in his neighbor's well," that this action "falls within the description of damnum absque injuria, which cannot become the ground of an action."[15]

The Texas Water Code serves to further promote the ambiguity of Texas' groundwater laws by asserting that groundwater ownership is the right of the landowner, except in cases when "those rights may be limited or altered by rules promulgated by a district."[16] House Bill 1763 passed by the 78th Texas Legislature in 2005, has allowed Texas groundwater conservation districts to place some caps on groundwater use by allowing the districts to restrict groundwater extraction permits to the total amount of estimated available groundwater. Under House Bill 1763, regional water planning groups are required to work in tandem with groundwater conservation districts to determine groundwater availability and "desired future conditions" for groundwater. Availability and desired future conditions estimates are to be completed by September 1, 2010, and are to be included in regional water plans, and therefore, in the official state water plan approved by the Texas Water Development Board.

While U.S. and Texas law separates groundwater and surface water, Chapter 3 of this paper will discuss the notion that this becomes difficult in practice. Furthermore, distinguishing one landowner's groundwater from the neighboring landowners' groundwater becomes even more difficult, if not impossible.

Three state agencies share the responsibility for managing Texas' water resources, the Texas Water Development Board (TWDB), Texas Parks and Wildlife Department (TPWD), and

[15] *Id.* at 149. (BLACK'S LAW DICTIONARY 420-21 (8th ed. 2004) DAMNUM SINE INJURIA, [Latin "damage without wrongful act"] Loss or harm that is incurred from something other than a wrongful act and occasions no legal remedy.

[16] TEX. WATER CODE ANN. § 36.002 (Vernon 2008).

TCEQ. Through the TWDB, the State of Texas has also delegated the responsibility of regional water management to local officials. Senate Bill 1, signed into law in 1997 by then-Governor George W. Bush, allowed the TWDB to divide the state into sixteen regional planning groups, and requested that each come up with regional water management plans that are approved and compiled into the state water plan by the TWDB. The purpose of the regional planning groups is to create a bottom-up structure to address local problems and find solutions that may not fit into a "one-size-fits-all" style of water management carried out at state and federal levels (TWDB 2009). The TPWD helps other agencies and nongovernmental organizations collect samples for scientific analysis of riparian and coastal areas (TPWD 2009), in addition to helping maintain these areas (Helmle 2005). As noted above, the TCEQ administers permits for surface water use.

Figure 2.4. Logos of Texas state agencies involved in water management.

Source: Texas Commission on Environmental Quality, Texas Parks and Wildlife Department, and Texas Water Development Board.

Water law in the Texas-Mexico border region is complex and involves all levels of government. Regional planning boards identify problems and work with the TWDB to find solutions to these problems at the local level. State laws broadly govern the allocation of surface

and groundwater separately throughout the state for waters within Texas' borders, and state agencies aid in administering theses laws. United States federal law establishes standards for water quality and pollution control, protects water flows for endangered species, and protects historically or culturally significant portions of rivers. Finally, an international treaty oversees the disposition of the Rio Grande, a cultural icon for both Texas and Mexico, and the largest source of water in the region. This treaty, and its history are discussed in the following section.

Figure 2.5. The Rio Grande at El Paso, Texas.
Photograph by Jack M. Turner. Reproduced with permission from Jack M. Turner, http://www.TrainWeb.com.

History of Rio Grande Water Management

> Government administration of water presents the most difficult administrative problem of all natural resources. In part, this is due to the fact that the management, conservation, and use of water are intricately bound up with the conservation and use of land (Thompson 1960, 1).

The Rio Grande is the main source of fresh water for most inhabitants of the Texas-Mexico border region. The Rio Grande has also served as the political border between the United States and Mexico since the signing of the Treaty of Guadalupe Hidalgo in 1848. Ever since the river became the international boundary, disputes have emerged, first over land and then over water. The first disputes over land occurred because of the natural drift of the river's course, causing tracts of land to shift from one side of the border to the other.[17] The disputes also gave rise to the International Boundary Commission in 1889 to oversee treaties in place to demarcate the political boundary (Timm 2008). Eventually, disagreement over the disposition of the river's water gave way to the "Equitable Distribution of the Waters of the Rio Grande between the United States and Mexico of 1906" (1906 Treaty), a treaty that first established Rio Grande water allocations from El Paso to Fort Quitman, Texas. Later the two nations crafted the "Rectification of the Rio Grande Convention between the United States and Mexico of 1933" (1933 Convention), a treaty meant to finally "stabilize" the river as it passed through the El Paso-Juarez Valley (Moore, et al. 2002). Water allocations from the Rio Grande south of Fort Quitman, Texas to the Gulf of Mexico were agreed upon in the *1944 Treaty*. The *Treaty* also incorporated agreements over water allocations and uses for the Colorado and Tijuana Rivers; a combination that has proved to make future changes to the *Treaty* even more difficult than

[17] Kibel and Schutz 2007. Known as the Chamizal dispute, this dispute began in 1873 and was finally resolved in 1963 when President John F. Kennedy agreed to a resolution that was first introduced in 1911.

expected (Mumme 2003).[18] The former International Boundary Commission became the International Boundary and Water Commission under the *1944 Treaty*, and became the international body in charge of overseeing the provisions of several treaties between the United States and Mexico (Mumme 2003).

The *1944 Treaty* is the established authority over water resources for most of the Rio Grande. The *1944 Treaty* was negotiated and agreed upon during a time of relatively low development and population growth; therefore policies were geared toward increasing economic development, rather than maximizing water resources (Kelley and Székely 2004). This omission, coupled with existing water law in both nations, has translated into tensions between the United States and Mexico. Policies in both nations have historically encouraged industrial and agricultural expansion, resulting in population growth of more than 300 percent since the *Treaty* was ratified (see table B in Appendix B) and dwindling water resources for this larger, continuously expanding community.

The first major dispute under the *1944 Treaty* was concerned with Colorado River water deliveries from the United States to Mexico. This dispute, known as the Colorado Salinity Crisis, arose when water delivered to Mexico had such high salinity levels that it was unusable without heavy treatment. The problem occurred when American farmers began diverting the river for irrigation, and allowing that water to percolate through the soil and back into the river system picking up high levels of salts that are prevalent in Western soils (Kibel and Schutz 2007). The *1944 Treaty*, not recognizing water quality as part of the agreement, was silent on this issue. Despite this fact, the Mexican government felt that salinity should be addressed by the *Treaty*,

[18] Although the *1944 Treaty* includes the Colorado, Tijuana, and Rio Grande Rivers, the scope of this paper is limited to the portion of the *Treaty* relevant Texas; therefore the scope of this paper is limited to the Rio Grande. See Mumme (2003) for a more in depth discussion of how the inclusion of these three river systems has created a hurdle to amending the *1944 Treaty*.

and began pushing the United States for a solution. After 12 years of conflict, and then negotiation, Minute 242[19] the "Permanent and Definitive Solution to the International Problem of the Salinity of the Colorado River" settled the salinity crisis (Mumme 2005*a*).

The second, and most recent dispute began with the 2002 lawsuit filed by *Bayview* against the nation of Mexico. The lawsuit was filed under Chapter 11 of the North American Free Trade Agreement (NAFTA) because the *1944 Treaty* does not give the authority for individuals to take action against a nation when disputes occur. NAFTA's Chapter 11 forbids one nation from seizing the property of citizens of another without just compensation, and prohibits discrimination against the citizens of another nation by giving favorable treatment to one's own citizens. The lawsuit was preceded by several years of drought, which caused Mexico to cut, and eventually stop water deliveries mandated by the *1944 Treaty*. After perceived inaction on the part of the U.S. Department of State, *Bayview* filed the lawsuit seeking $500 million in economic damages for cuts to water deliveries between 1992 to 2002 to the Rio Grande Valley region of Texas. The Ontario Superior Court of Justice dismissed the lawsuit in March 2008. Nevertheless, years of ongoing drought and lack of an acceptable political solution make this kind of conflict likely to continue. The *1944 Treaty* came under fire during the court battle, prompting Texas governmental officials, Texas farmers, and scholars to reconsider several aspects of the *Treaty* and the policies that led to the *Treaty*. A number of public policies in both countries over the last two centuries have encouraged practices that are unsustainable, and have continually added stress to this delicate environment. The roots of these policies can be traced as far back as the Spanish conquests, when European practices of livestock and crop production were first introduced to the region. The Homestead and Desert Land Acts passed by the U.S.

[19] IBWC 2009. The *1944 Treaty* can be amended in agreements called "Minutes." Both nations must agree upon and sign each Minute before it can be enacted.

Congress encouraged western settlement during the period of relative peacefulness that followed the signing of the Treaty of Guadalupe Hidalgo by the United States and Mexico in 1848. These Acts mandated that land be converted to farmland, irrigated land or ranch land in exchange for bargain-priced deeds.

Liverman, et al. (1999) provide a comprehensive history of U.S. industrial interests and political policies that have affected the border region, beginning with nineteenth-century mining interests that encouraged development and settlement of the region, and changes to the environment. Prohibition in the U.S. resulted in a boom in tourism for Mexico in the 1920s and 30s, and increased urban development resulted to accommodate this new industry. Throughout the twentieth century, heavily subsidized irrigation in both countries led to further development of irrigated farmland; planting high-value, high-water crops became a popular convention. Hydroelectric dams and multiple water projects during the New Deal era brought still more development and severe, permanent changes to the riparian habitat of the region.

Figure 2.6. Rio Grande Valley citrus crop.
Photograph courtesy of TxDOT.

Increased need for metals and manufacturing during World War II led a revival of settlement in the border region, as manufacturing plants and military bases were established in the region to be in close proximity to Mexican mines. The Green Revolution that started in the 1950s brought about technical innovations in farming, as well as heavy pesticide use and agriculture-intensive use

of the land causing erosion, runoff, and chemical seepage into groundwater. Increased agricultural production in the U.S. placed a heavy demand on labor, leading to the Bracero guest farmworker program in the 1940s to bring labor from Mexico (Liverman, et al. 1999). Thus, the *1944 Treaty* was an extension of policies that encouraged development and use of resources, including water resources.

Bayview v. Mexico[20] should serve as an important turning point to support new policies that encourage sustainability of water resources. It will be important to involve local water resource managers when discussing or implementing any changes to the *1944 Treaty*. Local water resource managers have region-specific knowledge of how current policies do or do not work well for their regions, and will have an understanding of how best to implement changes both from an infrastructural and social standpoint.

Chapter Summary

The Rio Grande is one of the longest rivers in North America. The river travels through the mountains of Colorado and flows through New Mexico before forming the international boundary between the United States and Mexico along the southern border of Texas and ending at the Gulf of Mexico. The Rio Grande travels through the many different climatic regions of Texas, which affect the river's utilization and the demand placed on the river by the increasing population along Texas' southern border.

Water law differs significantly between the United States and Mexico. The United States Constitution allows individual states to retain nearly all authority over water rights, therefore Texas laws governing the surface water and groundwater are of particular importance. In Texas, water rights laws are based off of two main philosophies, the *public trust doctrine*, which

[20] *Bayview Irrigation District #11 v. United Mexican States*, 2008 CanLII 22120 (ON S.C.).

pertains to surface waters, and the *rule of capture*, which applies to groundwater. Despite other laws, the *1944 Treaty* between the United States and Mexico governs use of Rio Grande water.

The *1944 Treaty* was ultimately shaped by the history of Rio Grande water management. Economic policies in the United States and Mexico led to population increases and increased reliance on the Rio Grande. Political disputes between the two countries led to several treaties to manage the Rio Grande, with the *1944 Treaty* becoming the treaty with broadest scope in the region. Since the ratification of the *1944 Treaty*, further political disputes motivated by economic concerns have led to amendments to the *Treaty* and the recent international lawsuit, *Bayview v. Mexico*.

The next chapter provides and in-depth look at the *1944 Treaty*, identifies six major issues that have arisen from the *Treaty* provisions, and introduces the first conceptual framework.

Chapter 3: *1944 Treaty* Issues

Chapter Purpose

The purpose of this chapter is to describe the six prominent issues in binational water management under the *1944 Treaty* as they relate to the Texas-Mexico border region through a review of the scholarly literature. The issues associated with the *1944 Treaty* are used to develop a descriptive categories conceptual framework. The descriptive categories employed in this chapter are used to organize subsequent empirical investigations of local Texas government officials' support for amending the *1944 Treaty*, and their opinion on the *Treaty*'s effectiveness. Local support for or against amending the *Treaty* is important because of the decentralization of water regulation in the United States. Opinions of local Texas government officials that manage water resources across the Texas-Mexico border region will have an influence on any future treaty negotiations that take place at the level of the U.S. Department of State.

A main focus of the *1944 Treaty* is the allocation of the international waters of the Rio Grande to the United States and Mexico. Additionally, the *Treaty* allocates specific amounts of water from the Rio Grande's 14 major tributaries and the Colorado River (Hurlbut 2001; United States 1944). The U.S. receives 1/3 of the water from the Rio Grande from Mexico, an amount not less than 350,000 acre-feet,[21] in exchange for 1.5 million acre-feet of water each year from the Colorado River (United States 1944, 8-10). The *Treaty* also provides that the countries will split in half all water in the Rio Grande not explicitly covered in the agreement, known as "50/50 water" (Phillips 2002, 2).

[21] An acre-foot is approximately 326,000 gallons, or the amount of water that would cover one acre of land at a depth of one foot.

At the time that the *Treaty* was negotiated, Mexico's focus for economic development was the Mexicali Valley.[22] Hence, rapid industrialization and population growth in the Texas region of the Rio Grande was not expected and water needed for such development was not allocated for (Fischhendler 2004). The population boom on the Texas-Mexico border, spurred by Mexico's Border Industrialization Program in the 1960s, has led to an increased demand on the Rio Grande River, causing water overallocation, and heightened political tensions between the United States and Mexico.

After reviewing the literature regarding the *1944 Treaty* issues of (1) scale, (2) groundwater exclusion, (3) extraordinary drought, (4) utilization, (5) dispute resolution, and (6) joint data sharing have emerged. These issues form the basis of the questionnaire sent to local officials in the Texas border region.

Scale

One element of the *1944 Treaty* that has led to political tension is the narrow scale of *Treaty* jurisdiction. The scale of the treaty has been a contentious issue since treaty negotiations began in the 1920s (Kibel and Schutz 2007), and have continued to the present day. Western states, with the exception of Texas, were opposed to the *1944 Treaty* from the outset and used their political power to restrict the *Treaty* to surface waters crossing the international boundary. The limited scale of the *Treaty* left water management elsewhere in the Rio Grande Basin to individual states (Fischhendler 2004), and has perpetuated the historically fragmented management system for the basin. At least five interstate and international agreements currently govern the use of water in the Rio Grande Basin:[23] the Rio Grande Compact of 1939;[24] the Pecos

[22] The Mexicali Valley is located in Mexico, south of California and along the Colorado River.
[23] The Rio Grande Basin spans a large geographic area that includes Colorado, New Mexico, and Texas in the United States and Chihuahua, Coahuila, Nuevo Leon, and Tamulipas in Mexico.

River Compact of 1948;[25] the Rectification of the Rio Grande Convention between the United States and Mexico of 1933;[26] the Equitable Distribution of the Waters of the Rio Grande between the United States and Mexico of 1906;[27] and the *1944 Treaty* (Moore, et al. 2002).

Figure 3.1. The Rio Grande at the New Mexico–Texas border.

Photograph by Robert Duke, Jr. Reproduced with permission from Robert Duke, Jr., www.el-paso-lifestyle.com.

Agreements that affect the upper basin, the Rio Grande Compact and Pecos River Compact, impact the water available for allocation downstream (Moore, et al. 2002). When these agreements were negotiated, population was sparsely scattered across the basin and water allocations stipulated by each agreement could more than meet the needs of inhabitants basin-wide. Seasonal variations in climate and hydrology, while known by the U.S. and Mexican governments to be an issue, were less of a threat because the population was smaller

[24] The Rio Grande Compact is an agreement between Texas, New Mexico, and Colorado.
[25] The Pecos River Compact is an agreement between Texas and New Mexico.
[26] Flood control, straightening of the channel, and bank stabilization to prevent erosion along a 155-mile reach of the river through the El Paso-Juarez Valley, was accomplished under the Rectification of the Rio Grande Convention between the United States and Mexico of 1933.
[27] The Equitable Distribution of the Waters of the Rio Grande between the United States and Mexico of 1906 is an agreement that apportions the Rio Grande River between the U.S. and Mexico, from El Paso, Texas to Fort Quitman, Texas.

(Fischhendler 2004). Population growth and climate uncertainty has created a need to increase the scale of water management agreements to consider the needs of the entire Rio Grande Basin.

Widening the scale of the *1944 Treaty* to include the entire basin is possible due to the built-in amendment mechanism, known as the "Minute" system.[28] The United States showed support for expanding the *Treaty*'s scale in a statement issued at the 1997 United Nations Convention on the Law of the Non-navigational Uses of International Watercourses. The statement acknowledged that activity in one part of the basin has consequences elsewhere, and this causal relationship is a reason to consider international legal rules that govern water resources on a basin-wide scale (Ingram 2004). Though the Minute mechanism allows the United States and Mexico to legally amend the scale of the *Treaty*, it will be difficult politically because Colorado, New Mexico, Texas, and Mexico must all agree to any amendment. The Mexican federal government has been reluctant to renegotiate the *Treaty* because changes to allocations from the Rio Grande River may affect allocations from the Colorado River (Fischhendler 2004).[29] Additionally, support from local water managers and each state government will be key in changing the scale of the *1944 Treaty*. Rio Grande Basin states have engaged in legal battles over water resources in the past (Earl and Czerniak 1996). If negotiations to amend the *1944 Treaty* would seek to redistribute water allocation to the states as well, it is plausible that disagreements between states would stop any *Treaty* amendments.

[28] The *1944 Treaty* can be amended through the addition of Minutes, official agreements between the two nations negotiated by the IBWC.
[29] United States 1944. Article 10 of the *1944 Treaty* stipulates that the United States deliver 1.5 million acre-feet of water to Mexico from the Colorado River.

Groundwater Exclusion

The exclusion of groundwater from the *1944 Treaty* has already created serious tensions between the United States and Mexico, and continues to be a major issue. Groundwater is a principal source of fresh water for many communities that straddle the international border and in the Rio Grande Basin. Many are either wholly or mostly dependent on groundwater as their source of fresh water for basic human needs (Mumme 2005*a*). Although it is a vital resource, the *1944 Treaty* did not address groundwater until Minute 242[30] was agreed to in 1973. Water from the Upper Colorado River Basin used by American farmers for irrigation became highly saline after the water percolated through the salty Western soils and back into the Colorado River

Figure 3.2. Irrigation channel.
Photograph courtesy of Texas Department of Transportation.

hydrological system as groundwater. By the time the water reached the Mexicali Valley in Mexico, it had become so saline that it was toxic for Mexican farmers' crops. To find fresh water

[30] IBWC 1973. Known as Minute 242, the Permanent and Definitive Solution to the International Problem of the Salinity of the Colorado River.

for irrigation, Mexican farmers began drilling more, and deeper, groundwater wells, causing a drawdown on aquifers straddling the border. These actions also caused much alarm for U.S. farmers just across the border, who were also dependent on groundwater (Ingram 2004; Mumme 2005*a*). Minute 242 was negotiated to manage salinity of the water flowing to Mexico, and to limit groundwater pumping in an eight-kilometer perimeter of the Arizona-Sonora boundary to a fixed annual amount (IBWC 1973). Extremely limited in scope and silent on any groundwater issues in the Rio Grande Basin, Minute 242 stops well short of providing guidance on how to best allocate, or even define groundwater resources.

Matsumoto (2002) describes two reasons why binational groundwater is often excluded from international water agreements, including the *1944 Treaty*. First, the physical characteristics of each aquifer vary, making the groundwater difficult to geographically define. The international border between the United States and Mexico shares at least ten aquifers, and at least four of those lie along the Texas-Mexico border.[31] Aquifers are difficult to delineate clearly[32] and other experts such as Mumme, researchers at the United Nations Educational, Scientific and Cultural Organization and the Organization of the American States (UNECSO/OAS), and the EPA have identified up to twenty shared aquifers along the U.S.-Mexico border.[33] Second, even with modern monitoring and modeling techniques, characterizing groundwater "ownership" is difficult, if not impossible. Aquifers are not located precisely within the borders of one specific owner or country, making it difficult to separate the water into distinct parcels. Scientists also argue that displacement or alternation of water in nearby aquifers, or in the surface water above, affects the quality and quantity of water in other aquifers, adding

[31] Todd Jarvis, e-mail message to author, October 10, 2009; International Groundwater Resources Assessment Centre (IGRAC). 2009. Transboundary Aquifers of the World. http://www.igrac.nl/.
[32] Aaron T. Wolf, e-mail message to author, October 8, 2009.
[33] Gabriel Eckstein, e-mail message to author, October 10, 2009.

another layer of complexity to a system that is not well understood (Matsumoto 2002; Patino-Gomez, et. al 2007).

Consequently, the dominating groundwater law in Texas, the *rule of capture*, becomes more difficult to justify when considering that the ownership of groundwater is scientifically impracticable and the displacement of large amounts groundwater has far-reaching negative effects.[34] One could argue that groundwater extraction on the Mexican side of the border could violate property rights of U.S. citizens by violating the *rule of capture*. Likewise, pumping on the U.S. side of the border could compromise water interests of Mexican citizens. Moreover, current groundwater extraction on both sides undermines current assessments of groundwater supply mandated by the Texas Legislature, thereby constraining the regional water planning process currently underway in Texas.[35] While these actions essentially violate the *rule of capture*, the rule itself exacerbates these problems by allowing unrestrained groundwater extraction. Without clear guidance from the *1944 Treaty*, the *rule of capture* becomes the prevailing law for groundwater management on the Texas side of the Rio Grande. Therefore, the *rule of capture* and the *1944 Treaty* become stumbling blocks for effective groundwater management.

Matsumoto (2002) and Mumme (2005*a*) argue that lack of reliable data makes it difficult to come up with an international legal framework to govern the use of groundwater, and dissuades neighboring countries from coming to an agreement because they may put themselves at a disadvantage without accurate information. Lack of data leads to uncertainty in groundwater management, and problems are often disregarded until a problem reaches the level of crisis. As communities along the Texas-Mexico border have grown in population, they have also increased their dependence on the Rio Grande and the groundwater found in binational aquifers. Water in

[34] See page Chapter 2 for an explanation of the rule of capture.
[35] Chris Brown, e-mail message to author, December 4, 2009.

the aquifer is being depleted, while the source of recharge for the aquifer is simultaneously being depleted. Hurlbut (2001) argues that the only two sources of water that exist for this region are both being depleted at unsustainable rates.

Booker, et al. (2005) contend that although groundwater has historically met the municipal and economic needs in the region, current groundwater withdraw is unsustainable. Lack of a framework with clear goals for international cooperation on this issue can only serve to exacerbate the problem. An amendment to the *1944 Treaty* that addresses groundwater allocation in binational aquifers would be a natural first step in establishing this framework (Hurlbut 2001; Mumme 2005*a*). Again, political and legal difficulties present challenges to regulating groundwater through an international treaty because this type of regulatory power is in direct conflict with the history of U.S. domestic water law and current Texas water law[36] (Hurlbut 2001; Mumme 2005*a*). Although the U.S. Constitution specifies that an international treaty trumps state law (Hurlbut 2001), any change in the regulatory authority of water will create political backlash. Including groundwater allocation in the *1944 Treaty* may be politically treacherous, but it may be necessary if water supply is to meet growing demand.

Extraordinary Drought

The "extraordinary drought clause" in Article 4 of the *Treaty* is of critical importance to Texans who depend on the Rio Grande. The extraordinary drought clause allows Mexico to run a water "deficit" [37] with the United States "in the event of extraordinary drought or serious accident to the hydraulic systems on the measured Mexican tributaries, making it difficult for Mexico" to deliver waters from the Rio Grande River to the United States (United States 1944).

[36] Texas water law is described in more detail in the "Water Law" section of this paper in Chapter 2.
[37] The *1944 Treaty* uses five-year "accounting" cycles to measure water flow; allotments are then based on this five-year cycle average.

Fischhendler (2004) maintains that Mexico was aware that fluctuations in water flow are a common experience along the Rio Grande, and is the reason that the Mexican government insisted that the extraordinary drought clause be included. Both the United States and Mexican governments assumed that Mexico would be able to pay back any deficit in either one or two of the five-year water accounting cycles, and that drought in the region would not have a long-term impact.

The central issue with the extraordinary drought clause is that the *Treaty* does not define what is meant by "extraordinary drought." Records of the *Treaty* negotiations between the United States and Mexico do not reveal a clear explanation either.[38] This ambiguity remained relatively unnoticed until Mexico fell over one million acre-feet short of *Treaty*-required water deliveries between 1992 and 1997, a period characterized by lower than average rainfall (Rosson, et al. 2003). Negotiations to make up the water deficit failed when Mexico claimed that extraordinary drought was preventing the delivery of both the standard yearly delivery and any deficit (Moore, et al. 2002). In spite of the extraordinary drought, agricultural production and irrigation continued and even increased slightly, according to a study conducted by Texas A&M University (Rosson, et al. 2003). Texas farmers and government officials began insisting that the drought was not extraordinary enough to stop agricultural production in Northern Mexico and that the Mexican government was intentionally keeping the water for its own use. Then-Agriculture Commissioner of Texas, Susan Combs, even presented satellite images of the Rio Conchos[39] and reservoirs in Mexico to the U.S. State Department to initiate federal government action to enforce *Treaty* provisions (Phillips 2002). Thus began the basis for the NAFTA lawsuit

[38] See Ingram 2004; Gleick 1988, Moore, et al. 2002; Mumme 2003.
[39] The Rio Conchos is the major Rio Grande tributary in Chihuahua, Mexico. It feeds the Lower Rio Grande Basin.

described in Chapters 1 and 2 of this paper, in which Texas sued Mexico over water ownership rights.

Exercise of the extraordinary drought clause sparked a firestorm of political controversy and pitted Southern Texas farmers against their Mexican neighbors. At the heart of this political and legal issue is an agreed-upon definition of extraordinary drought conditions. Extraordinary drought is likely to become an issue in the future in part due to the location of the region,[40] and because of higher dependence on the Rio Grande as the population increases. Negotiations between the United States and Mexico, and the addition of a Minute to define extraordinary drought would aid both countries in future situations when dispute resolutions should be sought.

Utilization of International Waters

Issues over the allocation of *Treaty* waters are not the only problems in the region. The utilization of *Treaty* waters has become an issue of greater importance as environmental concerns have grown as population and pollution have increased along the Texas-Mexico border. Article 3 of the *1944 Treaty* outlines the utilization of the international waters and provides a priority ranking of uses. Municipal uses are promoted as the most important, followed by agricultural and livestock use. Utilizing water for electric power production and other industrial uses are the next highest priorities, followed by navigation, fishing and hunting. Lastly, *Treaty* water can be used for any other beneficial uses as determined by the IBWC. The list of utilization priorities notwithstanding, the *Treaty* mandates that resolutions for border sanitation problems will take preference over all other uses (United States 1944). Environmental and

[40] See Chapter 2, Geography of Texas along the Rio Grande.

ecological uses are missing from this list of utilization priorities.[41] As urban and industrial development and agricultural production has increased in the Texas-Mexico border region, a small, yet growing emphasis on the destruction of the river and riparian habitat has emerged.

As with *Treaty* water allocation, issues with utilization have developed over the last 65 years since the *Treaty* was signed. Increases in urban development, agricultural production, and industrial growth in the Texas-Mexico border region, and the emergence of environmental issues into international politics have given credence to the idea of including environmental and ecological uses as a priority of the utilization of *Treaty* water. While several U.S. domestic laws provide protection for the environment and water-dependent species, the *Treaty* is ambiguous on this issue (Mumme 2003). As written, environmental and ecological uses could be considered as "any other beneficial uses" (United States 1944), the lowest priority use mentioned in the *Treaty*. The term "beneficial use" can be interpreted in many ways, leaving environmental and ecological uses little room for distinction. As Moore, et al. (2002, 9) assert: "The water needs for maintaining aquatic ecosystems, minimum instream flows, and freshwater for bays and estuaries, are often omitted or given scant attention in planning efforts." In other words, environmental and ecological are typically given little or no priority in economic development planning.

Moore, et al. suggest finding the smallest amount of water possible to sustain human, industrial and agricultural uses to give environmental and ecological uses room at the table during water resource planning discussions (2002). Implementation of the proposal suggested by Moore, et al. would require a water use paradigm shift, not just for water managers, but also for all water users. Hence, a shift in ideas from "how much can we use" to "how much should we use" will undoubtedly open the door to controversy as limiting water use tends to be an

[41] Hurlbut 2001; Mumme 2003. Although U.S. domestic laws give weight to environmental and ecological uses of the nation's water, the *1944 Treaty* is the highest legal authority for water in the Rio Grande. Therefore, uses prioritized by the *Treaty* take precedence over any others.

unpopular policy with most of the public. After all, limiting the use of water for the benefit of the environment will have economic and personal comfort ramifications for millions of people that have grown accustomed to using the resource without limitation. Such ramifications were seen when recent water cutbacks in California's Central Valley resulted in protests and layoffs for thousands of farm workers. The cutbacks can partially be attributed to a 2007 court ruling[42] that limits water pumped from nearby rivers in order to provide water flow for several endangered species of fish (Wood 2009). The Middle Rio Grande experienced a similar controversy in federal court in 2003[43] over the silvery minnow, an endangered fish that was being further threatened by Albuquerque's municipal water plan (Vesbach 2003). The federal Endangered Species Act of 1973 has provided a basis of protection for these fish, but not without struggles between environmental defenders, farmers, and residents being played out in the federal courts and broadcast by the media.

Figure 3.3. Rio Grande Silvery Minnow.
Photograph by Aimee Roberson/U.S. Fish and Wildlife Service.

Although U.S. domestic laws afford protection to environmental and ecological uses of water in the region, the *1944 Treaty* is the highest legal authority for Rio Grande water. Because the *Treaty* is ambiguous about protecting environmental and ecological uses of the Rio Grande, the IBWC may be called upon to mediate negotiations between the United States and Mexico to

[42] *Natural Resources Defense Council v. Kempthorne*, 506 F.Supp.2d 322, 2007.
[43] *Rio Grande Silvery Minnow v. Keys*, 469 F.Supp.2d 1003.

add a Minute to address new utilization priorities (Mumme 2003). The IBWC, however, has traditionally promoted policies in the Rio Grande Basin designed to increase water channel carrying capacity and remove vegetation from the riparian corridor. These actions are in direct conflict with environmentalist efforts to maintain or restore riparian habitat (Kelly and Székely 2004). The federal governments of the United States and Mexico direct the IBWC's policies. Therefore, a priority must be made for environmental and ecological uses of *Treaty* water at the Mexican and U.S. federal levels if a change in policy is to occur at the IBWC. Local officials can accelerate this policy change by showing support for placing environmental and ecological uses on equal footing with municipal, agricultural, and industrial uses.

Dispute Resolution

Dispute resolution of *Treaty* provisions has largely occurred through the negotiation and addition of Minutes to the *1944 Treaty* by the IBWC. The power to resolve disputes over *Treaty* waters is given to the IBWC by Article 2 of the *Treaty*, which considers the IBWC an international body comprised of two sections, a United States Section and a Mexican Section (United States 1944), The employees of each section are given diplomatic status (Mumme 2005*a*; United States 1944), and each

Figure 3.4. Irrigation channel at Santa Ana National Wildlife Refuge, Alamo, Texas.
Photograph courtesy of the author.

section works through their respective federal state departments to resolve disputes. Issues with the IBWC's dispute resolution process rose from the local to the international stage during the two most noted controversies over *Treaty* waters, the Colorado River Salinity Crisis, resolved in 1973, and the recent Rio Grande water deficit that ended with the NAFTA tribunal ruling in 2008. Critics charge that the dispute resolution process only reaches the level of "higher ranking staff" when issues reach the stage of crisis (Kelly and Székely 2004); Minutes are then added hastily and in an ad-hoc fashion, instead of addressing the underlying issues of the dispute (Mumme 2003).

One reason for the hasty, ad-hoc decisions of the IBWC, according to Ingram (2004), is that the U.S. and Mexican sections of the IBWC have developed close ties with their local counterparts, so that when disputes arise each section is much less willing to compromise. One could argue that the point of having an international commission is to negotiate and defend international interests, rather than local political interest that benefit specific parties. Similarly, Mumme (1985) describes that the close relations between the U.S. section of the IBWC and state governors and legislators is the reason for the Commission's bias toward state interests in past negotiations. Rather than remaining a neutral international mediator, each section of the IBWC is supporting their country's efforts for political gain. If, in fact, local and state officials sway the IBWC as Ingram and Mumme assert, the attitudes and opinions of these officials toward binational water management become increasingly important. Ingram and Mumme are critical of the IBWC's decisions, noting that the IBWC has done little to advance effective binational water management. If local and state officials can be persuaded to take positions that favor effective

management for the international community, rather than for specific localities, the IBWC will be better positioned politically to act on behalf of their full constituency.

Although historically the IBWC has leaned in favor of state interests, negotiations for the resolution of the Rio Grande water deficit failed to satisfy Texas' concerns with *Treaty* enforcement. The *Treaty* was dubbed the "toothless wonder" by Texas government officials, after Texas was unable to persuade the IBWC and the U.S. Department of State to take action against Mexico for the water deficit that was, in their opinion, illegal (Ingram 2004). Texas then took legal action under NAFTA, since neither the *1944 Treaty* or the IBWC has a provision for individuals seeking redress from countries (Sherman 2008).

The IBWC's role as an impartial, effective dispute mediator has been questioned by individuals, state officials, and scholars. Those outside of the IBWC perceive dispute resolutions as only reaching the level of public notice in times of crisis (Kelly and Székely 2004; Mumme 2005*b*). It is possible that other disputes have manifested and the IBWC has carried out its dispute resolution duties effectively. It is important to analyze the IBWC's effectiveness in this arena, and to gather perceptions from interested parties because the IBWC's decisions on the disposition of *Treaty* waters can potentially affect international agreements, such as NAFTA, or domestic laws meant to protect citizens or species (Ingram 2004).

Joint Data Sharing

Article 24 of the *1944 Treaty* sets an expectation that the IBWC will, under the auspices of each section, "provide hydrographic data necessary" to observe *Treaty* mandates, and that this information will be compiled and exchanged between the two sections as needed (United States 1944). Further, Minute 308, signed in 2002 as a response to the Rio Grande water deficit with Texas, recorded both countries' support of increasing the exchange of hydrological data to allow

the IBWC to carry out *Treaty* mandates (IBWC 2002). The biggest obstacle for joint data sharing is the development of a comprehensive database of information that includes information from both the United States and Mexico. Both nations gather data and have shared it with each other; however, this data has been considered unreliable due to large variances in the estimates between nations (Hurlbut 2001). Tate (2002) remarks that data is not shared between the government and the public, or between governments because it is standard procedure to treat all information as strategic. It is thought that sharing this information weakens the government's authority. Hence, variances in data or lack of data may be the result of poor information gathering, or alteration of data by governments to avoid alarm and diminished credibility.

Although scientifically possible through improved geographic information systems (GIS) technology (Hurlbut 2001; Patiño-Gomez, et al. 2007), the creation of a database is hindered by negative political interaction (Hurlbut 2001). Breaking down barriers of suspicion between the two sides should aid in the free sharing of data to enhance established databases and give the IBWC the tools to improve management of the Rio Grande. Researchers from The University of Texas at Austin, Deane McKinney and Carlos Patiño-Gomez, created the first major attempt at a transboundary water database known as the "Physical Assessment Project." Patiño-Gomez spent several years working in the Mexican government on water projects, and was instrumental in creating an atmosphere of diplomacy using his language skills and inside knowledge of the government (UT Austin 2005). McKinney noted that they had no trouble obtaining the data, although it took many years to build a relationship of trust between the major stakeholders.[44] Building and keeping the trust of major stakeholders will be necessary to the continuation of transboundary water databases such as this.

[44] Daene McKinney, e-mail message to author, October 13, 2009.

To capitalize on improved GIS technology and to expand on existing agreements for joint data collection and sharing, the United States Congress passed the United States–Mexico Binational Aquifer Assessment Act of 2006 (hereinafter "the Binational Aquifer Act").[45] The Binational Aquifer Act provides funding[46] and authority for federal and state agencies to engage in data collection and sharing with other entities, including those in Mexico (United States Congress 2006). The Binational Aquifer Act shows commitment from the U.S. federal government to support the *1944 Treaty* and Minute 308. What supporters of the Binational Aquifer Act may not have anticipated is apprehension on the part of Mexican government officials, who feel that the U.S. may be taking inventory of water supplies to lay a claim of ownership. Navarro (2008) states that while Mexican government officials agree certain provisions of the Binational Aquifer Act are needed, the unilateral action by the U.S. to begin the inventory of underground water supplies with little, if any, input from Mexico is alarming. This alarm is given more credence in light of the recent Rio Grande water deficit dispute.

The lack of reliable or available data inhibits the search for solutions to water management problems on the Rio Grande (Patiño-Gomez, et al. 2007). If parties engage in joint data sharing, findings can be analyzed and shared, providing benefit to both countries (Tate 2002). Hence, entities in the U.S. should engage Mexican authorities. Both nations should take steps to reassure the other that data collection and sharing activities are for mutual benefit, and not a way to gain ownership of scarce water resources. The first step in this process is for U.S. institutions to freely share data on water use and water supply to Mexican counterparts under the auspices of a joint collaboration for binational water management planning.

[45] House Committee on Resources, Subcommittee on Water and Power. Statement of Dr. P. Patrick Leahy on S.214/H.R. 469, "United States-Mexico Transboundary Aquifer Assessment Act," May 10, 2006.
[46] Eckstein and Hardberger 2008. The Congress initially funded the Binational Aquifer Act in 2008 with $1 million, although up to $50 million is approved over the next ten years.

Conceptual Framework 1: Descriptive Categories

The first purpose of this research is descriptive, and the conceptual framework used is descriptive categories. The use of descriptive categories organizes the inquiry by describing the main areas of binational water management addressed by the *1944 Treaty*. A review of the *1944 Treaty* and the scholarly literature has yielded six specific areas of binational water management. These six areas provided the basis for a questionnaire meant to gather the attitudes and opinions of local Texas government officials in the border region toward the effectiveness of the *1944 Treaty*. Table 3.1 lists the six binational water management issues and links them to the literature.

Table 3.1. Summary of Conceptual Framework, Research Purpose 1.

Research Purpose 1: describe the attitudes and opinions of local Texas government officials that manage water resources in the border region toward six binational water management issues under the *1944 Treaty*.	
Issue	*Literature*
1. Scale	Earl and Czerniak 1996; Fischhendler 2004; Ingram 2004; Kibel and Schutz 2007; Moore, et al. 2002
2. Groundwater Exclusion	Booker, et al. 2005; Eckstein 2009; Hurlbut 2001; IBWC 1973; IGRAC 2009; Ingram 2004; Jarvis 2009; Matsumoto 2002; Mumme 2005*a*; Wolf 2009
3. Extraordinary Drought	Fischhendler 2004; Gleick 1988; Ingram 2004; Moore, et al. 2002; Mumme 2003; Phillips 2002; Rosson, et al. 2003; United States 1944
4. Utilization	Kelly and Székely 2004; Moore, et al. 2002; Mumme 2003; United States 1944; Vesbach 2003; Wood 2009
5. Dispute Resolution	Ingram 2004; Kelley and Székely 2004; Mumme 1985; Mumme 2003; Mumme 2005*a*; Mumme 2005*b*; Sherman 2008; United States 1944;
6. Joint Data Sharing	Eckstein and Hardberger 2008; Hurlbut 2001; IBWC 2002; McKinney 2009; Navarro 2008; Patiño-Gomez, et al. 2007; Tate 2002; United States 1944; United States Congress 2006; UT Austin 2005

Chapter Summary

The *1944 Treaty* regulates binational management of the Rio Grande. The *Treaty* was negotiated at a time of high economic development and low population, thus the *Treaty* emphasizes activities that favor economic development. Political policies that stimulated population growth also over-allocated Rio Grande water resources, and have led to tensions over the *1944 Treaty* and the management of the river. Six major issues have arisen under the *1944 Treaty*:

(1) Scale. The scale of *Treaty* jurisdiction has led to a fragmented system of treaties and domestic laws that govern the whole of the Rio Grande Basin, leading to ineffective water management.

(2) Groundwater exclusion. The exclusion of groundwater from the *Treaty* has left a significant and rapidly diminishing water source without an internationally negotiated legal framework.

(3) Extraordinary drought. The *Treaty*'s authors did not define the term "extraordinary drought." This oversight led to the case *Bayview v. Mexico*, and is likely to lead to similar disputes in the future.

(4) Utilization. The *Treaty* lacks a priority for environmental and ecological uses of water from the Rio Grande. As portions of the river dry completely and the river periodically stops flowing to the Gulf of Mexico, animal and plant populations that depend on the river are put at risk.

(5) Dispute resolution. The *Treaty* mandates that the International Boundary and Water Commission (IBWC) resolve all disputes arising under the *Treaty*. The IBWC's current process has come under attack by critics who see it as slow and biased.

(6) Joint data sharing. The *Treaty* suggests, but does not require the United States and Mexico to engage in joint data sharing. Yet many scholars agree that the lack of data sharing has hindered binational water planning in the region.

The next chapter discusses other binational water management concerns that are not specifically related to the 1944 *Treaty* and introduces the second conceptual framework.

Chapter 4: Binational Water Management Concerns

Chapter Purpose

International relations fall under the jurisdiction of the federal government. Binational water management also falls under the jurisdiction of the federal government because management agreements involve two or more nations. Despite this, binational water management is a pressing issue for local water officials and public administrators in Texas. There are two reasons for increasing concern on the local level. First, historically, states have been delegated the authority to regulate water within their political boundaries. Rapid development and population increases in areas of Texas have caused heightened concern for adequate water *quantity* for new residents and business. Second, for local officials, there has been a shift of increasing financial and enforcement responsibility of federal environmental mandates to the states.

State governments, in turn, rely on local officials to monitor and aid in enforcement of such mandates (Brown 2008; Tresner 2009). "States now operate 96 percent of the federal [environmental] programs that are delegable to them" (Brown 2008, 1). The federal programs that encompass water, such as the Clean Water Act and the Safe Drinking Water Act, are largely centered on water *quality*. Concurrently, a shift in political ideals has led to greater local or state-centered control of social policy. EPA Deputy Administrator, Marcus Peacock, summed up this policy shift in a recent statement, "State and local officials often serve as the 'front line' managers of federally mandated environmental regulations" (EPA 2008). State and local governments have not only become responsible for "nearly all the enforcement of national

environmental laws," they have also had to make decisions in areas where "Congress has not acted" (Graham 1998, 66).

The purpose of this chapter is to examine how this increased reliance on local management of water resources affects local Texas government officials' willingness to support actions to conserve water supply and communication efforts with the international and local community. The literature review discusses issues that affect (1) willingness to support water conservation techniques, (2) international communication and cooperation, and (3) community involvement. Three working hypotheses are developed to explore these three issues.

Willingness to support water conservation techniques

As discussed previously, concerns about water supply plague the Texas region of the U.S.-Mexico border due to extensive drought, population increase, and increases in industrial and agricultural activity (Mumme 2003; Mumme 2005*a*). Yongmei, et al. (2005) note that in the Upper Rio Grande Basin, water supply is decreasing due to heavy extraction of groundwater from aquifers, the main source of fresh water in the region, for industrial, agricultural, and municipal uses. The City of El Paso, Texas, projects that Hueco Bolson, the main source of water for the cities of El Paso and Cuidad Juarez, Chihuahua, will be depleted by 2025 (Liverman, et al. 1999). The depletion of the Hueco Bolson will result in millions of people without a source of water for even the most basic human needs. In the Middle and Lower Rio Grande Basins, demand for water is also expected to outpace supply. Growth in industry, agriculture, and population in the major metropolitan areas of Laredo/Nuevo Laredo, McAllen/Reynosa, and Brownsville/Matamoros have accelerated water usage. The main source of water for this portion of the basin is the Rio Grande. At the current rate of use, the water supply in the Rio Grande is

expected to diminish rapidly in the second half of the 21st century (Eaton and Hurlbut 1992). The urgency was epitomized when the Rio Grande stopped flowing into the Gulf of Mexico for the first time in recorded history, in 2001 (Ingram 2004).

Figure 4.1. Satellite imagery of the Rio Grande at the Gulf of Mexico.
Image Courtesy of The University of Texas Center for Space Research.

Demand for water in the Texas border area is projected to increase 15 percent from 2010 to 2060 (Texas Water Development Board 2007) (see table 4.1).[47] Water conservation can alleviate strain on water supply, conserve money and energy by lessening the amount of water that must be treated by wastewater facilities, and extend the supply of fresh water for a longer period. The most politically, economically, and environmentally feasible way to address water supply issues, according to Gleick (1988, 36), is to change "the way existing water resources are priced and used."

[47] Regional water planning groups N, M, L, J, F, and E encompass the 32 counties in Texas that are defined as the border region. Due to the delineation of the regional water planning groups, more than the 32 border counties are included in this projection. See Appendix E for a map of the regional planning groups.

Table 4.1. Projected water demands for regional water planning groups N, M, L, J, F, and E.
Source: Texas Water Development Board State Water Plan, 2007.

Region	Year 2010	Year 2060	% Change from 2010 to 2060
N	226,691	308,577	36%
M	1,474,242	1,661,657	13%
L	985,237	1,273,003	29%
J	51,844	58,559	13%
F	807,453	825,581	2%
E	662,608	721,071	9%
Total for All Regions	4,208,075	4,848,448	15%

Moore, et al. (2002, 9) argue that increasing irrigation efficiency in the Rio Grande Basin could reduce water consumption by 25 percent or more, without any decrease in agricultural production. Another technique for agricultural water conservation is lining irrigation canals in the major irrigation districts. Similarly, municipal and industrial water use can be substantially decreased using modern conservation technologies, such as water use restrictions, water recycling (also known as gray water), low-flow plumbing and appliances, and xeriscaping (Moore, et al. 2002).

Figure 4.2. Illustration of a household gray water system.
Source: www.treehugger.com.

Other popular strategies to conserve water are market pricing and market transfers (Booker, et al. 2005). A market pricing system for water would adjust the price per unit of water

to reflect supply and costs associated with the draw, delivery, and treatment. As water prices rise, water users will, in theory, conserve water because of cost. Market transfers allow water users to sell or trade water rights with others. Market transfers allow water rights to go to those most willing to pay for the benefits. Mumme (2005a) and Vickery (2009) argue that without a cost incentive, there will be no incentive to conserve water. Conversely, market pricing and market transfers cause access concerns for water users at low incomes. Johansson, et al. (2002) suggest adopting variable pricing based on income, or water subsidies for lower income users to overcome this disparity.

Any strategy employed to conserve water must be effectively communicated and marketed to the public to encourage widespread adoption, whether the policy is voluntary or mandatory. Local Texas government officials that manage water resources may be reluctant to advocate mandatory adoption of some strategies, due to the perceived infringement on personal rights or the effects of cost incentives on lower income residents.

It is clear that the water supply is increasingly strained and some conservation strategies will have to be adopted to promote sustainable use. Due to the increased strain on water supply, one would expect:

WH_1: Local Texas government officials that manage water resources will support actions to restrict water usage.

International Communication and Cooperation

Sussman (2004) argues that rather than focusing on collaborative effort, global environmental policy has focused on the goals of individual nations: economic expansion,

political security, and international prestige. Thus, the first step to addressing environmental policy issues, which include water quantity and quality issues, is for nations to overcome differences, and strive for international cooperation.

Variation in regulations and regional norms across international boundaries present serious challenges to water managers and lawmakers. Saint-Germain (1995*b*) found that cultural and legal differences often keep local officials in the region from communicating with their counterparts across the border. In her study of cooperation among public managers in the Texas border region, public managers identified language, culture, politics, and initiative as barriers to increased cooperation. While these barriers were identified, "[t]he overwhelming majority of public managers interviewed in this study agreed that increased communication would benefit their agency" (1995*b*, 102). In addition to cultural and legal differences, local officials in both countries "fear lack of understanding of the border area by far-away bureaucrats or political appointees" (Saint-Germain 1995*a*, 95). When local officials reach across the border to initiate cooperation for public service delivery, the agreements are informal and undocumented because local officials do not have legal authority to enter into international agreements (Saint-Germain 1995*a*).

Giving state and local governments as much flexibility as possible to work with neighboring nations may be necessary for effective binational water management. Success may depend on our ability to adapt when government, business and people work together to solve these issues. Encouraging regional collaboration, and analyzing why collaborations succeed or fail is important to understanding how to adapt to a changing water situation (Graham 1998).

Given cultural, political and legal differences between the United States and Mexico one would expect:

WH_2: *Barriers to communication and cooperation make it difficult for local Texas government officials that manage water resources to work with their Mexican counterparts.*

Community Involvement

Addressing water management from the community perspective is necessary to create trust, balance stakeholder needs and perceptions, and to create an environment of open communication and collaboration (Wang and Van Wart 2007). Frisvold and Caswell (2000) argue that involvement of academic and scientific advisors in addition to the stakeholder groups should increase knowledge of the river basins and facilitate construction of infrastructure across communities and borders, creating an economy of scale and therefore significantly reducing cost and avoiding unnecessary duplication. Shared information and increased communication should educate all parties on possibilities for collaboration, and inform water managers of public opinion on potential policies and projects.

Keeping the community involved in water supply issues is important to advancing goals of water resource sustainability. Shifts in public attention for water supply issues cause unsteady political support and funding to address these issues. Downs (1972) argues that the American public only remains focused on any one issue for a limited duration, even if that issue is something as important as our relationship to water. He details a five-step process that the public enters into, beginning with a "pre-problem" stage that involves special interest groups or experts, and then advances to a second stage of "alarmed discovery and euphoric enthusiasm" (39). During this phase there exists a clamor to find a solution to the problem at hand. The clamor only

lasts until the third stage, when "realizing the cost of significant progress" causes the issue's urgency to diminish with the public (1972, 39). Often, the realization that one will have to give up benefits that are currently enjoyed (for instance a green, grassy lawn) causes members of the public to reconsider their once fervent support and wait for new technology to solve the problem. Once at this point, public interest quickly fades into disinterest even if popular support spawned a public program or policy to find a solution (Downs 1972). Jones and Baumgartner (2005) generally agree that the attention cycle tends to culminate in alarmed discovery, although they find Downs' theory to be overly pessimistic. They find that while the public policy agenda does shift as attention shifts from problem to problem, considerable activity and public attention continues after the alarmed discovery phase fades. In effect, the level of attention may change, but "even a short-lived spurt of interest may leave an institutional legacy" (Baumgartner and Jones 1993, 87). Therefore, institutional legacy continues to drive public action even when attention shifts to a new issue.

The lack of public participation in binational water issues in the Texas-Mexico border region may be a lack of what Baumgartner and Jones call the "institutional legacy," rather than a complete lack of interest on the part of the public. Public participation is not addressed in the *1944 Treaty*, and has not been addressed by the IBWC. Yet experts (Moore, et al. 2002; Mumme 2003) argue that public participation is one of the most critical issues in binational water management, and it is essential to finding long-term resolutions. Mumme (2003, 663) notes that although the IBWC is given latitude by each government to carry out *Treaty* responsibilities, the commission has chosen not to provide opportunities for "public relations, public consultation, or more direct forms of public participation in its affairs." The result is that the public is inspired to participate in binational water management issues "in times of drought and flood," but rarely

during “normal” periods (Tate 2002, 135). This trend leads to public misunderstanding of complex water management issues, and does not advance solutions. Binational water management is priority-driven, and public involvement, including citizens, nongovernmental organizations, and scientific and policy experts, are necessary to help determine what those priorities should be (Tate 2002).

Water supply issues may fade from immediate public concern, and decisions to forego benefits from the use of water may become stale in the hope of technological advancement. Nevertheless, researchers have found that a majority of Americans engage in types of “pro-environmental behavior,” including using less water, and that two-thirds of Americans support environmental protection over economic expansion (Sussman 2004, 352). While water issues may fade from headlines, certain actions and perceptions will persist and may gain traction as social acceptance increases.

What causes some behaviors to gain traction and become part of a community’s social expectations? Gregory and Di Leo (2003) find that knowledge of environmental issues causes individuals to become engaged in actions to resolve those issues. Although this knowledge does not immediately translate into action, this knowledge is usually a prerequisite step for action. Furthermore, if water users feel personal involvement (water scarcity is a personal threat), motivation to change water consumption behaviors is enhanced (Gregory and Di Leo 2003).

The same individuals who actively seek information on water supply issues often already possess pro-environmental attitudes. Water officials who want to use public knowledge about water supply issues to promote conservation should target education programs to citizens not engaged in environmental concerns. These education and outreach methods may need to be new and creative. The 1998 report *Sustaining and Enhancing Migratory Bird Habitat on the Upper*

San Pedro River found that 89 percent of surveyed residents in the San Pedro River Basin were interested in receiving more information on local water issues. [48] The same group of respondents indicated that less than four percent felt "very well informed" on local water issues. The three most preferred sources of information for respondents were newspapers, television, and the Internet (Moote and Gutiérrez 2001, 20). Therefore, the information is either not being communicated clearly through newspapers, television, and the Internet, or the information is not reaching a large audience. Current education and outreach efforts on local water supply issues may be too passive, and local water managers should implement proactive programs to target more residents.

Aside from keeping long-time residents informed, communities with a large population increase must educate new citizens and younger generations on local water supply issues. Hence, water supply education and outreach efforts must be continuous (Trumbo and O'Keefe 2005). The Texas border region is becoming increasingly diverse, including non-native English speakers and various cultures. Accordingly, water managers should expand communication methods to include other languages and cultures. This may include increasing the amount of information shared as well as how it is shared. As Parkins and Mitchell describe: "inclusion involves more than just a seat at the table" (2005, 537). In other words, water managers must avoid simply inviting the public to policy discussions in which they cannot actively participate, or feel that their participation is meaningless. The public must be actively engaged, informed, and feel that their input is being put into action.

[48] Moote and Gutiérrez 2001. The Upper San Pedro River flows north from Sonora, Mexico to Arizona. Respondents to the survey in the *Sustaining and Enhancing Migratory Bird Habitat on the Upper San Pedro River* report were residents of the border area. Both U.S. and Mexican residents were surveyed on their views of local water issues.

Involving the community in binational water management issues is complex and communication strategies are key. Nonetheless, to achieve water resources sustainability community involvement is necessary. Thus, one would expect:

WH_3: Local Texas government officials that manage water resources will have concerns about public involvement in water management (broadly defined).

WH_{3a}: Local Texas government officials that manage water resources want input from the public and nongovernmental organizations to help solve binational water management issues.

WH_{3b}: Water issues become important to the public only in times of crisis.

WH_{3c}: Local Texas government officials that manage water resources use multiple methods to educate and communicate with the public about water supply issues.

Conceptual Framework 2: Working Hypotheses

The second purpose of this research is exploratory, and the conceptual framework used is working hypotheses. The use of working hypotheses organizes the inquiry by exploring main concerns of water management in the Texas-Mexico border region, including (1) willingness to support water conservation techniques, (2) international communication and cooperation, and (3) community involvement. These areas were identified in the literature as main areas of concern for binational water management and are the basis for the second part of the questionnaire. The

second part of the questionnaire explores the perceptions of local Texas government officials that manage water resources toward each area of concern. Table 4.2 lists the working hypotheses and links them to the literature.

Table 4.2. Summary of Conceptual Framework, Research Purpose 2.

Research Purpose 2: explore the concerns of local Texas government officials that manage water resources in the Texas-Mexico border region regarding (1) willingness to support water conservation techniques, (2) international communication and cooperation, and (3) community involvement.	
Working Hypothesis	*Literature*
Willingness to support water conservation techniques	
WH_1: Local Texas government officials that manage water resources will support actions to restrict water usage.	Booker, et al. 2005; Eaton and Hurlbut 1992; Gleick 1988; Ingram 2004; Johansson, et al. 2002; Liverman, et al. 1999; Moore, et al. 2002; Mumme 2003; Mumme 2005*a*; Texas Water Development Board 2007; Vickery 2009; Yongmei, et al. 2005
International Communication and Cooperation	
WH_2: Barriers to communication and cooperation make it difficult for local Texas government officials that manage water resources to work with their Mexican counterparts.	Graham 1998; Saint-Germain 1995*a*; Saint-Germain 1995*b*; Sussman 2004
Community involvement	
WH_3: Local Texas government officials that manage water resources will have concerns about public involvement in water management (broadly defined). *WH_{3a}: Local Texas government officials that manage water resources want input from the public and nongovernmental organizations to help solve binational water management issues.* *WH_{3b}: Water issues become important to the public only in times of crisis.* *WH_{3c}: Local Texas government officials that manage water resources use multiple methods to educate and communicate with the public about water supply issues.*	Baumgartner and Jones 1993; Downs 1972; Frisvold and Caswell 2000; Gregory and Di Leo 2003; Jones and Baumgartner 2005; Moore, et al. 2002; Moote and Gutiérrez 2001; Mumme 2003; Parkins and Mitchell 2005; Sussman 2004; Tate 2002; Trombo and O'Keefe 2005; Wang and Van Wart 2007

Chapter Summary

States have historically been delegated the authority to regulate water within their borders. Additionally, there has been an increasing shift in responsibility from federal to local governments to enforce federal water mandates. Hence, there is an increased reliance on local government officials to enforce both state and federal water laws.

Increased reliance on local government officials may affect (1) officials' willingness to support water conservation techniques, (2) international communication and cooperation, and (3) community involvement. Increased demand for water in the Texas-Mexico border region has heightened the awareness of water conservation techniques. These techniques include mandatory water restrictions, increases in the price of water, water rights transfers, lining irrigation canals, water recycling, low-flow plumbing, and xeriscaping. International communication and cooperation are promoted by scholars that see this as the first step to solving policy issues related to water supply. However, local officials may find international communication and cooperation difficult due to differing political, legal and cultural norms. Finally, community involvement is promoted as a necessary step to create trust and balance the needs of the community. The methods by which local officials choose to communicate with and involve the community in decision making may affect the actual level of community involvement.

The next chapter discusses the methodology used to assess the attitudes and opinions of local Texas government officials that manage water resources in the U.S.-Mexico border region, the strengths and weaknesses of survey research, the survey population, statistics used in this research project, and human subjects protection.

Chapter 5: Methodology

Chapter Purpose

The purpose of this chapter is to describe the methodology used to assess the attitudes and opinions of local Texas government officials that manage water resources in the U.S.-Mexico border region. The descriptive categories described in Chapter 3 and the working hypotheses developed in Chapter 4 were used to formulate survey questions that were sent to local Texas government officials that manage water resources in the Texas-Mexico border region. This chapter also describes the research technique used, the population surveyed, statistics and human subjects issues.

Operationalization of Conceptual Frameworks

Tables 5.1 and 5.2 illustrate how each of the elements identified in the scholarly literature for both the descriptive categories and working hypotheses conceptual frameworks are operationalized into survey questions.

The operational relationship between the survey question and each descriptive category is illustrated in table 5.1. The questions use the issues identified in the scholarly literature and asks the respondent to indicate the strength of their opinion toward the issues. For example, the question "The *1944 Treaty* should be amended to address the allocation of groundwater in international hydrological zones" was used to assess the respondent's opinion toward the exclusion of groundwater from the *1944 Treaty,* which has been identified as a problem area by the scholarly literature.

A Likert scale (strongly agree, agree, disagree, or strongly disagree), ranking (rank the order of importance with one being the most important, and three being the least important), or multiple choice answer method measures the strength and/or direction of the respondent's agreement with the statement, the order of importance the respondent places on available selections, or reflects one or more choices that best answer the question. The survey begins by asking if the respondent is from a rural or urban area of Texas, and if the respondent is an elected or appointed official. The survey then presents a series of statements or questions that address the respondent's attitude and opinion on the issues and concerns identified.

Table 5.1. Operationalization of Conceptual Framework 1.

Research Purpose 1: describe the attitudes and opinions of local Texas government officials that manage water resources in the border region toward six binational water management issues under the *1944 Treaty*.	
Issue	*Survey Question*
1. Scale	The *1944 Treaty* should be amended to include a flexible allocation schedule that periodically reevaluates allocations and adjusts for changes in weather patterns, hydrology, and demographics of the Rio Grande Basin. (Likert) Five different treaties or compacts currently manage the Rio Grande Basin. Would you support a new treaty that includes all states that are part of the basin (Colorado, New Mexico, Texas, Chihuahua, Coahuila, Nuevo Leon and Tamulipas)? (Likert)
2. Groundwater Exclusion	The *1944 Treaty* should be amended to address the allocation of groundwater in international hydrological zones. (Likert)
3. Extraordinary Drought	The *1944 Treaty* should be amended to define what constitutes an extraordinary drought. (Likert)
4. Utilization	Please rank the top three most important water uses, with one being the most important and three being least important (ranking): a) Industrial uses_____ b) Hydroelectricity_____ c) Fishing and Hunting_____ d) Recreational use_____ e) Agriculture_____ f) Livestock_____ g) Municipal/residential use_____ h) Navigation_____ i) Ecology/environmental_____

	The *1944 Treaty* should be amended to include ecological and environmental restoration/protection as a top priority for the use of international waters.
5. Dispute Resolution	The IBWC favors individual state interests over international interests in dispute resolution negotiations. (Likert) The IBWC effectively enforces treaty provisions between the United States and Mexico. (Likert)
6. Joint Data Sharing	International hydrological data should be freely shared between the United States and Mexico. (Likert) Data on water withdraw rates and wastewater discharge should be freely shared between states and the United States and Mexico. (Likert)

The operational relationship between the survey question and each working hypothesis is illustrated in table 5.2. The questions explore local Texas government officials' opinions and attitudes regarding (1) willingness to support water conservation techniques, (2) international communication and cooperation, and (3) community involvement. Gathering the opinions and attitudes of local water officials will aid in a discussion about how to approach water supply problems through water conservation, and will give insight on how to better communicate with Mexican officials, and encourage public involvement. For example, the question "Barriers to increased cooperation with my Mexican counterpart" is used to explore the real or perceived barriers that keep respondents from communicating more freely with their Mexican counterparts.

Table 5.2. Operationalization of Conceptual Framework 2.

Research Purpose 2: explore the concerns of local Texas government officials that manage water resources in the Texas-Mexico border region regarding (1) willingness to support water conservation techniques, (2) international communication and cooperation, and (3) community involvement.	
Working Hypothesis	*Literature*
Willingness to support water conservation techniques	
WH_1: Local Texas government officials that manage water resources will support actions to restrict water usage.	Do you support the following to reduce water usage: (Likert) a. Increased price per unit of water b. Water use restrictions c. Water recycling ("gray water") d. Monetary incentives for water conservation

	(rebates or subsidies for improved irrigation, low-flow plumbing/appliances, xeriscaping) e. Restrictions on water withdraws
International Communication and Cooperation	
WH_2: Barriers to communication and cooperation make it difficult for local Texas government officials that manage water resources to work with their Mexican counterparts.	I regularly communicate with my Mexican counterpart on water policy issues. (Likert) Barriers to increased cooperation with my Mexican counterpart (multiple choice) a. Language b. Government/Laws c. Politics/international relationship d. Lack of resources e. Differences in public administration f. No time g. Lack of initiative h. Communication systems i. Crossing the border j. No barriers
Community involvement	
WH_3: Local Texas government officials that manage water resources will have concerns about public involvement in water management (broadly defined). *WH_{3a}: Local Texas government officials that manage water resources want input from the public and nongovernmental organizations to help solve binational water management issues.* *WH_{3b}: Water issues become important to the public only in times of crisis.* *WH_{3c}: Local Texas government officials that manage water resources use multiple methods to educate and communicate with the public about water supply issues.*	Binational water management should include input from the public, nongovernmental organizations, and government officials. (Likert) The public is only concerned with water issues in times of crises. (Likert) How do you educate your community on water supply issues? (multiple choice) a. Television b. Newspaper c. Radio d. Public forums e. Mail f. Internet g. None h. Other (please list) The public is invited to participate in water policy discussions by: (multiple choice) a. Posting notice in a public register b. Newspaper c. Radio d. Television e. Internet f. Other g. The public is not invited to water policy discussions

Survey Research

This study used survey research to gather attitudes and opinions of local Texas government officials that manage water resources in the Texas-Mexico border region toward the *1944 Treaty*, and the following concerns of binational water management: (1) willingness to support water conservation techniques, (2) international communication and cooperation, and (3) community involvement. Because this research is concerned with the general attitudes and opinions of individuals toward binational water management, survey research is an effective method to use (Babbie 2007). To reach local elected and appointed water officials who deal with binational water policy quickly and effectively, survey research was the best way to approach this research purpose. There are advantages for using survey research for descriptive and exploratory research. Surveys allow the researcher to apply uniform standards for questions and answers across the survey population, giving survey research a high measure of reliability (Babbie 2007). Surveys help both public officials and researchers "to determine what people need, want, prefer, or demand" (Folz 1996).

Survey research can present some weaknesses. Surveys rely on standardized questions that may seem to only superficially measure a complex issue and do not account for the "total life situation" of a respondent (Babbie 2007, 276). Issues with the *1944 Treaty* and binational water management are complex issues, therefore survey research should serve as a starting point for further, in-depth research. Also, surveys are "inflexible" and require the "initial study design [to] remain unchanged" (Babbie 2007, 276). Survey research makes it difficult for the researcher to identify new variables. Survey research cannot be modified as field conditions call for, unlike other research methods using direct observation.

Survey Population

Table 5.3. Survey Population by city, county, and groundwater district.

City Manager, Water/Utility Managers	Alpine	Hidalgo	Pharr
	Brownsville	La Feria	Rio Grande City
	Edinburg	Laredo	South Padre Island
	El Paso	McAllen	Uvalde
	Harlingen	Mercedes	
County Commissioner's Courts	Brewster County	Jim Hogg County	Starr County
	Brooks County	Kenedy County	Sutton County
	Cameron County	Kinney County	Terrell County
	Crockett County	La Salle County	Uvalde County
	Culberson County	Maverick County	Webb County
	El Paso County	Pecos County	Willacy County
	Frio County	Presidio County	Zapata County
	Hidalgo County	Real County	Zavala County
	Jeff Davis County		
Groundwater Conservation Districts	Brewster County Groundwater Conservation District		
	Crockett County Groundwater Conservation District		
	Culberson County Groundwater Conservation District		
	Evergreen Underground Water Conservation District		
	Hudspeth County Underground Water Conservation District		
	Jeff Davis County Underground Water Conservation District		
	Kenedy County Groundwater Conservation District		
	Kinney County Groundwater Conservation District		
	McMullen County Groundwater Conservation District		
	Middle Pecos Groundwater Conservation District		
	Presidio County Underground Water Conservation District		
	Real - Edwards Conservation and Reclamation District		
	Red Sands Groundwater Conservation District		
	Starr County Groundwater Conservation District		
	Sutton County Underground Water Conservation District		
	Uvalde County Underground Water Conservation District		
	Wintergarden Groundwater Conservation District		

The population for the study is local Texas government officials in the Texas-Mexico border region[49] that manage water resources (see table 5.3, above). Purposive sampling was used to draw the sample for this study. Babbie (2007) states that it is appropriate to select a sample on the basis of knowledge of a population, its elements, and the purpose of the study. Because this study seeks a population with a particular knowledge, purposive sampling is appropriate.

[49] See Appendix D for map of the Texas–Mexico border region.

The sampling frame is a list of officials from this region obtained by researching various municipal, city, county, and state government websites.[50] A total of 172 names with contact information were identified. Appendix A includes a copy of the survey instrument and accompanying cover letter sent by mail. Surveys sent via email included the cover letter in the body of the email, with a link to the survey instrument using SurveyMonkey.com.

Statistics Used

Descriptive statistics were used to summarize respondent data. Descriptive statistics reduce the data obtained to a manageable and meaningful summary. Further, descriptive statistics provide a broad assessment of the attitudes and opinions of the study population group toward the effectiveness of the *1944 Treaty* to manage binational water resources, and the attitudes and opinions of local elected and appointed water officials regarding (1) willingness to support water conservation techniques, (2) international communication and cooperation, and (3) community involvement. The data contributes to our understanding of the current attitudes and opinions of local and appointed water officials in the Texas region of the U.S.-Mexico border area. The data can also be used in future research to compare these findings with water officials in different regions of Texas, the United States, or to other stakeholders.

Human Subjects Protection

This research required human subjects, and as a result potential ethical concerns were addressed. According to Babbie (2007), primary areas of ethical concerns are voluntary participation, physical or mental harm to participants, privacy, and deception. To ensure

[50] Websites utilized included the Texas City Management Association, the Texas Commission for Environmental Quality, the Texas Association of Counties, the Texas Water Development Board, and individual county and irrigation district websites when information was not included in one of the other sources.

voluntary participation and prevent any appearance of deception, all surveys included a full description of the research purpose, and a description of how the findings would be used. To address privacy issues, the researcher will remain the only person with access to individual responses; responses or identities of respondents will not be disclosed publicly. This assurance of confidentiality was included in writing at the beginning of the survey. Participation in the survey was completely voluntary and refusal to respond to the survey caused no penalty or loss of benefits to those contacted.

This applied research project was submitted to the Texas State Institutional Review Board (IRB), and as expected, received exemption. The IRB application number for this project is 2009A6814. A copy of the official exemption communication from the IRB is included in Appendix C.

Chapter Summary

This paper used descriptive categories and working hypotheses conceptual frameworks to formulate survey questions that were sent to local Texas government officials that manage water resources in the Texas-Mexico border region to assess their attitudes and opinions toward the *1944 Treaty* and binational water management concerns. Tables are included that detail the operationalization of the two conceptual frameworks used.

This research used survey research to gather data on the attitudes and opinions of local Texas officials. Survey research is an effective research method to use when gathering general opinions and can be deployed quickly across a broad geographic area. Further, surveys allow the researcher to apply uniform standards for questions and answers across the survey population, increasing research reliability. Survey research does present some weaknesses. In this case, standardized questions were used to measure a complex issue, and may not account for all

internal or external factors. Surveys can also be an inflexible instrument to use when new variables are identified that may be significant to the research.

The survey population for this research is local Texas government officials in the Texas-Mexico border region that manage water resources. The border area is defined as 100 kilometers from the political boundary of the state of Texas and Mexico. A list of officials in this region and their contact information was compiled by researching various municipal, city, county, and state government websites.

The statistics used in this survey are descriptive statistics. Descriptive statistics reduce the data to a manageable and meaningful summary while providing a broad assessment of the survey population. This data is useful to understand current attitudes and opinions of local Texas officials, and can be used in future research to compare findings in different regions and across survey populations.

Human subjects were used for this research, and as such, ethical concerns were addressed. All survey recipients received a full description of the research purpose and how findings would be used. The responses and identities of survey respondents will remain confidential. Participation in this survey was completely voluntary and refusal to participate did not result in any penalties or loss of benefits. The Texas State Institutional Review Board granted exemption for this research project. A copy of the exemption communication can be found in Appendix C.

The following chapter includes a description of the returned surveys and discusses the results to the survey used for this research.

Chapter 6: Results

Chapter Purpose

The purpose of this chapter is to present and discuss the results of the binational water management survey administered to local Texas government officials that manage water resources in the U.S.-Mexico border region. This data addresses the research purpose of assessing the attitudes and opinions of local Texas government officials that manage water resources in the U.S.-Mexico border region toward binational water management.

Description of Returned Surveys

A total of 172 names of local Texas government officials that manage water resources in the U.S.-Mexico border region with contact information were identified. Seventy-five surveys were sent via email, and an additional 97 were sent by mail. The surveys sent by mail included a self-addressed stamped envelope to encourage respondents to return the survey. The United States Postal Service returned a total of seven surveys as undeliverable, reducing the total number of surveys to 165. Of the 165 surveys sent, 26 were returned, making the overall response rate to this survey approximately 16 percent. The response rate is below 50 percent, which Babbie notes as the lowest response rate that is "considered adequate for analysis and reporting" by most social research literature (2007, 262). Babbie also notes that this is a "rough guide" and that "response bias is far more important than a high response rate" (2007, 262). The low response rate makes it impossible to generalize the survey results to all local Texas government officials in the Texas-Mexico border region that deal with binational water management. All results must be interpreted with caution.

Research Purpose 1

The first research purpose is to describe the attitudes and opinions of local Texas government officials that manage water resources in the border region toward six binational water management issues under the *1944 Treaty*. Results of the survey questions are provided in tables that summarize the survey question, the number of responses to the question (N), the percentage of respondents that strongly agreed and agreed, and the response mode.

Scale

Two questions addressed respondent's opinion of the scale of the *1944 Treaty*. Table 6.1 provides the cumulative percentage of water officials that support amending the *Treaty* to address scale.

Table 6.1. *Treaty* Scale.

Survey Question	N	% Strongly Agree and Agree	Mode
The *1944 Treaty* should be amended to include periodic reevaluation and readjustment of water allocation.	21	67%	Agree
Would you support a new treaty that includes all states that are part of the Rio Grande Basin?	22	64%	Agree

A majority of respondents (67 percent) support the idea that the *1944 Treaty* should be amended to address the entire Rio Grande Basin. Support for this idea establishes a basis for a larger discussion of how the *Treaty*, or future international law, should consider geography, hydrology, demographics, and political actors when addressing water allocation. Respondents agreed that the *Treaty* should be amended to include some kind of reevaluation framework that would allow for readjustments to current water allocations given changes in the available water supply from fluctuating weather patterns, changes in regional hydrology, and changes in the

demographics of the region. Furthermore, respondents showed support for a new treaty that incorporates the interests and regional characteristics of the entire Rio Grande Basin, which includes Colorado, New Mexico, Texas, Chihuahua, Coahuila, Nuevo Leon, and Tamulipas.

Groundwater Exclusion

The survey included one question regarding the respondents' opinion toward the inclusion of groundwater in the *1944 Treaty*. Table 6.2 shows that a majority (67 percent) of respondents agree that groundwater should be included in the *Treaty*. Support for this idea among local elected and appointed water officials is congruent with scholarly support for amending the *Treaty* to recognize groundwater as an important part of the water supply, and that it should be managed by the *Treaty*.

Table 6.2. *Treaty* exclusion of groundwater.

Survey Question	N	% Strongly Agree and Agree	Mode
The *1944 Treaty* should be amended to address the allocation of groundwater.	21	67%	Agree

Extraordinary Drought

Table 6.3 shows the result of the survey question addressing the extraordinary drought provision of the *1944 Treaty*. Eight-one percent of survey respondents agreed that the *Treaty* should be amended to define the term extraordinary drought, showing strong support for updating this section of the *Treaty*. This support aligns with scholarly support for defining extraordinary drought to avoid future disputes like the lawsuit *Bayview v. Mexico*. Currently, there is disagreement as to what an extraordinary drought is, and when the extraordinary drought clause in the *1944 Treaty* should be exercised.

Table 6.3. Definition of Extraordinary Drought.

Survey Question	N	% Strongly Agree and Agree	Mode
The *1944 Treaty* should be amended to define what constitutes an extraordinary drought.	21	81%	Agree

Utilization

Two survey questions were meant to assess local Texas government officials' opinions about the priority of ecological and environmental uses of international waters. Table 6.4 illustrates that a majority of survey respondents support the idea that the *1944 Treaty* should be amended to include ecological and environmental uses of international waters as a top priority. In contrast, when respondents were asked to rank the most important uses of water, ecological and environmental uses were not ranked in the top three (see table 6.5).

Table 6.4. Utilization of *Treaty* waters.

Survey Question	N	% Strongly Agree and Agree	Mode
The *1944 Treaty* should be amended to include ecological and environmental uses as a top priority.	21	71%	Strongly Agree

Table 6.5. Top Three Most Important Uses of Water.

Survey Question	N	Use	Number of Times Selected
Rank the most important uses:	26	Municipal	25
		Agricultural	20
		Livestock	15

Although the respondents agreed that ecological and environmental uses should be a priority, other uses ranked in the list of top-three priorities. These results demonstrate the many competing and important uses of water, and the difficulty in prioritizing these uses. Local elected and appointed water officials must carefully balance many needs when making decisions regarding local water management plans.

Dispute Resolution

Table 6.6 shows responses to two survey questions that assess the opinions of local Texas officials toward the effectiveness of the IBWC's dispute resolution process. The IBWC is given the authority to resolve disputes over international waters governed by the *1944 Treaty*. Respondents remained neutral to the statement that the IBWC favors state interests rather than international interests in the dispute resolution process. Likewise, the question asking if respondents felt that the IBWC effectively enforces treaty provisions received a majority of neutral responses. Respondents did not indicate a uniform or strong opinion on the IBWC's dispute resolution activities.

Table 6.6. Dispute Resolution

Survey Question	N	% Strongly Agree and Agree	Mode
The IBWC favors individual state interests over international interests.	22	23%	Neutral
The IBWC effectively enforces treaty provisions.	22	27%	Neutral

Joint Data Sharing

The final element of the *1944 Treaty* addressed by the survey is that of joint data sharing between the United States and Mexico. Table 6.7 shows that a majority of survey respondents agreed that international hydrological data and data related to water withdraw rates and wastewater discharge should be shared amongst the two nations. Currently, the gap in information sharing still exists, and the scholarly literature indicates that a reluctance to share data is one of the root causes. Responses to this question show strong support for freely sharing hydrological data, as well as data on water withdrawal and wastewater discharge, see table 6.9.

Table 6.7. Joint Data Sharing

Survey Question	N	% Strongly Agree and Agree	Mode
International hydrological data should be freely shared.	23	83%	Strongly Agree
Data on water withdrawal and wastewater discharge should be freely shared.	23	87%	Strongly Agree

As noted previously, the low response rate to this survey makes it difficult to generalize these findings to all local Texas government officials that manage water resources in the U.S.-Mexico border area. Caution should be used when interpreting the results.

Research Purpose 2

The second research purpose is to explore the concerns of local Texas government officials that manage water resources in the Texas-Mexico border region regarding (1) willingness to support water conservation techniques, (2) international communication and cooperation, and (3) community involvement. Results of the survey questions are provided in tables that give an abbreviated version of the survey question, the number of responses to the question (N), the percentage of respondents that strongly agreed and agreed, and the response mode.

Willingness to support water conservation techniques

The first working hypothesis (WH_1) tested was local Texas officials' support of water conservation techniques (see table 6.8). With the exception of increasing the price of water, respondents showed support for water conservation techniques. Respondents were mostly neutral (38 percent) to the idea of increased prices per water, but most supported water use restrictions (77 percent), water recycling (83 percent), monetary incentives for water conservation (83 percent), and restrictions on water withdraws (67 percent). Although the evidence is weakened

by the poor response rate, the responses provide evidence that local Texas officials show limited support for WH_1.

Table 6.8. Willingness to support water conservation techniques.

Survey Question	N	% Strongly Agree and Agree	Mode
Do you support the following:			
Increased price per unit of water	24	29%	Neutral
Water use restrictions	22	77%	Agree
Water recycling	24	83%	Agree
Monetary incentives for water conservation	23	83%	Agree
Restrictions on water withdraws	24	67%	Agree

International Communication and Cooperation

Two questions addressed the second working hypothesis (WH_2), barriers to communication and cooperation affect local Texas officials' ability to work with their Mexican counterparts. While respondents indicated three main barriers to cooperating with Mexican officials (see table 6.9), a majority of survey respondents did not indicate strong or weak communications with their Mexican counterparts (see table 6.10). The responses provide evidence that local Texas officials show limited support for WH_2.

Table 6.9. Barriers to cooperation.

Survey Question	N	Barrier	Number of times selected
Barriers to cooperation with Mexican counterpart	22	Politics/International Relationship	13
		Government/Laws	11
		Differences in public administration	6

Table 6.10. Communication across the international border.

Survey Question	N	% Strongly Agree and Agree	Mode
I regularly communicate with my Mexican counterpart.	24	13%	Neutral

Community involvement

Four questions addressed WH_3 and sub-hypotheses, that local Texas officials will have concerns about public involvement in water management. Responses to the question for WH_{3a} show strong support (87 percent) that local officials will want input from the public and nongovernmental organizations, in addition to government officials (see table 6.11). Similarly, respondents showed support (67 percent) for WH_{3b}, the idea that the public is only concerned with water issues during times of crisis (see table 6.11). The evidence provided by the responses shows strong support for WH_{3a}, and support for WH_{3b}.

Table 6.11. Public Cooperation.

Survey Question	N	% Strongly Agree and Agree	Mode
Input from the public, NGOs, and government officials should be included.	23	87%	Agree
The public is only concerned with water issues in times of crises.	24	67%	Agree

Two questions were used to explore WH_{3c}, that local Texas officials use multiple methods of communication for water supply issues. The first question asked how the respondents educate the community on water supply issues. Table 6.12 shows that communication by newspaper and public forums are the most popular ways respondents educate the community on water supply issues. The second question asked how the public was invited to participate in water policy discussions. Again, respondents indicated that the newspaper is the method of communication most often used to invite the public to water policy discussions, with the public register being the second most used (see table 6.13). The responses provide strong support for WH_{3a}.

Table 6.12. Methods used to educate community.

Survey Question	N	Communication Method	Number of Times Selected
Methods used to educate community on water supply issues	23	Newspaper	18
		Public Forums	9
		Mail	8
		Television	6
		Internet	6
		Radio	4
		None	1

Table 6.13. Methods used to invite community to water policy discussions.

Survey Question	N	Communication Method	Number of Times Selected
Methods used to invite community to water policy discussions	21	Newspaper	17
		Public Register	9
		Radio	6
		Television	4
		Internet	4
		Public is not invited	0

Chapter Summary

The purpose of this chapter was to present and discuss the results of the binational water management survey administered to local Texas government officials in the U.S.-Mexico border region. The results presented in this chapter should be interpreted with caution due to the low response rate.

The survey results for research purpose 1, attitudes and opinions toward the *1944 Treaty*, showed strong support from respondents to amending the *1944 Treaty* to resolve issues with regard to scale, groundwater, extraordinary drought, utilization, and joint data sharing. Respondents did not indicate strong opinions toward the dispute resolution processes of the International Boundary and Water Commission (IBWC).

Research purpose 2 explored concerns of water conservation, communication and cooperation across the international border, and public involvement in water management. Results showed support for water conservation techniques, with the exception of increasing the

price of water. Respondents indicated difficulty in cooperating with the Mexican counterparts to facilitate binational cooperation due to politics/international relationship, differences in government/laws, and differences in public administration. Although cooperation barriers were indicated, respondents did not show a strong response to whether they regularly communicated with their Mexican counterparts on water supply issues. Respondents generally felt that the public was only concerned with water supply issues during times of crisis. Despite this, respondents showed strong support for input from the public and nongovernmental organizations for binational water management. Finally, respondents indicated that they used multiple communication methods, although the most popular communication for both water education and inviting the public to water discussions is the newspaper. Overall, the three working hypotheses, including sub-hypotheses, were supported by survey results.

The next chapter summarizes the research purpose, findings, and policy recommendations and discusses steps for further research.

Chapter 7: Conclusion

Chapter Purpose

This final chapter provides a summary of the research purpose and key research findings related to the *1944 Treaty* and binational water management. Local Texas government officials in the U.S.-Mexico border region were asked to express their attitudes and opinions of the *1944 Treaty*, the international agreement that governs the use of water from the Rio Grande along the Texas-Mexico border. Additionally, local Texas government officials in the U.S.-Mexico border region were asked questions to explore attitudes and opinions regarding (1) willingness to support water conservation techniques, (2) international communication and cooperation, and (3) community involvement.

Summary of Research

The purpose of this research was to describe the attitudes and opinions of local Texas government officials in the U.S.-Mexico border region regarding key issues in binational water management. To provide background and perspective on these issues, a brief overview of the geography of Texas, water law, and a history of the *1944 Treaty* were presented.

First, using the scholarly literature, key binational water management issues that have emerged from the *1944 Treaty* were identified. Second, the literature was also used to identify concerns regarding (1) willingness to support water conservation techniques, (2) international communication and cooperation, and (3) community involvement with respect to binational water management. Tables 7.1 and 7.2 summarize the results of the survey that was formulated from issues and concerns identified in the literature.

Table 7.1. Summary of Survey Results for Purpose 1.

Issue	*Survey Question*	*Results*
Scale	i) The *1944 Treaty* should be amended to include periodic reevaluation and readjustment of water allocation. ii) Would you support a new treaty that includes all states that are part of the Rio Grande Basin?	Changes are supported.
Groundwater Exclusion	The *1944 Treaty* should be amended to address the allocation of groundwater.	Change is supported.
Extraordinary Drought	The *1944 Treaty* should be amended to define what constitutes extraordinary drought.	Change is supported.
Utilization	i) The *1944 Treaty* should be amended to include ecological and environmental uses as top priorities. ii) Rank the most important uses of water:	i) Change is strongly supported. ii) Municipal; agriculture; livestock
Dispute Resolution	i) The IBWC favors individual state interests over international interests. ii) The IBWC effectively enforces treaty provisions.	i) Neutral. ii) There are problems with the existing system.
Joint Data Sharing	i) International hydrological data should be freely shared. ii) Data on water withdrawal and wastewater discharge should be freely shared.	Data sharing is strongly favored.

Overall, the local elected and appointed water officials agreed with ideas that would fundamentally alter the *1944 Treaty* if implemented. Changing the scale of the *Treaty*, incorporating groundwater in the *Treaty* provisions, and adding an explicit definition of extraordinary drought to the *Treaty* would take careful deliberation. The results of this study show support to open this type of discussion. It is important to note, however, that the author has assumed that the local Texas officials surveyed have some knowledge of the *1944 Treaty*. The

lower response rates to the questions that fall under research purpose 1, when compared with the response rates under research purpose 2, may be an indication of a lack of knowledge of the *Treaty*.

Table 7.2. Summary of Survey Results for Purpose 2.

Working Hypothesis	*Results*
WH_1: Local Texas government officials that manage water resources will support actions to restrict water usage.	Hypothesis is supported.
WH_2: Barriers to communication and cooperation make it difficult for local Texas government officials that manage water resources to work with their Mexican counterparts.	Hypothesis is supported.
WH_3: Local Texas government officials that manage water resources will have concerns about public involvement in water management (broadly defined). WH_{3a}: Local Texas government officials that manage water resources want input from the public and nongovernmental organizations to help solve binational water management issues. WH_{3b}: Water issues become important to the public only in times of crisis. WH_{3c}: Local Texas government officials that manage water resources use multiple methods to educate and communicate with the public about water supply issues.	Hypotheses are supported.

Similarly, there is agreement on the idea that ecological and environmental uses of *Treaty* water should be a top priority. However, when asked what the three most important uses of water are, most identified these uses as municipal, agricultural, and livestock. The difference in the answers to these two questions underlines the difficulty in placing priorities on *Treaty* water. Many competing and overlapping interests exist, and there is support for many of these interests among local Texas government officials that manage water resources in the U.S.-Mexico border region. It is likely that this sentiment reflects the sentiments of residents of the areas as well, and agreeing on a list of priorities will be a very difficult prospect.

Responses to the questions addressing the dispute resolution process and the role that the IBWC plays show that many local Texas government officials that manage water resources have an indifferent, if somewhat negative response to the process. Responses to the idea that the IBWC favors state interests rather than international interests were neutral. Neutrality may be an indication that local officials do not have interactions with the IBWC at a level that will allow them to confidently answer this question positively or negatively. Or neutrality may indicate bias on the part of respondents, given that a tilt toward state interests by the IBWC is also a tilt toward local interests on a larger scale. Likewise, the enforcement of *Treaty* provisions elicited a neutral and disagree/strongly disagree response from a majority of respondents. A higher rate of disagreement was expected to this question, given that the *Bayview* lawsuit is less than two years old and the lawsuit provoked a rather powerful and widespread political outcry from Texas government officials at all levels, as well as from border farmers and residents. Neutrality may indicate the lack of interaction between local water managers and the IBWC.

Local Texas government officials that manage water resources agreed that sharing data on water withdraw rates, wastewater discharge, and hydrological data about international waters should be practiced freely. The literature regarding this issue suggests that data sharing is not actually happening. The second purpose of this research, WH_2, may provide insight as to why there is a difference in the attitude that data should be shared and the action of not sharing. Cooperation barriers may play an active role in keeping this important data from being shared.

Local Texas government officials that manage water resources also appear agreeable to utilizing tools to restrict water usage for water conservation. Water use restrictions, water recycling, monetary incentives for water conservation, and restrictions on water withdraw were all supported by respondents. The only idea that was not supported was the increased price per

unit of water. The reluctance to support increased prices may stem from current economic crises, or a fear of political backlash. Water users have grown accustomed to water being relatively cheap, or even free, and the implementation of a policy that increases water cost may be the choice of last resort for most water managers. Also, it is important to state that answers to questions of water conservation may be politically motivated, as the State of Texas provides incentives for local conservation activities. These incentives may or may not have had an effect on the responses to the questions regarding water conservation.

While a majority of the respondents were neutral to the question of regular communication with their Mexican counterparts, obvious cooperation barriers emerged in the second question. Although four respondents noted that there were no barriers, the rest of the respondents noted at least one barrier to cooperation with Mexican counterparts. Most stated that politics/international relationship and government/laws were obstacles to cooperation. Additionally, one respondent noted that there were no real counterparts to cooperate with. The Mexican government is highly centralized in contrast with the American system of government, so this statement may be true for many or most local water managers. Of course, this would be a major difference in government/laws between the two nations, and will continue to cause difficulty if not addressed in some way.

Local Texas government officials that manage water resources noted that input from the public, nongovernmental organizations and government officials was needed for binational water management. While there is interest in receiving public input, most respondents agreed that the public is concerned only in times of crises. This indicates a strained relationship between local government officials and the public, and actions should be taken to resolve this imbalance, whether real or perceived. Further, the majority of respondents noted that the public was

informed of water issues and water policy discussions by newspaper, and secondly by either public forums or the public register. While Moote and Gutiérrez' (2001) study indicated that most residents in the San Pedro River Basin preferred outreach and education through the newspaper, there was also a high interest in receiving this information via the television and the Internet. Respondents to this survey indicated a rather low use of both the television and Internet in communications with public. Further study of the most appropriate communications is warranted, given the gravity of the water supply situation.

Respondents to this survey were asked to identify whether they were appointed or elected officials, and whether they managed water resources for a rural or urban area. Responses to these two questions were filtered to try to identify any differences between appointed or elected officials, and between rural or urban water managers. Responses were heavily skewed toward elected officials and rural water managers (see table 7.3 and 7.4). Therefore, analyzing the results based on these two factors presents a response rate that is too low to assume any broad applicability across all elected or appointed, rural or urban water managers in the Texas-Mexico border region.

Table 7.3. Rural/urban respondents.

Survey Question	N	Rural	Urban	Mode
I manage/oversee water resources for:	22	19 (86%)	3 (14%)	Rural

Table 7.4. Appointed/elected respondents.

Survey Question	N	Elected	Appointed	Mode
I am an:	24	18 (75%)	6 (25%)	Elected

Policy Recommendations

Water sustainability is an important issue for Texas, the nation, and the world. Two areas in need of more urgent attention worldwide, and in particular in the Texas-Mexico border region, are groundwater and water conservation.

A common thread among treaties across the world is that groundwater use and sustainability are not addressed, with the exception of one European treaty.[51] Given the heavy dependence on groundwater and the connection between groundwater and surface water, groundwater is an area that is in critical need of study and regulation. The U.S. Congress' passage of the United States–Mexico Binational Aquifer Assessment Act of 2006 (the Binational Aquifer Assessment Act) is a step forward. How activities under the Binational Aquifer Assessment Act are executed will be imperative to the success or failure of this policy. As discussed in Chapter 3, the Binational Aquifer Assessment Act immediately evoked suspicion in Mexico. This suspicion signals that foreign relations between the United States and Mexico are in need of serious attention in order to solve problems of water sustainability. Despite the difficulty of foreign relations and the complex nature of groundwater, groundwater regulation is an issue that cannot continue to be ignored.

Water conservation is really the only solution to ensuring water sustainability. The supply of water is ultimately finite, and solutions that involve large-scale water catchment systems, such as reservoirs, or water importation are expensive, difficult to manage, and promote water waste. Water conservation begins with education and outreach, and is enhanced by policies that encourage conservation. Providing incentives for citizens to make simple, yet effective choices

[51] International Water Law Project. 2009. There is only one transboundary aquifer agreement in the world: Convention relative a la protection, a l'utilisation, a la realimentation et au suivi de la Nappe Souterraine Franco-Suisse du Genevois, in force 1 January 2008 (Convention on the Protection, Utilisation, Recharge and Monitoring of the Franco-Swiss Genevois Aquifer).

empowers them to become part of a long-term, multifaceted solution to water sustainability. Water conservation policy, and effective education and outreach methods to encourage voluntary compliance should be top priorities for water managers locally and nationally.

Recommendations for future research

Current research on the attitudes and opinions of local Texas government officials that manage water resources with regard to binational water issues is minimal. Because the response rate to this survey was relatively low, additional research should be conducted to validate survey results, and to explore issues in more depth. Issues related to the *1944 Treaty* and binational water management are complex, highly political, and personal for both local government officials and residents. Additional surveys, structured interviews, and focus groups are all appropriate strategies for further research. Furthermore, the study population can be extended to include specific user groups, such as residents, farmers, and industrial users, as well as incorporating these same groups in Mexico to create a complete picture of the depth and breadth of opinions on binational water issues. For local groups, additional study into the most effective communication methods with the public should be conducted. Educating the public about water supply issues is key to implementing solutions, even if solutions are unpleasant.

References

Albright, Steven J. 2006. Water, Water Everywhere…Now What to Do with It: An Assessment of Water Management Strategies for East Texas. *Applied Research Projects*, Texas State University. Paper 181. http://ecommons.txstate.edu/arp/181.

Arnold, Lane. 2007. The Emerging Water Crisis Along the U.S.-Mexico Border. *Law and Business Review of the Americas* 13:679.

Babbie, Earl. 2007. *The Practice of Social Research, 11th edition*. Belmont, CA: Wadsworth Publishing/Thompson Learning, Inc.

Barron, Wendy. 2006. An Assessment of Public Participation in the South Central Texas Regional Water Planning Group. *Applied Research Projects*, Texas State University. Paper 162. http://ecommons.txstate.edu/arp/162.

Baumgartner, Frank R. and Bryan D. Jones. 1993. *Agendas and Instability in American Politics*. Chicago, IL: The University of Chicago Press.

Bernal, John M., and Arturo Herrera Solis. 2000. Conflict and Cooperation on International Rivers: The Case of the Colorado River on the US–Mexico Border. *Water Resources Development* 16(4): 651-660.

Billingsley, Bill G. 2002. An Assessment of Municipal Drought Contingency Planning in Texas. *Applied Research Projects*, Texas State University. Paper 62. http://ecommons.txstate.edu/arp/62.

Booker, James F., Ari M. Michelsen, and Frank A. Ward. 2005. Economic impact of alternative policy responses to prolonged and severe drought in the Rio Grande Basin. *Water Resources Research* 41.

Brock, L., M. Kelly, K. Chapman. 2001. Legal & Institutional Framework for Restoring Instream Flows in the Rio Grande: Fort Quitman to Amistad. Texas Center for Policy Studies. Presented to the World Wildlife Fund March 16, 2001. Accessed at http://www.texascenter.org/publications/instreamflow.pdf.

Brown, Steven R. 2008. State environmental expenditures, 2005-2008. *Ecos Green Report* (March) 2008: 1-6.

Cantu, Luci. 2004. Texas Regional Councils' Assessment of Security Vulnerabilities in Local Infrastructures. *Applied Research Projects*, Texas State University. Paper 16. http://ecommons.txstate.edu/arp/16.

Carter, Nicole and Leonard Ortolano. 2000. Working Toward Sustainable Water and Wastewater Infrastructure in the US-Mexico Border Region: A Perspective on BECC and NADBank. *Water Resources Development* 16(4):691-708.

Cash, David W. and Susanne C. Moser. 2000. Linking global and local scales: designing dynamic assessment and management processes. *Global Environmental Change* 10:109-120.

Combs, Susan. 2004. The Mexico Water Debt. *Texas Bar Journal*, News and Publications Section. http://www.texasbar.com (accessed September 3, 2009).

Downs, Anthony. 1972. Up and down with ecology: The issue-attention cycle. *The Public Interest* 28: 38-50.

Earl, Richard A. and Robert J. Czerniak. 1996. Sunbelt Water War: The El Paso–New Mexico Water Conflict. *The Social Science Journal* 33(4): 359-379.

Eaton, David J. and David Hurlbut. 1992. *Challenges in the Binational Management of Water Resources in the Rio Grande/Rio Bravo.* The Board of Regents, The University of Texas System, Austin, Texas.

Eckstein, Gabriel and Amy Hardberger. 2008. State Practice in the Management and Allocation of Transboundary Groundwater Resources in North America. *Yearbook of International Environmental Law* 18: 96–125.

Environmental Protection Agency. 2006. American Heritage Rivers, Rio Grande River (TX). http://www.epa.gov/rivers/98rivers/riogrande.html.

Environmental Protection Agency. 2008. "State, Local Governments Get More Say in Federal Environmental Decision-Making." News release date November 19, 2008. http://yosemite.epa.gov/opa/admpress.nsf/d0cf6618525a9efb85257359003fb69d/0b682c17429f5086852575060061845 4!OpenDocument (accessed November 12, 2009).

Environmental Protection Agency. 2009. "Introduction to the Clean Water Act." http://www.epa.gov/watertrain/cwa (accessed October 26, 2009).

Evans, Jennifer. 2006. Transboundary Groundwater in New Mexico, Texas, and Mexico: State and Local Legal Remedies to a Challenge Between Cities, States, and Nations. *William and Mary Environmental Law and Policy Review*:471-511.

Fischhendler, Itay. 2004. Legal and Institutional Adaptation to Climate Uncertainty: A Study of International Rivers. *Water Policy* 6: 281–302.

Fischhendler, Itay, Eran Feitelson, and David Eaton. 2004. The Short- and Long-Term Ramifications of Linkages Involving Natural Resources: The U.S.-Mexico Transboundary Water Case. *Environment and Planning C: Government and Policy* 22(5): 633-650.

Folz, David H. 1996. *Survey Research for Public Administration*. Thousand Oaks, CA: Sage Publications, Inc.

Frisvold, George B., and Margriet F. Caswell. 2000. Transboundary water management Game-theoretic lessons for projects on the US–Mexico border. *Agricultural Economics* 24:101-111.

Gillfillan, Abigail. 2008. Using Geographic Information Systems to Develop and Analyze Land-Use Policies. *Applied Research Projects,* Texas State University. Paper 273. http://ecommons.txstate.edu/arp/273.

Gleick, Peter H. 1988. The Effects of Future Climatic Changes on International Water Resources: The Colorado River, the United States, and Mexico. *Policy Sciences* 21(1): 23-39.

Graham, Mary. 1998. Why states can do more: The next phase in environmental protection. *American Prospect* 36: 63-4.

Gregory, Gary D. and Michael Di Leo. 2003. Repeated Behavior and Environmental Psychology: The Role of Personal Involvement and Habit Formation in Explaining Water Consumption. *Journal of Applied Social Psychology* 33(6): 1261-1296.

Hall, Robert. 2004. Transboundary Groundwater Management: Opportunities Under International Law for Groundwater Management in the United States Border Region. *Arizona Journal of International & Comparative Law* 21(3).

Helmle, Samuel F. 2005. Water Conservation Planning: Developing a Strategic Plan for Socially Acceptable Demand Control Programs. Applied Research Project, Texas State University. Paper 2. http://ecommons.txstate.edu/arp/2.

House Committee on Resources, Subcommittee on Water and Power. Statement of Dr. P. Patrick Leahy on S.214/H.R. 469, "United States-Mexico Transboundary Aquifer Assessment Act," May 10, 2006.

Hurlbut, David. 2001. The Good, the Bad, and the Arid. *Forum for Applied Research and Public Policy* 16(1): 9-13.

Ingram, Steven G. 2004. In a Twenty-First Century "Minute." *Natural Resources Journal* 44(1): 163-212.

International Boundary and Water Commission, United States Section. 1973. Permanent and Definitive Solution to the International Problem of the Salinity of the Colorado River (Minute 242). http://www.ibwc.state.gov/treaties_minutes/minutes.html.

_____. 2002. United States Allocation of Rio Grande Waters During the Last Year of the Current Cycle (Minute 308). http://www.ibwc.state.gov/treaties_minutes/minutes.html.

_____. 2009. http://www.ibwc.state.gov/.

International Groundwater Resources Assessment Centre (IGRAC). 2009. Transboundary Aquifers of the World. http://www.igrac.nl/.

International Water Law Project. 2009. http://www.internationalwaterlaw.org.

Jarvis, et al. 2005. International Borders, Ground Water Flow, and Hydroschizophrenia. *Ground Water* 43(5): 764-770.

Johansson, Robert C., Yacov Tsur, Terry L. Roe, Rachid Doukkali, and Ariel Dinar. 2002. Pricing irrigation water: a review of theory and practice. *Water Policy* 4: 173-199.

Jones, Bryan D. and Frank R. Baumgartner. 2005. *The Politics of Attention: How Government Prioritizes Problems*. Chicago, IL: The University of Chicago Press.

Kelley, Mary, and Alberto Székely. 2004. Modernizing the International Boundary and Water Commission. Center for Latin American Studies. CLAS Policy Papers. Paper 1. http://repositories.cdlib.org/clas/pp/1.

Kibel, Paul Stanton and Johnathan R. Schutz. 2007. Rio Grande Designs: Texans' NAFTA Water Claim Against Mexico. *Berkeley Journal of International Law* 25(2): 228-267.

Leach, William D. 2006. Collaborative Public Management and Democracy: Evidence from Western Watershed Partnerships. *Public Administration Review* 66 Suppl. no. 1:100-110.

Legates, David R. 2005. "Climate and Water: Precipitation, Evapotranspiration, and Hydroclimatological Aspects" in *Water for Texas* (Texas A&M University Press, College Station), 149-152.

Liverman, Diana, Robert Varady, Octavio Chávez, and Roberto Sánchez. 1999. Environmental Issues Along the United States-Mexico Border: Drivers of Change and Responses of Citizens and Institutions. *Annual Review of Energy and the Environment* 24:604-43.

Magers, Phil. "Analysis: Angry Texas farmers sue Mexico." *United Press International*, August 30, 2004.

Matsumoto, Kyoko. 2002. Transboundary Groundwater and International Law: Past Practices and Current Implications. Master's thesis, Oregon State University.

May, Marlynn, Gloria J. Bowman, Kenneth S. Ramos, Larry Rincones, Maria G. Rebollar, Mary L. Rosa, Josephine Saldana et al. 2003. Embracing the Local: Enriching Scientific Research, Education, and Outreach on the Texas-Mexico Border through a Participatory Action Research Partnership. *Environmental Health Perspectives* 111(13): 1571-1576.

Metz, Leon. 2008. *Handbook of Texas Online,* s.v. "Rio Grande" http://www.tshaonline.org/handbook/online/articles/RR/rnr5.html (accessed September 19, 2009).

Michaels, Dave. 2008. "South Texans take water fight with Mexico to Canada court." *Dallas Morning News*, February 19, 2008, http://www.dallasnews.com/sharedcontent/dws/news/nation/stories/DN-waterfight_19nat.ART.State.Edition2.4687ff5.html (accessed November 24, 2008).

Moore, J. G., W. Rast, and W.M. Pulich. 2002. Proposal for an Integrated Management Plan for the Rio Grande/Rio Bravo. *Paper Presented at First International Symposium on Transboundary Waters Management, Monterrey, Nuevo Leon, Mexico, November 18-22, 2002.*

Moote, Ann and María Gutiérrez. 2001. Views from the Upper San Pedro River Basin: Local Perceptions of Water Issues. Udall Center for Studies in Public Policy.

Mumme, Stephen P. 1985. State Influence in Foreign Policymaking: Water Related Environmental Disputes along the United States-Mexico Border. *The Western Political Quarterly* 38(4): 620-640.

Mumme, Stephen P. 2003. Revising the 1944 Water *Treaty*: Reflections on the Rio Grande Drought Crises and Other Matters," *Journal of the Southwest* 649-670.

_____. 2005*a*. Advancing Binational Cooperation in Transboundary Aquifer Management on the US-Mexico Border. *Colorado Journal of International Environmental Law and Policy* 16(1): 77-111.

_____. 2005*b*. The International Boundary and Water Commission Under Fire: Policy Prospective for the 21st Century. *The Journal of Environment and Development* 14(4): 507-524.

Navarro, Carlos. 2008. Mexican Government Considers Adding Aquifers to 1944 Water *Treaty*. *Latin American Database* 19(34).

Norwine, Jim, John R. Giardino, and Sushma Kirshnamurthy. 2005. *Water for Texas*. Texas A&M University Press, College Station.

Office of the State Climatologist. 2009. http://www.met.tamu.edu/osc/.

Parkins, John R. and Ross E. Mitchell. 2005. Public Participation as Public Debate: A Deliberative Turn in Natural Resource Management. *Society and Natural Resources* 18:529-540.

Patiño-Gomez, Carlos, Deane C. McKinney, and David R. Maidment. 2007. Sharing Water Resources Data in the Binational Rio Grande/Bravo Basin. *Journal of Water Resources Planning and Management*, September/October.

Pecos River Compact, Agreement between the State of New Mexico and the State of Texas, signed December 3, 1948.

Phillips, Travis. 2002. "Behind the U.S.-Mexico Water Treaty Dispute." Texas House of Representatives House Research Organization, *Interim News*, April 30, 2002.

Rio Grande Compact, Agreement between the State of Colorado, the State of New Mexico, and the State of Texas. Public Act No. 96, 76th Congress, approved by the President May 31, 1939.

Rosson, C. Parr, Aaron Hobbs, and Flynn Adcock. 2003. The U.S./Mexico Water Dispute: Impacts of Increased Irrigation in Chihuahua, Mexico. *Selected Paper prepared for presentation at the Southern Agricultural Economics Association Annual Meeting, Mobile, Alabama, February 1-5, 2003.*

Rowland, Marty. 2005. A Framework for Resolving the Transboundary Water Allocation Conflict Conundrum. *Ground Water* 43(5): 700-705.

Sabet, Daniel. 2005. "Building Bridges: Binational Civil Society Cooperation and Water-Related Policy Problems." *The Journal of Environmental Development* 14(4): 463-485.

Saint-Germain, Michelle. 1995*a*. "Problems and Opportunities for Cooperation among Public Managers on the U.S.-Mexico Border. *The American Review of Public Administration* 25(2).

_____. 1995*b*. Similarities and Differences in Perceptions of Public Service among Public Administrators on the U.S.-Mexico Border. *Public Administration Review* 55(6): 507-516.

Sherman, Christopher. 2008. "Texas farmers take water war to Canada," *USAToday*, http://www.usatoday.com/money/economy/2008-02-06-3677522660_x.htm (accessed November 18, 2008).

Scott, Christopher A. and Jeff M. Banister. 2008. The Dilemma of Water Management 'Regionalization' in Mexico under Centralized Resource Allocation. *Water Resources Development* 24(1): 61-74.

Shields, Patricia M. 1998. Pragmatism as philosophy of science: A tool for public administration. *Research in Public Administration* 4: 195-225. http://ecommons.txstate.edu/polsfacp/33/.

Shields, P. and H. Tajalli 2006. Intermediate theory: the missing link in successful student scholarship. *Journal of Public Affairs Education* 12 (3): 313-334. http://ecommons.txstate.edu/polsfacp/39/.

Shmueli, Deborah. 1999. Water quality in international river basins. *Political Geography* 18:437-476.

Sussman, Glen. 2004. The USA and global environmental policy: Domestic Constraints on effective leadership. *International Political Science Review* 25(4): 349-69.

Tate, Diane Elizabeth. 2002. Bringing Technology to the Table: Computer Modeling, Dispute Resolution, and the Rio Grande. Master's thesis, The University of Texas at Austin.

Texas. 2008. Texas Water Code (Vernon's Texas Codes Annotated). Thomson/West, Eagan, Minnesota.

Texas A&M AgriLife Extension Service. 2009. Texas Water Law. http://texaswater.tamu.edu/waterlaw.texas.htm.

Texas Association of Counties. 2009. County Profiles from The County Information Project. http://www.txcip.org/tac/census/CountyProfiles.php.

Texas City Management Association. 2009. http://www.tcma.org.

Texas Commission on Environmental Quality. 2009. http://www.tceq.state.tx.us.

Texas Comptroller of Public Accounts. 2008. Texas in Focus: A Statewide View of Opportunities. http://www.window.state.tx.us/specialrpt/tif/ (accessed October 25, 2009).

Texas Department of State Health Services. 2009. Projected Texas Population by Area, 2009. http://www.dshs.state.tx.us/chs/popdat/st2009.shtm.

Texas Parks and Wildlife Department. 2009. http://www.tpwd.state.tx.us.

Texas State Data Center and Office of the State Demographer. 2009. Texas Population Projections Program. http://txsdc.utsa.edu/tpepp/2008projections/.

Texas Water Development Board. 2007. Texas State Water Plan. http://www.twdb.state.tx.us/wrpi/swp/swp.htm.

Texas Water Development Board. 2009. Regional Water Planning. http://www.twdb.state.tx.us/wrpi/rwp/rwp.htm.

Thompson, John T. 1960. *Public Administration of Water Resources in Texas*. Board of Regents of The University of Texas (Austin).

The University of Texas at Austin, Office of Public Affairs. "Civil engineers receive $750,000 to address Rio Grande water questions, inform decisions about river water use along U.S., Mexico Border. http://www.utexas.edu/news/2005/08/29/engineering/ (accessed October 10, 2009).

Timm, Jacqueline E. 2008. Rio Grande Water Apportionment. *Handbook of Texas Online*. http://www.tshaonline.org/handbook/online/articles/RR/mgr5.html (accessed September 19, 2009).

Tresner, Erin C. 2009. Factors Affecting States' Ranking on the 2007 Forbes List of America's Greenest States. Applied Research Project, Texas State University–San Marcos. http://ecommons.txstate.edu/arp/293.

Trumbo, Craig W. and Garrett J. O'Keefe. 2005. Intention to Conserve Water: Environmental Values, Reasoned Action, and Information Effects Across Time. *Society and Natural Resources* 18:573-585.

United States. 1907. Convention between the United States and Mexico Equitable Distribution of the Waters of the Rio Grande, 16 January, 1907 (1906 Treaty).

United States. 1933. Rectification of the Rio Grande, 25 April 1933. Statutes at Large (1933) 48 Stat. 1621, Treaty Series No. 864.

United States. 1944. Treaty between the United States of America and Mexico relating to the utilization of the Waters of the Colorado and Tijuana Rivers and of the Rio Grande, 3 February 1944. Statutes at Large (1944), 59 Stat. 1219, Treaty Series No. 994.

United States Congress. 2006. *United States–Mexico Transboundary Aquifer Assessment Act of 2006.* Public Law 109-448. 120 Stat. 3328.

United States Congress. House of Representatives. Committee on Resources, Subcommittee on Water and Power. *Statement of Dr. P. Patrick Leahy on S.214/H.R. 469, "UNITED STATES-MEXICO TRANSBOUNDARY AQUIFER ASSESSMENT ACT,"* May 10, 2006.

United States Environmental Protection Agency. 2009. http://www.epa.gov.

United States Geological Survey. 2009. Groundwater Atlas of the United States, Rio Grande Aquifer System. http://pubs.usgs.gov/ha/ha730/ch_c/C-text4.html. Accessed September 25, 2009.

United States Government Accountability Office. 2000. U.S.-Mexico Border: Despite Some Progress, Environmental Infrastructure Challenges Remain. Accessed online at: http://www.gao.gov/products/NSIAD-00-26.

Vesbach, Jeremy. 2003. "Tiny fish could pull plug on city's water plan," *Christian Science Monitor*, May 21, 2003, http://www.csmonitor.com/2003/0521/p03s01-uspo.html (accessed October 11, 2009).

Vickery, Mark. 2009. Water Regulation in Texas. Roundtable discussion at Bureau of Economic Geology Centennial Symposium, Austin, Texas.

Wang, Xiao Hu, and Montgomery Van Wart. 2007. When Public Participation in Administration Leads to Trust: An Empirical Assessment of Manager's Perceptions. *Public Administration Review* 67(2): 265-278.

Ward, Frank and J. Phillip King. 1998. Reducing institutional barriers to water conservation. *Water Policy* 1: 411- 420.

Ward, Frank and Manuel Pulido-Velazquez. 2007. "Efficiency, equity, and sustainability in a water quantity-quality optimization model in the Rio Grande Basin." *Ecological Economics*, 66, 23-37.

Wilson, Jim. 2009. Policy Actions of Gulf Coast Cities to Mitigate Hurricane Damage: Perspectives of City Officials. *Applied Research Projects*, Texas State University.

Wolf, Aaron T. 1998. Conflict and cooperation along international waterways. *Water Policy* 1:251-265.

Wood, Daniel B. 2009. "California's drought raises rural-urban tensions over water," *Christian Science Monitor*, April 17, 2009, http://www.csmonitor.com/2009/0418/p02s01-usgn.html (accessed October 11, 2009).

Yongmei, Li, Stephen D. Arnold, Charles Kozel and Sue Forster-Cox. 2005. Water Availability and Usage on the New Mexico/Mexico Border. *Journal of Environmental Health* 68(3): 10-17.

Appendix A: Survey Instrument

September 25, 2009

To Whom It May Concern:

The goal of this survey is to determine the opinions of local elected and appointed water management officials in the Texas region of the U.S.-Mexico border toward the international treaty, the *Utilization of Waters of the Colorado and Tijuana Rivers and of the Rio Grande Treaty*, signed in 1944 (hereinafter the *1944 Treaty*), and key issues in binational water resource management. Findings from this survey will be used to complete an Applied Research Project that is a requirement for the Masters of Public Administration degree at Texas State University–San Marcos.

The survey process should take approximately 15 minutes to complete. Refusal to participate in this survey will involve no penalty or loss of benefits to which you are entitled. Participation in this survey is voluntary and any responses given will remain confidential. I alone will have access to the information you provide. Please feel free to stop filling in this survey at any time if you feel uncomfortable.

Please use the self-addressed stamped envelope to return the survey. No personal information is required and all responses will remain confidential. If you should have any questions about your rights or any other questions please feel free to contact me at ot1009@txstate.edu.

Please complete this survey and place in the mail by **October 12, 2009**.

Thank you very much for your assistance.

Sincerely,
Olivia Thompson
MPA Graduate Student
Texas State University–San Marcos

Please circle the best response to the following items.

1. I manage/oversee water resources for a: rural area (19) urban area (3)

2. I am an: elected official (18) appointed official (6)

3. Please rank the top three most important water uses, with one being the most important and three being least important:

Industrial uses (4)

Hydroelectricity (3)

Fishing and Hunting (3)

Recreational use (6)

Agriculture (20)

Livestock (15)

Municipal/residential use (25)

Navigation (2)

Ecology/environmental (5)

Please circle all that apply.

4. How do you educate your community on water supply issues?

a. Television (6)

b. Newspaper (18)

c. Radio (4)

d. Public forums (9)

e. Mail (8)

f. Internet (6)

g. None (1)

h. Other (2) In person.

5. The public is invited to participate in water policy discussions by:

g. Posting notice in a public register (9)

h. Newspaper (17)

i. Radio (6)

j. Television (4)

k. Internet (4)

l. The public is not invited (0)

Other (3) Public meetings.

6. Barriers to increased cooperation with my Mexican counterpart:

a. Language (2)

b. Government/Laws (11)

c. Politics/international relationship (13)

d. Lack of resources (5)

e. Differences in public administration (6)

f. No time (1)

g. Lack of initiative (1)

h. Communication systems (4)

i. Crossing the border (4)

j. No barriers (4)

k. Other (1) No counterpart to communicate with.

Please indicate the extent to which you agree or disagree with the following statements by using the scale below:

SA - Strongly Agree
A - Agree
N - Neutral
D - Disagree
SD - Strongly Disagree

7. The *1944 Treaty* should be amended to include a flexible allocation schedule that periodically reevaluates allocations and adjusts for changes in weather patterns, hydrology, and demographics of the Rio Grande Basin…….…….…….	SA (6)	A (8)	N (4)	D (2)	SD (1)
8. Five different treaties or compacts currently manage the Rio Grande Basin. Would you support a new treaty that includes all states that are part of the basin (Colorado, New Mexico, Texas, Chihuahua, Coahuila, Neuvo Leon and Tamulipas)?.....	SA (4)	A (10)	N (3)	D (2)	SD (2)

9. The *1944 Treaty* should be amended to address the allocation of groundwater in international hydrological zones…….. SA A N D SD
(4) (10) (3) (2) (2)

10. The *1944 Treaty* should be amended to define what constitutes an extraordinary drought…… SA A N D SD
(6) (11) (2) (1) (1)

11. The *1944 Treaty* should be amended to include ecological and environmental restoration/protection as a top priority for the use of international waters…… SA A N D SD
(8) (7) (4) (1) (1)

12. The IBWC favors individual state interests over international interests in dispute resolution negotiations……..….. SA A N D SD
(0) (5) (12) (4) (1)

13. The IBWC effectively enforces treaty provisions between the United States and Mexico……...…….…... SA A N D SD
(0) (6) (8) (4) (4)

14. International hydrological data should be freely shared between the United States and Mexico…….. SA A N D SD
(12) (7) (3) (1) (0)

15. Data on water withdraw rates and wastewater discharge should be freely shared between states and the United States and Mexico…SA A N D SD
(12) (8) (2) (1) (0)

16. Do you support the following to reduce water usage:
a. Increased price per unit of water ……SA A N D SD
(2) (5) (9) (5) (3)

b. Water use restrictions……. SA A N D SD
(2) (15) (5) (0) (0)

c. Water recycling (“gray water”)…….. SA A N D SD
(4) (16) (3) (1) (0)

d. Monetary incentives for water conservation (rebates or subsidies for improved irrigation, low-flow plumbing/ appliances, xeriscaping)……..... SA A N D SD
(8) (11) (3) (0) (1)

e. Restrictions on water withdraws……..…SA A N D SD
(3) (13) (7) (1) (0)

17. The public is only concerned with water issues in times of crises…….. SA A N D SD
(5) (11) (4) (4) (0)

18. Binational water management should include input from the public, nongovernmental organizations, and government officials……...SA A N D SD
(5) (15) (2) (1) (0)

19. I regularly communicate with my Mexican counterpart on water policy issues……...….. SA A N D SD
(0) (3) (13) (7) (1)

Additional comments (please use back of page, if needed):

Appendix B: Border Population Data

Table B. Population change in Texas border counties from 1940 to 2009, including projected population data for 2040. Changes of 100% or more are highlighted in yellow.

County Name	1940	2009	2040	% change between 1940 and 2009	% change between 2009 and 2040	% change between 1940 and 2040
Brewster	6,478	9,408	9,509	45%	1%	47%
Brooks	6,362	7,889	10959	24%	39%	72%
Cameron*	83,202	408,951	675,777	392%	65%	712%
Crockett	2,809	4,545	4,516	62%	-1%	61%
Culberson	1,653	2,733	3,517	65%	29%	113%
Dimmit*	8,542	9,816	13,412	15%	37%	57%
Duval	20,565	12,153	15,781	-41%	30%	-23%
Edwards	2,933	2,211	2,001	-25%	-9%	-32%
El Paso*	131,067	763,712	1,150,619	483%	51%	778%
Frio	9,207	17,807	23,731	93%	33%	158%
Hidalgo*	106,059	768,405	1,434,632	625%	87%	1253%
Hudspeth	3,149	3,772	3,843	20%	2%	22%
Jeff Davis	2,375	2,777	1,887	17%	-32%	-21%
Jim Hogg*	5,449	5,495	6,873	1%	25%	26%
Kenedy	700	465	513	-34%	10%	-27%
Kinney*	4,533	3,447	3,564	-24%	3%	-21%
La Salle	8,003	6,030	9,167	-25%	52%	15%
McMullen	1,374	875	662	-36%	-24%	-52%
Maverick*	10,071	54,461	87,365	441%	60%	767%
Pecos	8,185	17,741	20,110	117%	13%	146%
Presidio*	10,925	8,542	13,036	-22%	53%	19%
Real	2,420	3,317	2,666	37%	-20%	10%
Reeves	8,006	11,276	15,098	41%	34%	89%
Starr*	13,312	65,944	112,710	395%	71%	747%
Sutton	3,977	4,584	4,930	15%	8%	24%
Terrell*	2,952	1,103	869	-63%	-21%	-71%
Uvalde	13,246	27,695	38,193	109%	38%	188%
Val Verde*	15,453	49,616	70,021	221%	41%	353%
Webb*	45,916	251,096	545,292	447%	117%	1088%
Willacy*	13,230	21,865	30,512	65%	40%	131%
Zapata*	3,916	14,944	22,001	282%	47%	462%
Zavala	11,603	12,735	15,884	10%	25%	37%
Total	**567,672**	**2,575,410**	**4,349,650**	**354%**	**69%**	**666%**

*Entire county is within the federal definition of the U.S.-Mexico border region.

Sources: 1940 population data retrieved from the County Information Project, Texas Association of Counties; 2009 population data retrieved from the Texas Department of State Health Services; 2040 population data retrieved from the Texas State Data Center.

Appendix C: IRB Exemption

Confirmation of Approval: IRB Application 2009A6814. DO NOT REPLY to this message.

OSP IRB <ospirb@txstate.edu> Thu, Sep 24, 2009 at 9:43 AM
To: ot1009@txstate.edu

This email message is generated by the IRB online application program. Do not reply.

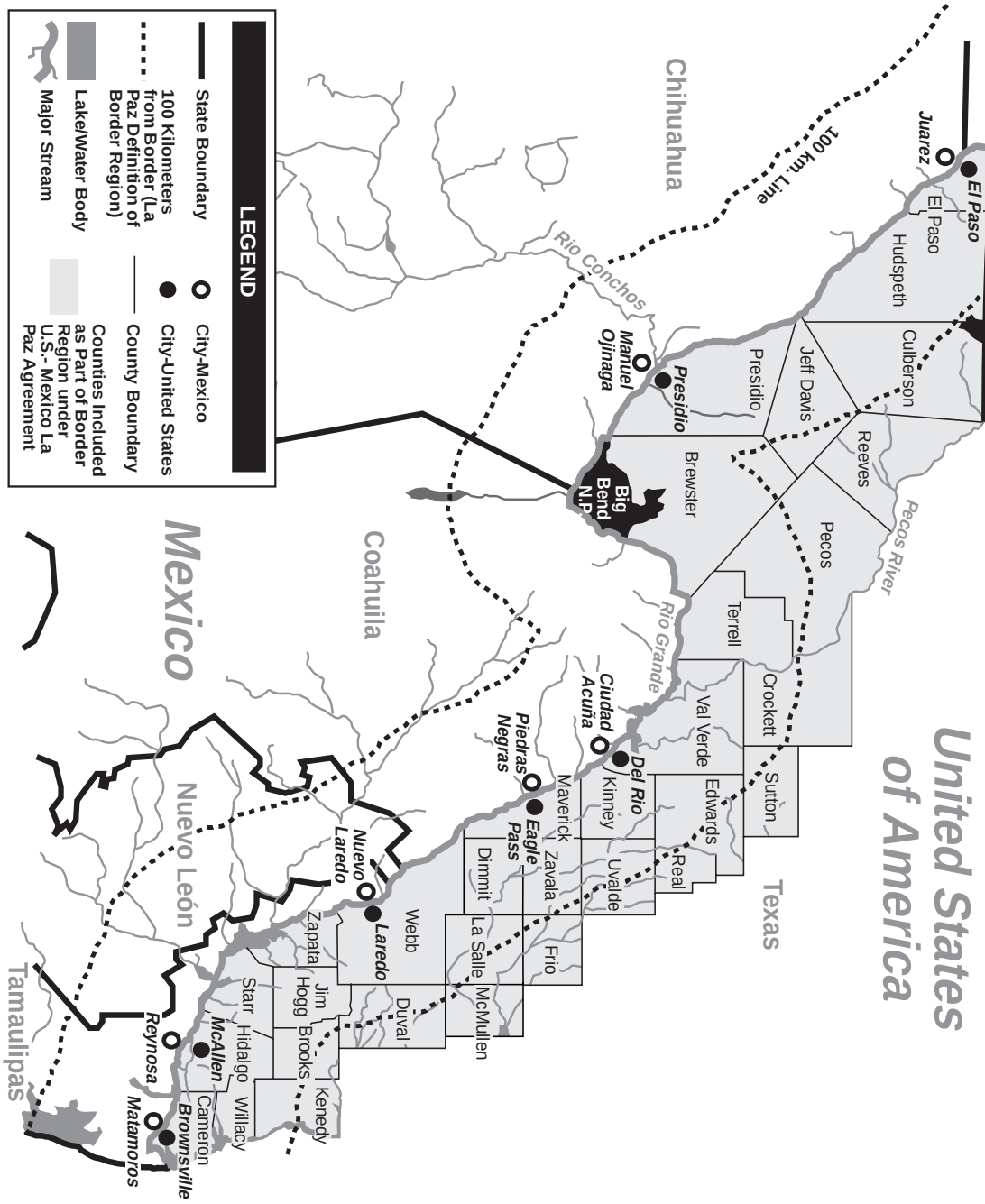
The reviewers have determined that your IRB Application Number 2009A6814 is exempt from IRB review. The project is approved.

If you have questions, please submit an IRB Inquiry form at:
http://www.txstate.edu/research/irb/irb_inquiry.html

==========

Institutional Review Board
Office of Research Compliance
Texas State University-San Marcos
(ph) 512/245-2314 / (fax) 512/245-3847 / ospirb@txstate.edu / JCK 489
601 University Drive, San Marcos, TX 78666

Appendix D: Map of the Texas – Mexico Border Region



Appendix E: Map of Texas Regional Water Planning Groups

Source: Texas Water Development Board