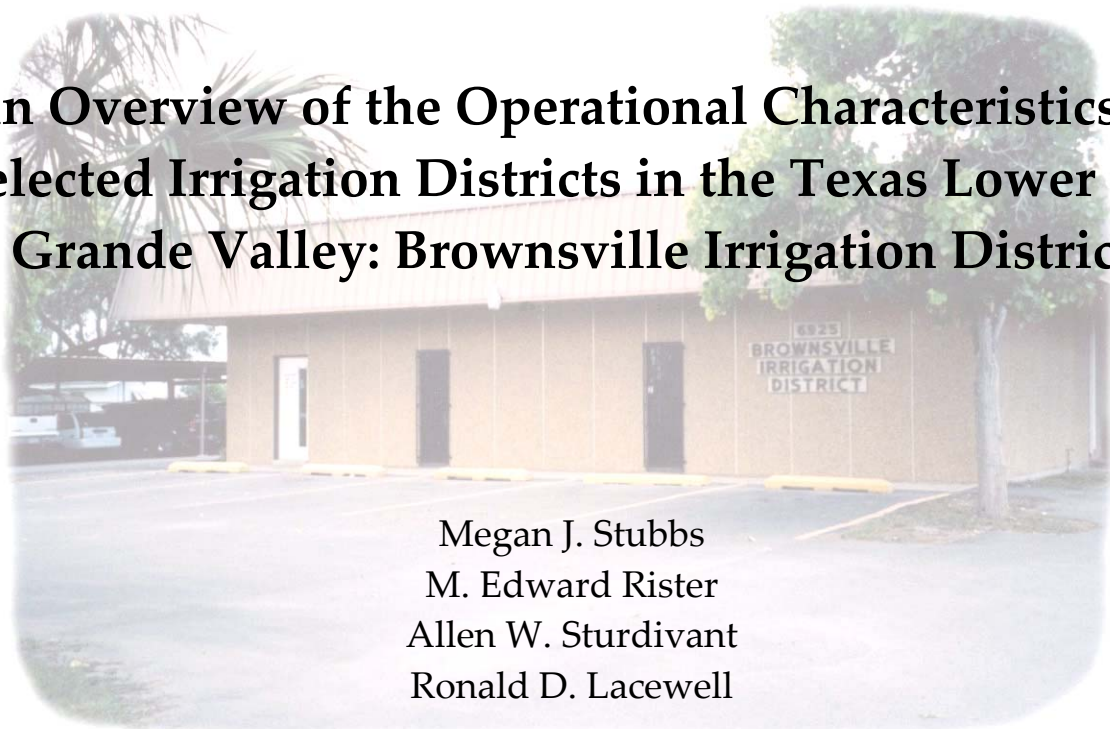


## **An Overview of the Operational Characteristics of Selected Irrigation Districts in the Texas Lower Rio Grande Valley: Brownsville Irrigation District**



Megan J. Stubbs  
M. Edward Rister  
Allen W. Sturdivant  
Ronald D. Lacewell

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**Texas Water Resources Institute**

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# **An Overview of the Operational Characteristics of Selected Irrigation Districts in the Texas Lower Rio Grande Valley: Brownsville Irrigation District**

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## **Preface**

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With the publicity and public recognition of water shortages that have existed across the Texas Lower Rio Grande Valley (Valley) in the 1990s and early 2000s, many questions have surfaced related to the characteristics, basic operations, and how irrigation districts allocate water among users. In response to questions about the history and legal framework related to water in the region, the report “Evolution of Irrigation District and Operating Institutions: Texas, Lower Rio Grande Valley” (Stubbs et al.) was developed to give insight on the overall evolution of agriculture and the establishment of institutions for irrigation operations. A series of reports are being developed that address specific characteristics of selected districts. Through case-study evaluations of individual irrigation districts, the plan is to compare and contrast methods of operation and water allocation across irrigation districts. An irrigation district that provides water to both urban communities and agriculture (which includes most of the irrigation districts in the Lower Rio Grande Valley) brings forth more questions related to how each of these systems operate. Individual or groupings of irrigation districts’ methods of operation remain unknown to many and, to a large extent, may impact the image of all irrigation districts – particularly with regard to basic efficiency and capability to react to alternative conditions. That is, the clientele base, infrastructure, adoptive rate of technology, etc. can vary significantly across irrigation districts. So, to completely understand and appreciate the collective Lower Rio Grande Valley irrigation district system, one must understand the idiosyncrasies that distinguish one from another. This research is intended to provide a ‘blueprint’ to be used in developing corresponding evaluations for several other irrigation districts. This first report in the series addresses the specific operation characteristics of the Brownsville Irrigation District.

# **An Overview of the Operational Characteristics of Selected Irrigation Districts in the Texas Lower Rio Grande Valley: Brownsville Irrigation District**

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## **Abstract**

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Population expansion and water shortfalls have placed the Texas Lower Rio Grande Valley (Valley) center stage in water publicity. The unique characteristics and lack of public knowledge on how irrigation districts divert and convey water from the Rio Grande to municipal, industrial, and agriculture consumers have precipitated questions regarding the operations and makeup of these districts. Differences between and similarities across irrigation districts can be partially attributed to the topography, water-delivery infrastructure system, past financial decisions, and each irrigation district's population demographics and clientele base. The Brownsville Irrigation District (BID), with its unusual use of a natural resaca system and advanced technology directing flow-control mechanisms, is one of the 29 distinct irrigation districts in the Valley. This study presents a comprehensive analysis of BID that includes a brief historical background, a description of the District, and discussion of the District's current operations. Specific information in the report details not only the use of technology within the District, but also how the District diverts and delivers its allocated water from the Rio Grande, how it is used (i.e., municipal, industry, and agriculture), and mechanisms for allocation within and outside the District.

The uniqueness of the Lower Rio Grande Valley irrigation districts requires an understanding of their origins and operating mannerisms in order to explain their overall institutional effects. Through unlocking some of the conundrum associated with these individual irrigation districts, policymakers and other interested stakeholders should have a better perception of the culture and evolution that surround these unique districts, thereby facilitating improved policy-making decisions affecting the region's water supply and usage.

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## About the Authors

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- **Joe Barrera.** General Manager of the Brownsville Irrigation District; provided continuous information and support essential to this report;
- **Andrew “Andy” Slovak and Arturo “Art” Cabello.** Head Canal Rider and Information Specialist, respectively, at the Brownsville Irrigation District; both provided information and insight regarding many daily operational activities;
- **Glenn Jarvis.** Continues to serve as our legal expert related to compacts, institutions, and legal processes and outcomes. We are most grateful for his time and expertise;
- **The Stillman House and Museum.** A gracious staff assisted in the formation of the historical section of this report; and
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Thanks to the individuals noted above. Nonetheless, we, the authors of this manuscript, accept all responsibilities for any errors and/or other oversights that are present in the manuscript. In publishing this report, we are describing operations and

practices of the irrigation district and, therefore, offer no opinions. Specific operations and practices are neither supported nor criticized by the authors or the Texas A&M University System.

**MJS**  
**MER**  
**AWS**  
**RDL**

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## Chapter 1

### Introduction and Background

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The Texas Lower Rio Grande Valley (Valley) irrigation districts that exist today were officially formed after the turn of the twentieth century. Article III, Section 52 of the Texas Constitution allowed for the public development of the State's surface water. Created in 1904, this article allowed farmers within the Lower Rio Grande Valley to organize and create districts that became legal entities of the State. Due to the financial failure of many land and irrigation development companies in the Valley, local farmers were able to purchase the water rights and infrastructure through the legal indebtedness that Article III, Section 52 allowed (Strambaugh and Strambaugh). The Great Depression of the 1930s caused most of the land and development companies to collapse, leaving the newly created irrigation districts to maintain the lifeblood of the Valley: irrigated agriculture.

This chapter introduces historical and background information pertaining to the Brownsville Irrigation District (BID) and the entire Valley. The intent is to present an informed understanding of how the area operated in the past, and to explain some of the current day practices. Also discussed are other relevant cooperating agencies, such as the Texas Commission on Environmental Quality (TCEQ) and the International Boundary and Water Commission (IBWC). Both the TCEQ Rio Grande Watermaster program and the U.S. Section of the IBWC significantly influence the daily operations of Valley irrigation districts.

#### *Historical Overview*

In the beginning of the twentieth century, land developers and businessmen alike stumbled upon a stretch of land for which irrigation opportunities and fortunes had previously been overlooked by others. Consequently, the Texas Lower Rio Grande Valley did not become heavily populated until the 1920 –1930s (**Table B1 and B2, and Figure A1**). Prior to that time, mostly descendents from the Spanish-Mexican settlements and former military men from Fort Brown lived in the area.

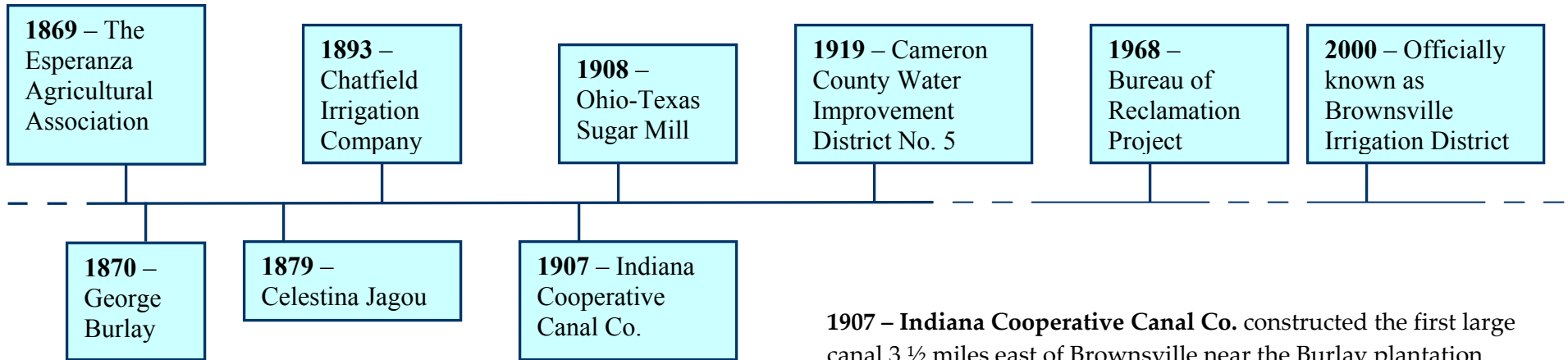
It was not until the idea of expanding irrigation beyond the banks of the Rio Grande evolved that large masses of people from northern areas of the country began moving south to what was then called “The Magic Valley” (Strambaugh and Strambaugh). As irrigation and agriculture expanded, so did development across the Valley. This growth is evident by the fact that in 1903, prior to the railroad’s arrival, the City of Brownsville had a population of only 7,000 (Allhands). After the railroad arrived, the population more than tripled to 22,021 in 1930 (Garza and Long).

During this time of prosperity, the area that is now the BID flourished as well. As early as 1869, large-scale irrigation attempts were made in the BID area. As shown in the timeline represented in **Exhibit 1**, the La Esperanza Ranch was purchased by former military men of the nearby Fort Brown for the purpose of expanding irrigation beyond the banks of the Rio Grande (Allhands).

Though the Esperanza Agricultural Association operation failed, individuals made other early irrigation attempts until the arrival of the Indiana Cooperative Canal Company (Allhands). Beginning in 1907, the cooperative was initially made up of investors from Indiana with a beginning investment of \$25,000 (Allhands). The private cooperative was eventually purchased by local farmers in 1919 and became the Cameron County Water and Improvement District No. 5 (Cameron County Water and Improvement District No. 5). Few significant events took place in the District over the next four decades, until 1968, when the Board of Directors elected to borrow \$5 million for a three-year Bureau of Reclamation (BOR) project that placed all of the District’s canal system into underground pipeline, with the exception of the Main Canal (Barrera 2003a). The Cameron County Water and Improvement District No. 5 officially became the Brownsville Irrigation District on May 18, 2000 (Border Environment Cooperation Commission).

### *The Rio Grande Watermaster*

The Watermaster acts as a policing force in controlling and enforcing water rights along the Rio Grande. Operating under Chapter 303-304 of the TCEQ regulations, the Watermaster is required to regulate, monitor, and record the flow levels, patterns, and rates of water being diverted and used within the Watermaster’s program area. Diverters of the Rio Grande must notify the Watermaster’s office prior to diverting and are subject to recorded measurements by the Watermaster to ensure that



**1869 – The Esperanza Agricultural Association (EAA)** was formed when groups of civil war troops purchased 640 acres along the lower third of the Espiritu Santa Grant. The group’s venture failed and the land was sold to Celestina Jagou.

**1870 – George Burlay** purchased 1,000 acres 9 miles east of Brownsville called the Rio Grande Plantation. He began the first large-scale irrigation operation and successfully grew sugarcane.

**1879 – Celestina Jagou** purchased the former EAA 640 acres and installed a crude irrigation system by 1883.

**1893 – Chatfield Irrigation Company** was formed by Lieutenant W. H. Chatfield and had a beginning capital of \$1,000,000. His large-scale idea was to irrigate the entire Valley using a system of storage basins and running water systems. His forward thinking never progressed beyond the planning stage.

**1907 – Indiana Cooperative Canal Co.** constructed the first large canal 3 ½ miles east of Brownsville near the Burlay plantation. On May 18, 1908, the head gates were opened on the 6-mile intake. By 1909, the canal irrigated approximately 12,000 acres.

**1908 – Ohio-Texas Sugar Mill** was constructed north of Brownsville by farmers from Ohio. The mill was in operation until 1918, when it was abandoned.

**1919 – Cameron County Water Improvement District No. 5** held its first Board of Directors meeting in the Merchants National Bank Building in Brownsville, Texas.

**1968 – Bureau of Reclamation Project** that placed the majority of the District’s canal system into underground pipeline. The project cost \$5 million and took 3 years to complete.

**2000 – Officially known as Brownsville Irrigation District** by the Texas Commission on Environmental Quality, May 18<sup>th</sup>.

Sources: Allhands; Brownsville Case Study; Foscue; Garza and Long; Strambaugh and Strambaugh.

**EXHIBIT 1. Key Historical Events Affecting the Organization and Development of the Brownsville Irrigation District (1869-2000).**

diverters are the true holders of the water rights and that they are diverting no more than their allotted amount (Texas Commission on Environmental Quality 2004).

The first Rio Grande Watermaster program began in the 1950s as a voluntary water administration commonly called the “Falcon Compact” (Jarvis). Under the Falcon Compact, water rights holders voluntarily employed a Watermaster and voluntarily divided over 450,000 acres of irrigation water equally (Jarvis). This program worked for only a few years. In 1956, Falcon Reservoir was drained below the desired minimum level, and combined with the lack of enforcement powers by the Watermaster, excessive and illegal pumping occurred along the Rio Grande. A landmark lawsuit ensued, *State of Texas v. Hidalgo County Water Control and Improvement District No. 18* (1969), commonly called the “Valley Water Suit” which took thirteen years to resolve.

When the Valley Water Suit was filed on June 27, 1956, the district court judge in Hidalgo County took possession of the U.S. share of the Rio Grande waters and appointed a Watermaster (Jarvis). During the Valley Water Suit, the court-appointed Watermaster controlled and enforced the allocations and regulations of the Rio Grande. In 1967, the State passed the *Water Rights Adjudication Act* that created a new administrative and judicial process for dealing with water rights. Upon completion of the Valley Water Suit in 1969, the Texas Water Commission gained control over the Watermaster program from the courts, under the provisions previously established in the *Water Rights Adjudication Act* of 1967. Currently, the TCEQ is the state agency that manages the Watermaster Program. The executive director of TCEQ appoints one Watermaster per division. Currently, the State of Texas has only two Watermaster division areas: the South Texas Watermaster and the Rio Grande Watermaster. The Rio Grande below Fort Quitman is managed by the Rio Grande Watermaster (**Figure 1**).

The Watermaster program is funded through flat rate and variable fees charged to water right holders within the Watermaster’s program area. The current annual flat rate (i.e., base) fee is \$50.00 per water rights holder, plus an assessment fee that is based on the projected operating budget and the amount of water rights owned by the user (Texas Commission on Environmental Quality 2004). The 2003 and 2004 assessment fees are listed below in **Table 1**. An exception to variable rate charges being assessed based upon the amount of water rights held is the instance of “no-charge” water, which is based on the volume of water diverted.<sup>1</sup> No-charge water is priced to the districts based upon the type of water and the year diverted.

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<sup>1</sup> No-charge water refers to a temporary situation of excess water flow in the Rio Grande whereby the Watermaster allows the diversion of water at “no charge” to the district’s Watermaster-controlled



**TABLE 1. TCEQ Watermaster Assessment Rates for Fiscal Years 2003-2004**  
(Hinojosa).

Type of Water-Use	Fiscal Year Per Acre-Foot Price <sup>a</sup>	
	2003	2004
Municipal	\$0.2721	\$0.2509
Industrial	\$0.2721	\$0.2509
Irrigation	\$0.2177	\$0.2007
Mining	\$0.2721	\$0.2509
Hydroelectric	\$0.0136	\$0.0125
Recreation	\$0.2721	\$0.2509
Recharge	\$0.1360	\$0.1254
Secondary	\$0.1360	\$0.1254
Salt Water	\$0.0272	\$0.0250
Spreader Dam	\$0.1088	\$0.1003
Livestock/Domestic	\$0.2721	\$0.2509
Storage	\$0.1088	\$0.1103
Stock Raising	NA <sup>b</sup>	\$0.2509
Game Preserves	NA <sup>b</sup>	\$0.2509
Livestock	NA <sup>b</sup>	\$0.0501
Non-consumptive	NA <sup>b</sup>	\$0.2007
Reuse	NA <sup>b</sup>	\$0.1254
Public Parks	NA <sup>b</sup>	\$0.2007
Industrial Non-consumptive	NA <sup>b</sup>	\$0.0501
Multi Use	NA <sup>b</sup>	\$0.2509
Other	NA <sup>b</sup>	\$0.2509

<sup>a</sup> Assessments are charged per acre-foot of water right.

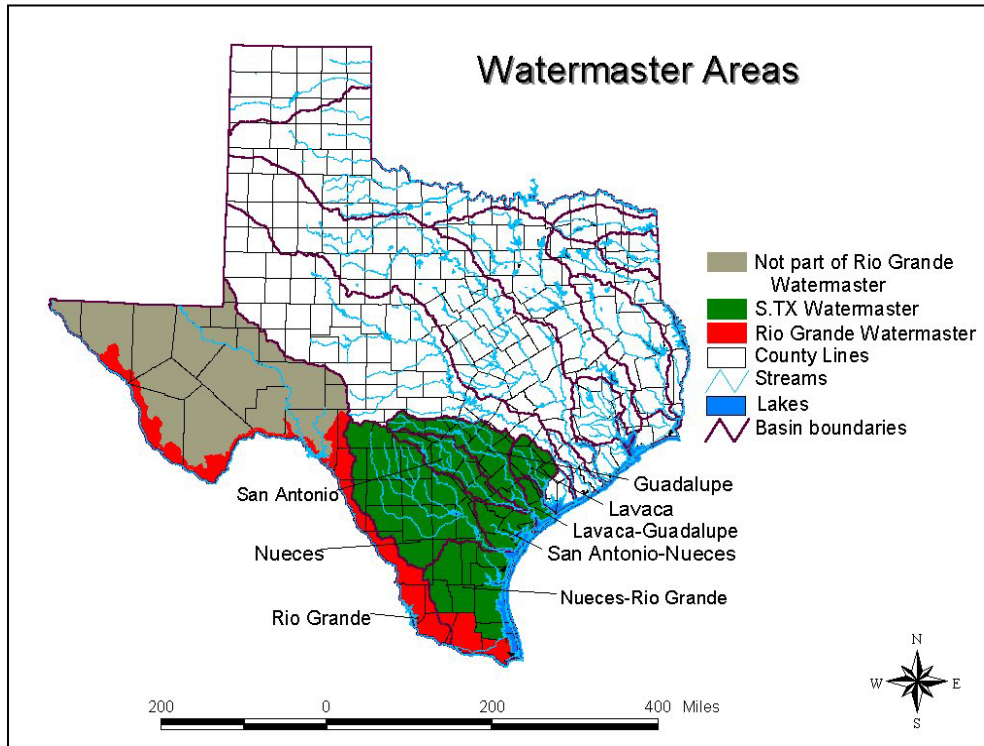
<sup>b</sup> New water-use type beginning in 2004.

The Rio Grande Watermaster Advisory Committee (RGWAC) provides oversight and administrative guidance to the Watermaster. Established in 1998, the RGWAC consists of 15 members and one alternate, each who serve a two-year term (**Figure A2**). Members serve voluntarily, hold water rights or represent those who hold water rights,

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allocation. That is, the district's annual claim to Rio Grande flows is not reduced by any amount when it diverts under no-charge conditions. Note that no-charge water is not "free" as the district does incur certain costs such as the variable rate assessed by the Watermaster and energy costs to divert the no-charge water from the Rio Grande.

and are chosen by the executive director of TCEQ based on the amount of water rights held, experience in water management, geographic location, and water-use type (i.e., irrigation user, municipal supplier, etc.) (Texas Commission on Environmental Quality 2004). The RGWACs responsibilities include: providing recommendations to the Rio Grande Watermaster and executive director, reviewing the annual budget of the Rio Grande Watermaster Program, and other duties as requested by the executive director (Texas Commission on Environmental Quality 2004).



**FIGURE 1. Geographical Location of the Watermaster Areas in Texas, 2004**  
(Texas Commission on Environmental Quality 2004).

*International Boundary and Water Commission*

The first International Boundary Commission (IBC) for the U.S.-Mexico border was created to survey the California-Baja California border in 1848 and then again to survey the New Mexico-Chihuahua border in 1853. The third temporary commission was established to conduct surveys and studies along the U.S.-Mexico border in 1882. In 1889, the Convention between the United States and Mexico permanently established the IBC for the purpose of carrying out the duties of the 1884 Convention. These duties included resolving boundary disputes, as well as water investigations for the Rio Grande and Colorado Rivers (U.S. General Accounting Office).

A 1944 Treaty changed the IBCs name to the International Boundary and Water Commission (IBWC) and created additional duties. The 1944 Water Treaty, "Utilization of Waters of the Colorado and Tijuana Rivers and of the Rio Grande,"<sup>2</sup> divided the international portions of the Rio Grande from Fort Quitman, Texas to the Gulf of Mexico. The Treaty also commissioned the IBWC to construct and maintain international dams for the purpose of flood control. In 1953 and 1969, construction was completed on the two international reservoirs, Falcon and Amistad, respectively (U.S. Section, International Boundary and Water Commission).

The IBWC plays a large role in the daily operations of the Valley irrigation districts. The rules set forth by the 1944 Water Treaty are still in practice today and because the irrigation districts receive their water supply from an international river (i.e., the Rio Grande), they too must abide by these rules. When irrigation districts contact the TCEQ Watermaster's office requesting the diversion of water, it is the Watermaster that contacts the IBWC to release water from the reservoirs.

Articles 4-9 of the 1944 Water Treaty deal directly with the distribution of the Rio Grande waters.<sup>3</sup> Article 4 defines specific allocation procedures from tributaries contributing to the Rio Grande (**Table 2**). The IBWC is responsible for recording and measuring the flows of contributing streams that are stated in the 1944 Water Treaty (U.S. Section, International Boundary and Water Commission). Each IBWC section (i.e., U.S. and Mexico) is responsible for maintaining and funding its country's operations and equipment. Most cooperative project costs are shared proportional to the benefits received unless otherwise contractually stated (U.S. Section, International Boundary and Water Commission).

It is the provisions of sub-paragraph (c) of Paragraph B in Article 4 that has created a recent controversy relating to Mexico's delivery obligations to the U.S.<sup>4</sup> Though the IBWC operates under broad treaties, specific agreements between the U.S. and Mexican governments come in the form of Minutes.<sup>5</sup> Recent Minutes from the IBWC are evidence of attempts made to allow Mexico to repay its water debt to the U.S.

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<sup>2</sup> Commonly referred to as the 1944 Water Treaty.

<sup>3</sup> Excerpts of 1944 Water Treaty that are cited in the text are included in **Appendix D**.

<sup>4</sup> For additional information regarding the 1944 Treaty non-compliance, refer to "Evolution of Irrigation Districts and Operating Institutions: Texas, Lower Rio Grande Valley" (Stubbs et al.).

<sup>5</sup> Minutes are documented decisions or recommendations between the U.S. and Mexico. Once each Minute is signed by the required Commissioner, Secretaries, and governments, the Minute becomes a binding contract between the U.S. and Mexico (U.S. Section, International Boundary and Water Commission).

in a timely fashion. As of July 28, 2004, Mexico owes the U.S. approximately 750,000 acre-feet (ac-ft) of water (White). This number accounts for all of the deliveries from Mexico to date and assumes the minimum payments for the rest of the six-month cycle.

**TABLE 2. U.S. and Mexico Allocations of the Rio Grande According to the 1944 Water Treaty** (U.S.-Mexico Treaty for Utilization of the Waters of the Colorado and Tijuana Rivers and of the Rio Grande).

Contributing Flows	To the United States	To Mexico
Rio San Juan	None	All Flows
Rio Alamo	None	All Flows
Pecos River	All Flows	None
Devils River	All Flows	None
Good-enough Springs	All Flows	None
Alamito Creek	All Flows	None
Terlingua Creek	All Flows	None
San Felipe Creek	All Flows	None
Pinto Creek	All Flows	None
Rio Conchos	1/3 of Flows <sup>a</sup>	2/3 of Flows
Rio San Diego	1/3 of Flows <sup>a</sup>	2/3 of Flows
Rio San Rodrigo	1/3 of Flows <sup>a</sup>	2/3 of Flows
Rio Escondido	1/3 of Flows <sup>a</sup>	2/3 of Flows
Rio Salado	1/3 of Flows <sup>a</sup>	2/3 of Flows
Las Vacas Arroyo	1/3 of Flows <sup>a</sup>	2/3 of Flows
Main Flows of Rio Grande below Falcon	1/2 of Flows	1/2 of Flows
Non Measured Contributing Flows & not named in Treaty	1/2 of Flows	1/2 of Flows
Measured Contributing Flows & not named in Treaty	100% of Flows <sup>b</sup>	100% of Flows <sup>b</sup>

<sup>a</sup> The average annual minimum delivery required of Mexico (over each five-year cycle) is 350,000 ac-ft. See Article 4, Section B, Subsection (c) in **Appendix D**.

<sup>b</sup> 100% of contributing flows that are measured and not named in the 1944 Treaty belong to the country from which the flows originated.

### *Chapter Summary*

This chapter discussed significant historical events that took place in BID. Beginning as far back as 1869, the BID area has played an intricate role in shaping the Valley’s irrigation practices. Many past decisions and events have formed both the

current structure of the District, as discussed in Chapter 2, and the current operating practices, as discussed in Chapter 3.

Also discussed were relevant state and international agencies, such as the TCEQ Watermaster program and the IBWC. The Watermaster program plays an important role in the daily operations of the Lower Rio Grande Valley irrigation districts. The organization of the Lower Rio Grande Watermaster program was the result of a failure of the irrigation districts to voluntarily control their own pumping along the Rio Grande in the 1950s. The program's current enforcement and distributive powers, as well as the RGWAC, significantly impact irrigation districts' operations. The IBWC also has an impact on the daily operations of the irrigation districts. The requirements of the 1944 Water Treaty dictate the amount of the Rio Grande and its contributing flows that belong to the U.S. The amount of water that each irrigation district is allocated by the Watermaster's office is dependent on these flows, making the IBWCs role increasingly important in times of drought and reduced water flow.

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## Chapter 2

### District Description

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The Brownsville Irrigation District (BID) covers approximately 20,040 acres within its 62-mile border and delivers water to approximately 10,600 acres of farmland each year (Border Environment Cooperation Commission). Though its operations are similar to that of other Valley irrigation districts, each district is unique in makeup and design. Each district is dependent upon the topography, infrastructure, past financial decisions, etc. BID is no exception to these qualifications. With its unusual resaca<sup>6</sup> system and advanced technology, BID represents only one of the 29 different irrigation districts in the Valley.

First discussed in this chapter is BID's use of technology. BID has one of the most advanced systems found among irrigation districts in the Valley. Though all irrigation districts adhere to the same regulations, how and where the district diverts its water from the Rio Grande is exclusive to that individual district and is the point where districts began to exhibit their differences. The second section describes the water's release from Falcon Reservoir to BID's diversion point and into the District's system. As with all systems, there is a continuous need for maintenance and repair. Discussed in the third section are the current improvements to the canal system and to the District as a whole. Infrastructure only describes one aspect of a district; cropping patterns, water-use, water rights, and urban areas also affect the operation of the district. These issues are discussed in the later sections of this chapter.

#### *Technology*

The Brownsville Irrigation District is unique in many ways. Not only does the District's water-delivery system lie almost completely underground in pipelines, the District also utilizes some of the most advanced technologies, allowing almost the entire

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<sup>6</sup> Resacas (or 'oxbow lakes' as they are sometimes referred to) are the remains of previous river channels and are commonplace in the southeast portion of Cameron County (i.e., the location of BID).

system to be operated from a remote location. The few sections of the District that are above ground, (i.e., unlined canal), are scheduled to be replaced with pipelines soon.<sup>7</sup>

When comparing across irrigation district operating systems in the Lower Rio Grande Valley, BID is considered very technologically advanced. In 1996, BID purchased the Wonderware® software program, which has the ability to remotely control numerous aspects of water-delivery company operations (Barrera 2003a). The software is based upon the use of a system of “tags” that are specific to the operation being performed.<sup>8</sup> One tag allows performance of one function or one piece of electronically operated equipment. For example, turning a switch on at a particular pump requires one tag. To turn the switch off requires the use of another tag. If a canal rider would like to look at the amount of water being pumped, another tag is required, and so forth. When BID purchased this software in 1996, the District purchased 3,000 tags (Barrera 2003b). Upon completion of the Main Canal Project,<sup>9</sup> an additional 250-500 tags will be purchased, as well as an upgrade in the Wonderware® software program (Barrera 2004).

The use of this technology appears to be expensive, when one considers only its initial investment and set-up cost. The initial cost of the program was \$5,000 (Barrera 2003b). The installation and system set up is custom designed to meet the needs and requirements of BID. This process took approximately one year to complete. The cost of the initial installation and set up was approximately \$45,000 (Barrera 2003b). Over the last seven years, the District has updated and purchased an additional \$25,000 worth of improvements to the system (i.e., resaca sensors, remote gate operations, etc.) (Barrera 2003b). Consideration of the increased water-delivery efficiencies and reduced labor requirement associated with use of the technology indicates this “expensive” investment is well justified (Barrera 2004).

After the initial installation, the system encountered unexpected problems. For example, if a pump is scheduled to turn on at 10:00 p.m. and there is a power failure at 11:00 p.m., the computer is disabled, and consequently the pump would run until manually stopped. In an effort to correct problems such as this, a “watchdog” feature has been added. If the pump does not receive at least two signals from the computer within a thirty-minute time frame, the pump automatically shuts down. The computer

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<sup>7</sup> This is discussed further in the ‘Improvements and Maintenance to the System’ section on **page 17**.

<sup>8</sup> A “tag” is simply an operating function of the system. Each tag allows you to perform one function (e.g., turn on a pump, turn off a pump, open a gate, etc.). The number of tags purchased from the software company denotes a form of “licensing” that limits the number of functions performed by the system.

<sup>9</sup> This is discussed further in the ‘Improvements and Maintenance to the System’ section on **page 17**.

is constantly polling the system (such as pumps) to determine what is on, off, functioning properly, etc. to insure proper performance. This watchdog feature requires one tag to monitor one pump.

The system is monitored by the Head Canal Rider at the District's headquarters. Upon receiving a request for water, the Head Canal Rider checks the system in that resaca area. All BID pumps are located along a resaca. The appropriate pump is then turned on at headquarters by utilizing radio signals through the computer system. If the reading from the pump comes back as being 'low,' that signal indicates to the Head Canal Rider that the standpipe is not yet fully charged. Once the standpipe is charged and the farmer opens the valve to his property, the system will relay a 'system satisfied' reading to the Head Canal Rider. Upon completion of the watering, the farmer will shut off his valve. This causes the system to go into a 'high' mode, in which the standpipe fills to capacity and overflows. This overflow goes directly back into the resaca. After the farmer completes his watering, the pump is shut off by the Head Canal Rider or programmed on a timer to turn off (Slovak).

Each pump has a running clock that monitors the time that the pump is running. This timer can be utilized to turn pumps on and off, without anyone having to physically push the button at headquarters. All of these actions are logged on an "alarm summary" and can be compiled on a monthly basis to indicate pump-running times. This information can also be viewed from a remote location, using a radio signal. This historical tracking system has been very beneficial as it convincingly dissolves complaints regarding discrepancies in pump run time (Slovak).

### *Diversion From the Rio Grande*

BID is located approximately 120 miles southeast of Falcon Reservoir and is the farthest diversion point on the U.S. side of the Rio Grande (Barrera 2003b). In order to request water from Falcon Reservoir, the District manager must contact the Rio Grande Watermaster and file a formal request. The Watermaster's office normally anticipates an approximate 6-day travel time to deliver water from the Falcon Reservoir to BID's point of diversion on the river. Depending on flow currents and precipitation after release time, however, the delivery time may vary. According to Barrera (2003a), BID has averaged a 20-day travel time from Falcon Reservoir in the past few years. This extended travel time had been due to a combination of factors including: aquatic weeds, low flow in the river, and low reservoir levels at Falcon (Barrera 2003a).



BIDs diversion point is located 6.75 miles downstream from the Gateway Bridge in downtown Brownsville, directly on the Rio Grande (Holdar-Garcia & Associates). The water must first flow through a screen approximately 20 feet in front of the intake pipes (**Exhibit C1**). A floating barrier and the submersed screen are used to keep water hyacinth and hydrilla from entering the intake pipes, seeking to avoid a potential damaged pump and for pipeline. Water enters the pumping facility through three intake pipes, one measuring 48 inches in diameter and the other two measuring 36 inches in diameter. These intake pipes travel approximately 25 yards under a small earthen road and lift the water approximately 22-24 feet into the pump house (Barrera 2003c).

The pump house contains three pumps. Two pumps are 45 cfs<sup>10</sup> pumps with 250 horsepower motors that run at 300 rpms<sup>11</sup> and use 2400 volts per motor (**Exhibit C2**). The third pump is a 95 cfs pump with a 400 horsepower motor that runs between 250-300 rpms and uses 2400 volts (**Exhibit C3**). These pumps were purchased in 1942 for approximately \$25,000 each (Barrera 2003b).

The lowest amount of water BID can extract from the river at any one time is 45 cfs. The peak pumping capacity is 185 cfs using all three pumps. This peak-pumping capacity has not been reached in the last 5 years due to the high amount of invasive weeds (Barrera 2004). The 95 cfs pump is not presently in use due to the high amounts of water hyacinth and hydrilla (Slovak). The high amount of invasive weeds and the velocity of the pump cause weeds to be sucked up against the barrier screen. This can cause damage to the screen and potential damage to the pumps themselves. For this reason, the 95 cfs pump is not used during the nighttime hours, but only during the daylight hours when it can be properly monitored (Slovak). The 45 cfs pumps provide a lower suction and are not prone to congest the barrier screen.

According to TCEQ rules, the Rio Grande Watermaster administers regulatory functions along the Rio Grande pertaining to diversions.<sup>12</sup> The Watermaster records and certifies each diverter (i.e., irrigation district) along the Rio Grande based on §303.11 (TCEQ).<sup>13</sup> Each diverter must first have an authorized diversion site (TCEQ §303.11.a) recognized by the Watermaster. Then, for each diversion, the diverter must have written certification from the Watermaster in advance, stating the intended

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<sup>10</sup> Cubic Feet per Second (cfs).

<sup>11</sup> Revolutions per Minute (rpm).

<sup>12</sup> The terms “Diversions” and “pumping” are used interchangeably in this section.

<sup>13</sup> Excerpts of TCEQ Rules and Regulations that are cited in the text are included in **Appendix D**.

amount of water to be diverted and the number of pumps that will be used in the diversion process (TCEQ §303.11.b).

The diverter is also responsible for providing, maintaining, and operating meters that accurately measure the amount of water being diverted (TCEQ §303.11.e). BIDs Rio Grande diversion meters are located behind the pumping facility, approximately 200 yards from the river. The records for these meters are kept by the Watermaster and subtracted from the diverter's account. The district does not get penalized if the diversion amount is plus or minus 10% of the total amount requested (TCEQ §303.12.e.1). If the district pumps less than 90% of what was requested from the Watermaster, they are still charged 90% of that request (TCEC §303.12.e.2). This rule is intended to discourage the wasting of water for those who would request too much water and not divert it. If the district pumps more than 110% of the requested amount, then the district is charged for the exact amount of what was pumped and could face penalties for this violation by the Watermaster (TCEQ §303.12.e.3). This rule is intended to discourage the diverting of water requested by downstream users.

### *Water-Delivery Infrastructure System*

From BIDs pumping facility, water travels through an open canal approximately 150 yards (**Exhibit C4**) where it is then conveyed through two 52-inch pipes underneath an access road (**Exhibit C5**). The purpose of the two 52-inch pipes being submerged is to insure a full pipe when pumping (Barrera 2003b). Located within these two pipes are flow meters that measure the flow of the water. By measuring the flow and knowing the size of the pipes, the District is able to accurately calculate the amount of water being pumped at any one time. This data is recorded daily (when pumping) and sent to the Watermaster to document the amount of water being diverted from the Rio Grande by BID.

The water flows into what is called the Main Canal. The Main Canal is an earthen canal (i.e., open and unlined) and is approximately 2.5 miles in total length (Slovak). The Main Canal travels northeast approximately 6,000 feet and forks (**Figure 2**). There is a gravity flow gate (and pump number 6) located at this fork that opens either to the east or the west (Slovak). The western portion of the Main Canal travels approximately 2,500 feet before reaching the Resaca de la Palma (Holdar-Garcia & Associates). Here, the water in the resaca is first stored and eventually pumped to other areas in the western portion of the District. This western canal also services the Public



**FIGURE 2. Partial Illustration of Brownsville Irrigation District, Highlighting the 2.5 Mile-Long Main Canal, 2001 (Holdar-Garcia & Associates).**

Utilities Board of Brownsville (PUB) when necessary.<sup>14</sup> The eastern portion of the Main Canal travels approximately 3,600 feet before reaching the eastern section of the Resaca de la Palma (Holdar-Garcia & Associates). At this location, water is stored and then eventually pumped with pump number 8 to the eastern portion of the District through its pipeline system.

Brownsville Irrigation District has a unique resaca system, which provides a naturally flowing component to the District's water-delivery infrastructure system. This resaca system provides approximately 2,400 ac-ft of reservoir storage for the District (Barrera 2003c).

BID uses this naturally occurring resaca system to store and convey water throughout the District. With the aid of pumps located along resacas, the District can relift the "resaca-conveyed" water into gravity-flow operated infrastructure, ensuring deliveries to end-users. This approach allows the District to capitalize on nature's engineering to move water throughout the District. There are resacas located within the District that are completely surrounded by urbanization. These resacas serve no other purpose to BID other than pumping and storing water for other resacas located elsewhere within the District. Beyond the BID's perspective, resacas have become popular residential waterfronts (Barrera 2003a).

This naturally occurring storage and conveyance system comes with a price. Though these resaca systems act as excellent storage facilities, they are also a source of considerable water loss through seepage and evaporation. BID's system water loss<sup>15</sup> is approximately 15% a year (Barrera 2003b). Within each resaca lies a sensor that measures the level of the resaca at all times (**Exhibit C6**). These sensors are encased within a half-inch steel pipe and buried approximately 11 feet below the resaca floor to prevent theft and damage (Barrera 2003b). Measurements from these sensors are continuous and are monitored via radio signal on a computer at headquarters. The Head Canal Rider monitors these sensor reports illustrating the varying levels of the resacas throughout the day. These reports, combined with data recording the amount of water pumped in and out of the resaca, allows for an accurate calculation of seepage and evaporation loss, and potential unauthorized takings or system damage. Water loss from a resaca greater than the anticipated evaporation loss (varying by temperature and wind levels up to 4 inches per day) indicates various problems: potential unauthorized taking of water from the resaca, broken or leaking drain, gate not properly shut, etc. (Slovak).

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<sup>14</sup> This is expanded upon in the 'District Revenue and Sales' section on **page 31**.

<sup>15</sup> Also known as a "water duty."

Evaporation losses have risen in previous years due to social and political pressures to maintain resaca water levels, thereby improving urban aesthetics (Barrera 2003b). All resacas located within the BID are owned by the District, as well as the water held within the resacas (Slovak). The BID has no responsibility to keep urbanized resacas full for aesthetic purposes (Barrera 2003b). For this reason, BID is considering giving certain urbanized resacas to PUB with contractual stipulations attached. Currently, irrigation water is being used to fill certain resacas although it is unnecessary and the District is not required to maintain them at a full level. Because PUB benefits from the tax revenue generated from these locations, they would be given the resaca easement and the responsibility to fill it. BID would then contract with PUB for the water that they use from that resaca and subtract it from PUBs account with BID.<sup>16</sup>

There are 11 relift pumps located throughout the District. **Exhibit C7** is of Pump number 11 located on Resaca De La Guerra representing an example of the types of relift pumps used by BID. Pumps are typically located at resacas and are used to lift water into the 183 miles of pipeline running throughout the District. Pipe size within the BID delivery infrastructure ranges from 12 inches to 60 inches in diameter. This can be seen in **Figure 3**, where the pipe size layout within BID is illustrated. The District, as part of a BOR Project, installed almost the entire pipeline delivery system from 1968 to 1971. This system is currently rated as being in fair condition and is being converted on an as needed basis to PVC<sup>17</sup> pipe (Barrera 2004).

### *Improvements and Maintenance to the System*

Similar to many large-scale operations that rely heavily on infrastructure, repairs and maintenance are necessary for maintaining efficiency of BIDs water-delivery system. In addition to daily maintenance, the water-transportation system is continually being updated with improvements that will streamline BIDs operations and consequently improve its water-delivery efficiency to consumers. With an irrigation district that is required to provide water continuously throughout the year to farmers and municipalities alike, scheduling an ideal time for maintenance and repairs is difficult.

Nearly all of BIDs water-delivery system consists of underground pipeline and has water flowing through it all of the time. If a repair or improvement needs to be

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<sup>16</sup> This account is discussed later in the 'Revenue and Sales' section.

<sup>17</sup> Poly Vinyl Chloride.

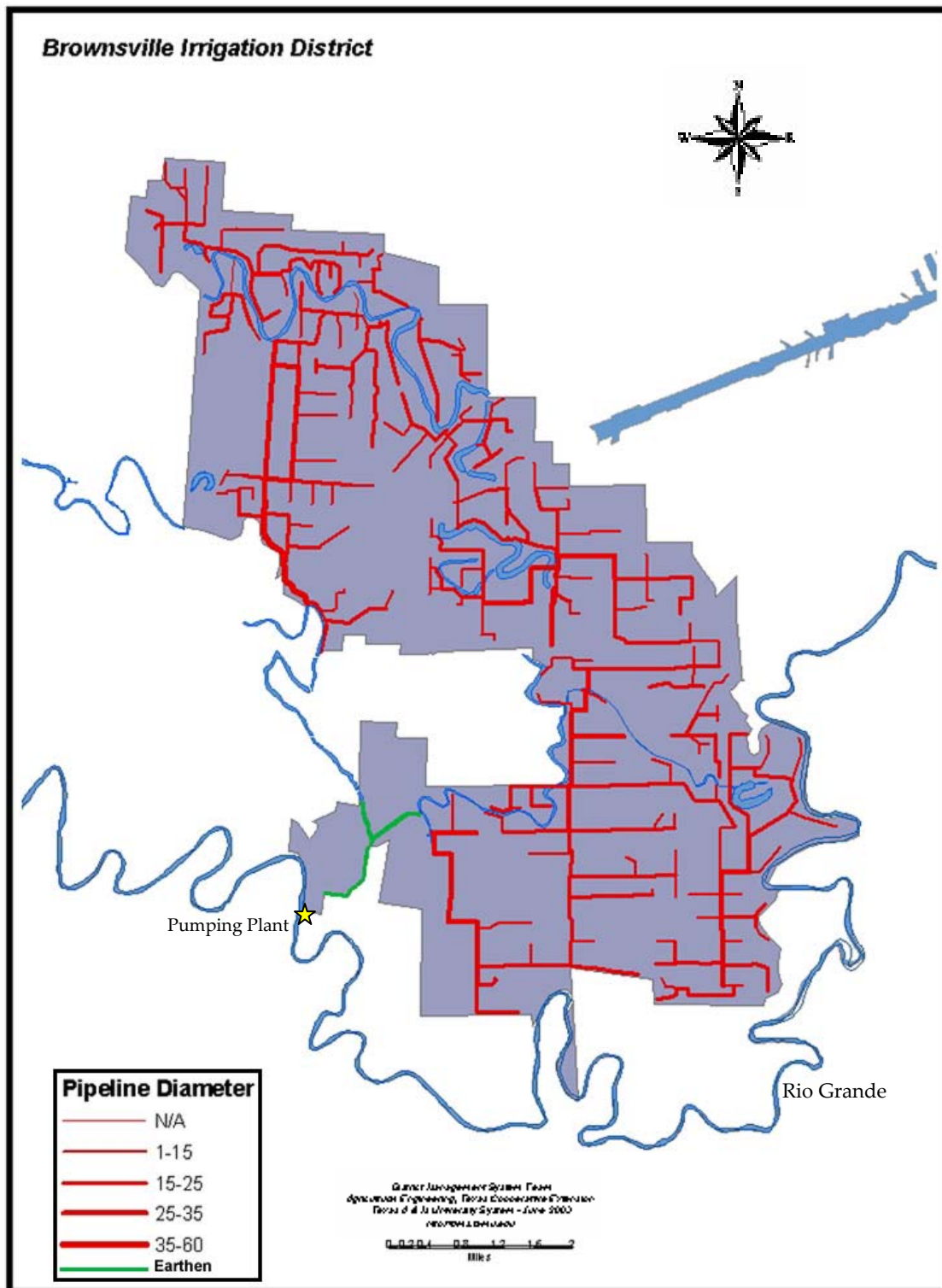


FIGURE 3. Illustrated Layout of Brownsville Irrigation District, Highlighting the Pipeline Diameter of Key Water-Delivery Infrastructure, 2000 (Fipps et al.).

made within a pipeline, the maintenance crew uses a “balloon” to stop the flow of water. A “balloon” (**Exhibit C8**) is made of a soft grooved rubber that expands to fit the interior of the pipe. Balloons are affixed with long stems that allow for the balloon to be lowered into a pipe and then inflated, thereby stopping the flow of water. Chains are also attached to the balloons to ensure that they do not float away if pressure is not maintained. They range in size from 18 to 30 inches and cost between \$400 and \$1,000 each (Barrera 2003b).

### Main Canal Project

Along with maintenance and repairs, BID is continually improving and updating its water-delivery system. In 1968, the Board of Directors made a major decision of putting the entire District conveyance system underground and into pipeline. In a collaborative effort with the BOR, BID undertook a three-year, \$5 million project. Though the project placed most of the District underground, the 2.5-mile Main Canal remains an open, earthen canal (Barrera 2003a) (**Figure 2**).

In 2000, Congress enacted “The Lower Rio Grande Valley Water Resources Conservation and Improvement Act of 2000” (Public Law 106-576) which authorized the BOR to commence with the capital improvement projects of four irrigation districts in the Valley. In 2002, fifteen additional projects were authorized under House Resolution 2990, also known as the “Lower Rio Grande Valley Water Resources Conservation and Improvement Act of 2002.” BIDs Main Canal Project was among the fifteen projects authorized in 2002.

In addition to the above legislation, the North American Development Bank (NADB), which is a bi-national development bank between the U.S. and Mexico, created the Water Conservation Investment Fund (WICF) in 2002. The WICF allocated \$80 million (\$40 million for the U.S. and \$40 million for Mexico), subject to certification, for the purpose of water conservation for the border region. BID submitted its BOR application to NADB and has received preliminary notification of a \$1,178,000 grant to be used for the Main Canal project.

The Main Canal project consists of replacing 6,000 feet of open unlined canal with 72-inch pipe and using 54-inch pipe to place the east and west fork (3,600 and 2,500 feet respectively) underground (Barrera 2003c). As illustrated in **Figure 2**, the Main Canal represents BIDs main artery. It is the only connection point between the pumping facility at the river and the entire District. The Main Canal is in use an average of 189 days a year, with an average duration of pumping being 9 days (Holdar-

Garcia & Associates). The Main Canal project is expected to cost approximately \$2,356,000 and take one year to complete.<sup>18</sup>

### Inclusion<sup>19</sup> of Land to the District

Land can be, and occasionally is, added and/or removed from a district. For land to be legally added to an existing irrigation district, the owner of the land must adhere to an application process and request the Board of Directors adopt a resolution and record such approval within its meeting minutes (Texas Water Code §58.706).<sup>20</sup> The owner must assume all taxes levied on the land after the land is included into the district, as if it had been incorporated originally into the district (Texas Water Code §58.706). Also, the irrigation district has a responsibility to service and provide water to the new land as it does to land originally incorporated in the district (Texas Water Code §58.713).

The inclusion of land into an existing irrigation district is an uncommon occurrence in the Valley. Most existing irrigation districts are land locked by municipalities and other irrigation districts and therefore do not have the option of including additional land into their district. Due to the location of BID and other distinguishing characteristics, the opportunity to include land still presents itself.

### *Cropping Patterns and Water-Use Trends*

Cropping patterns in BID have shifted over the last few years away from planting one crop per year to planting two to three crops per year. This has caused an increase in overall water-use, even while total irrigated acres are declining. Currently, BID irrigates approximately 12,000 acres throughout the year (Barrera 2003a).<sup>21</sup> According to Barrera, there is a trend of farmers moving away from cotton toward the more profitable vegetable crops. See **Table 3** and **Figure 4** for an illustration of this trend.

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<sup>18</sup> For additional information regarding this project and the anticipated costs of water and energy savings thereof, refer to “Economic and Conservation Evaluation of Capital Renovation Projects: Brownsville Irrigation District– 72” and 48” Pipeline Replacing Main Canal - Final” (Rister et al.).

<sup>19</sup> “Inclusion” is a *voluntary* application process of being included into the District that is initiated by the landowner. The word “annexation” is not used in this section because it is an act usually initiated by a city or district, not the landowner.

<sup>20</sup> Excerpts of the Texas Water Code that is cited within the text are located in **Appendix D**.

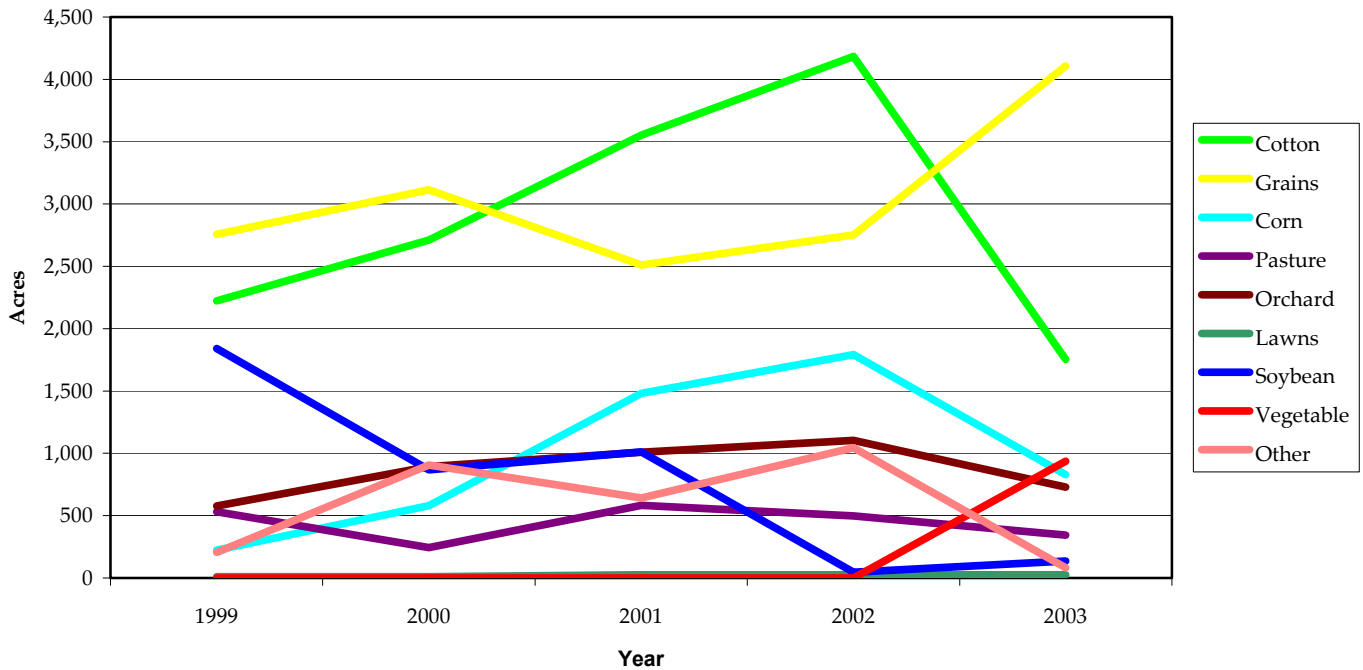
<sup>21</sup> This includes acreage that is double and triple cropped. Barrera (2004) estimates that 70% of the 12,000 acres (8,400 acres) is being cropped multiple times per year, with 80% of the 70% being double cropped (6,720 acres) and 20% of the 70% is triple cropped (1,680 acres).



**TABLE 3. Total Acreage Irrigated for Fiscal Years 1999-2003 (Brownsville Irrigation District).**

Crop	Fiscal Year					Percentage of 5-Year Total
	1999	2000	2001	2002	2003	
Cotton	2,222	2,711	3,553	4,185	1,752	29.5
Grains <sup>a</sup>	2,757	3,115	2,510	2,752	4,107	31.2
Corn	224	580	1,480	1,792	830	10.0
Pasture	531	243	582	499	344	4.5
Orchard	578	894	1,009	1,105	729	8.8
Lawns	10	10	25	26	26	0.2
Soybean	1,840	867	1,011	47	137	8.0
Vegetable	-	-	-	-	936	1.9
Other	206	905	643	1,046	83	5.9
<b>Total</b>	<b>8,368</b>	<b>9,325</b>	<b>10,813</b>	<b>11,452</b>	<b>8,944</b>	<b>100.0</b>

<sup>a</sup> 'Grain' includes only grain sorghum.



**FIGURE 4. Graphical Illustration of Total Acreage Irrigated for Fiscal Years 1999-2003 (Brownsville Irrigation District).**

Approximately 99% of the District's irrigated acreage uses either a furrow or flood system. There are currently 10-20 acres under drip irrigation and there are no micrometer or sprinkler systems. The most heavily irrigated sections of the District lie in the southern portion. GIS technology is utilized to determine crop patterns, water usage, and urban growth in an effort to focus improvement projects in the area that most benefit the District's customers (Barrera 2003a).

### *Water Rights*

There are two separate types of surface water accounts within the State of Texas: one for the Lower and Middle Rio Grande below Amistad Dam, and the other for the remainder of Texas. The area located below Falcon Dam operates under a water rights system that was established after the landmark 1969 Valley Water Suit. After that lawsuit, Domestic, Municipal, and Industrial (DMI) water rights were placed into a separate category from irrigation water rights. Historical-cropped acreages were used to determine the amount of water rights that were allocated to each irrigation district or farmer. Within the irrigation water rights category, two separate sub-categories of irrigation water rights are identified: Class A and Class B. Class A rights were given to those entities who could prove prior documented water rights (i.e., riparian, prior appropriation, or Spanish/Mexican land grant). Class B rights were awarded to those entities who could prove a history of diversion from the Rio Grande.

BID currently has a right to 33,949.45 ac-ft of Class A authorized annual water rights (Barrera 2003a). This is roughly 2.42% of the total irrigation water rights in the Valley. They also own 926.55 ac-ft Class B water rights and 6,071.00 ac-ft of DMI water rights (Barrera 2003a). The DMI water rights are under contract with PUB and El Jardin Water Supply Co. Some 4,200 ac-ft are contractually provided to PUB and 1,500-1,600 ac-ft are provided to El Jardin. El Jardin is only on contract for 1,500 ac-ft; however, the additional 100 ac-ft are provided if requested. This contracted water is sold by a water transfer<sup>22</sup> and therefore pumped entirely by PUB. PUB pumps and treats the water for both its customers and the El Jardin Water Supply Co. The water sold to PUB represents a safety cushion for BID. The majority of the water pumped by PUB is with water rights owned by PUB, thereby making BID a supplemental supplier of raw water. It is more cost efficient to El Jardin to purchase the raw water from BID and then have PUB pump and treat it rather than purchase treated water from PUBs water rights.

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<sup>22</sup> See 'Transfer Options' section on page 30.

PUB has a dedicated water-rights fund that is used to purchase water rights in anticipation of the future growth of their customer base (Barrera 2003a). Part of the contract with PUB includes the purchase of DMI water rights from BID. The original contract with PUB was for 6,000 ac-ft. PUB purchased 1,800 ac-ft of these rights and the contract with PUB is currently under renewal. According to Barrera (2003a), BID does not plan on selling any water rights in the near future.

The sale of any water rights must be approved by a vote of the Board of Directors. The selling of water rights by an irrigation district is seldom done in the Valley. This is because annual water allocations are based on the number of water rights owned by the district. Unlike municipal water rights, that are give priority and are reset to the total amount of water rights owned at the beginning of every month, irrigation water rights are carried forward from the previous year (Texas Commission on Environmental Quality 2004). Irrigation accounts are replenished only when the Watermaster has determined there to be excess water available within a given month. By selling water rights, a district decreases its base amount of water used in determining the Watermaster's monthly allocations for that district. This is particularly important in times of drought when water is allocated less frequently. Irrigation districts can convert their irrigation water rights to DMI water rights; however, there is 2-to-1 conversion factor<sup>23</sup> (i.e., two ac-ft of irrigation water rights are required to obtain one ac-ft of DMI water right).<sup>24</sup>

### *Urban Areas*

The nearest urban area to BID is the City of Brownsville (**Figure A3**) which is the second oldest city in the Valley and has a population of 150,425 (Allhands and U.S. Census Bureau). Due to the Rio Grande located to the south of town, the city has been growing to the north and northeast, which is directly into the BID.

This pattern of growth and expansion has caused BID to stop water-delivery services to small portions of its acreage because of urban encroachment. According to Barrera (2003a), the rapid city expansion has slowed considerably in the past year. The peak of the city's recent boom occurred from 1999 to 2001. If a subdivision were to be built inside of the current District lines, the development company would have to

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<sup>23</sup> For further information regarding DMI conversion, see Chapter 2, page 18, in "Evolution of Irrigation Districts and Operating Institutions: Texas, Lower Rio Grande Valley" (Stubbs et al.).

<sup>24</sup> Because the water rights that PUB purchased from BID were already DMI water rights, there was no need to convert more irrigation water rights to DMI water rights and, therefore, the sale of water rights did not affect the District's allocation.

receive approval from BID prior to building. This approval is to ensure that development did not occur on any of the District's easements. If the land were excluded, the water rights would not be transferred with the land and would subsequently remain with the irrigation district.

For a subdivision to be excluded from the district, it must petition the district. Under §58.702 - §58.713 of the Texas Water Code, any land that is no longer considered to be agricultural in nature or able to be irrigated can be excluded from the district. For an exclusion to occur, the landowner must apply with the district and a hearing must take place. A notice must be published in a local newspaper 10-20 days prior to the hearing (Texas Water Code §58.708) and the Board of Directors must conduct an open hearing for all parties involved and anyone wishing to participate (Texas Water Code §58.709). If the Board of Directors approves the application, it may be adopted into the minutes, thereby excluding the land from the district (Texas Water Code §58.710). Because there are costs associated with this process, BID instituted an application fee of \$500 to all developers that desire to have their land excluded. Since the change in current voting laws, fewer developers have applied for exclusion of their land from the District (Barrera 2003a). The new law (Texas Water Code §58.222) states that if the landowner owns less than one acre, they are automatically excluded from the district. Because most development areas are developed into less than one acre lots, they are excluded automatically without having to file an application with the district.

### *Chapter Summary*

This chapter provided a descriptive overview of the advanced technology that BID employs, which allows for increased control and monitoring throughout the entire District. Also discussed was the release and conveyance of water from Falcon Reservoir to BID's diversion point and into the District's delivery system. BID utilizes a natural system of resacas to store and move water from one point to another throughout the District. In addition to the resacas, 183 miles of pipeline require continuous maintenance and repair to function properly. Infrastructure is only one aspect that differentiates BID from other districts. Also discussed were cropping patterns, water-use, water rights, and urban areas. All of these elements of the District were discussed such that the reader is provided a "picture" of BID, thereby enabling an informative "look" into this District, as well as a base to compare to other irrigation districts as future reports are published.

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## Chapter 3

### District Operations

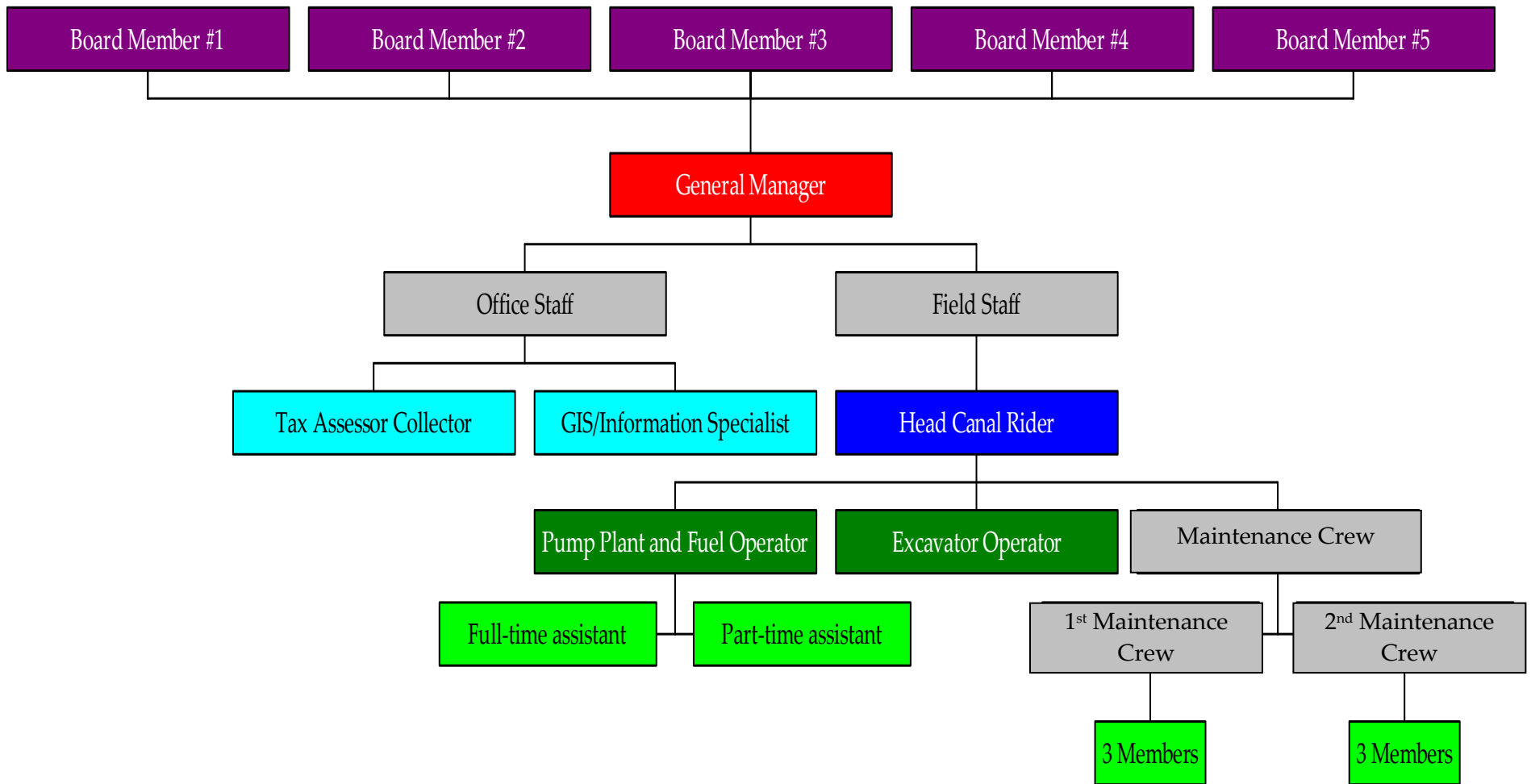
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The operating practices of individual irrigation districts in the Valley are not well understood by the general public. It is evident that each irrigation district is made up of different components that attribute to its uniqueness, its operating principles, and complexity. Each district is subject to the same set of rules, but the actual implementation thereof and mechanisms employed may vary significantly from district to district.

This chapter discusses many of the operating practices of the BID. First, identification of the organizational hierarchy and the Board of Directors of the District provides the foundation of district operations. Secondly, the allocation procedures for both the District and all of the irrigation districts within the Valley are discussed. This includes two small sections on how no-charge water and the transferring of water inside and outside of the District are handled. How a district sells water is one of the most distinct aspects of a district. This authority plus other revenue-making activities are examined. Finally, other special water districts that operate near BID and the water conservation efforts in which BID participates are discussed.

#### *Organizational Hierarchy*

BID currently employs a total of 14 individuals (**Exhibit 2**). In addition, five board members comprise the Board of Directors and serve as unpaid elected officials that preside over the District. One General Manager supervises the operations of the District and is hired by the Board of Directors. The General Manager oversees the day-to-day operations of the District and supervises both the office and field staff. The office staff consists of one Tax Assessor Collector and one GIS (Graphic Information Systems) and Information Specialist. The field staff is led by the Head Canal Rider who oversees: the Pumping Plant operator (who is also in charge of the fuel duties) and his two staff members (one part-time, one full-time); the excavator operator; and two maintenance crews consisting of 3 individuals each (Barrera 2003b).



**EXHIBIT 2. Brownsville Irrigation District Organizational Chart, 2004 (Barrera 2003b).**

## *Board of Directors*

According to the Texas Water Code §58.071, the Board of Directors is a governing body that must consist of five individuals. All Board of Directors are formally elected within a district and serve four-year, staggered terms. To be eligible to hold a director's position, a person must: be at least 18 years of age, have no prior payment obligations to the district, be a resident of the State of Texas, and "be the owner of record of fee simple title to land in the district" (Texas Water Code §58.072). Currently, five directors, all actively engaged in the agricultural profession, oversee the BID (**Figure A4**). An at-large board election is held every year ending with an even number, and on the first Saturday in February (Barrera 2004). In February 2004, three board members were up for re-election; however, none were contested. If no one contests a current director(s) up for election, they are elected without contest and serve another 4-year term (Barrera 2004). BID has not had a board election since 1996 (Barrera 2004).

The Board of Directors vote on improvement projects within the District, with each project required to receive a majority of the votes before being implemented. According to Barrera (2003a), improvement projects are presented to the Board by the General Manger. Projects are presented for consideration to the Board often months before there is a vote. Similar to a privately run business, projects are measured through profitability and time sensitivity (Barrera 2003a). Information is evaluated from the computer record-keeping system (Wonderware<sup>®</sup>) and allows the management to make improvement decisions based on location, payback, timeframe, and benefit to consumers.

## *Allocation Procedures*

According to the previous chapter, every irrigation district in the Lower Rio Grande Valley owns a certain amount of water rights. The Watermaster's office is responsible for keeping track of the total amount of water in the Falcon and Amistad reservoirs and the amount that water right holders are entitled to receive (while accounting for a 225,000 ac-ft reserve for DMI users, and an operating reserve of 75,000 ac-ft) (TCEQ §303.21.b). The Watermaster allocates water using the following steps:

- 1) From the total usable storage of the Falcon and Amistad reservoirs, as reported by the IBWC, the dead storage<sup>25</sup> is deducted;
- 2) From the remaining amount, the 225,000 ac-ft of water that acts as the DMI reserve is deducted. This reserve is re-established at the end of every month;
- 3) Next the 75,000 ac-ft of operating reserve<sup>26</sup> is deducted; and
- 4) The remaining amount after deductions is allocated to Class A and Class B irrigation water rights holders. This allocation is based on the ending monthly balance for the irrigation account holders.

When the District needs water to be released from Falcon, the General Manager contacts the Watermaster's office and places a request for the desired amount. Depending on the travel time associated with the District's diversion point, the required advanced notice to the Watermaster's office varies. Because each water right holder is limited to their annual authorization amount, the manager does not request a release amount in excess of what they can pick up at the river. If water that is requested from the Watermaster by a district is not diverted into the district system from the river, then the loss is solely absorbed by the irrigation district. Balances in irrigation accounts with the Watermaster's office are rolled over from one year to the next (Stubbs et al.). Water loss that occurs during travel from Falcon to the diverter's diversion point (due to evaporation, invasive weeds, etc.) does not affect the amount of water the diverter is allowed to pump. The loss incurred during transportation is covered by the operating reserve mentioned above.

Each district handles individual allocation accounts within the district differently. BID has approximately 1,600 irrigation accounts (Border Environment Cooperation Commission). Starting January 1 of the planning year, the first water assignments, or allocations, are made (Barrera 2003a). The first assignments are based on the number of acres a farmer plans on planting during the upcoming crop year. This initial projected amount of acreage is determined from the number of acres planted in previous years. If the farmer is planning on increasing the amount of acres planted, it is the farmer's responsibility to notify the District of this change (Barrera 2003a). Conversely, if the farmer is allocated water for a said amount of acres and plants less than that amount, the District readjusts the farmer's account to reflect the actual number of acres planted (Barrera 2003b).

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<sup>25</sup> Dead storage is the amount of water behind the dams that cannot be removed because of hydrologic restrictions (TCEQ §303.22.a).

<sup>26</sup> Operating reserve covers seepage, evaporation, and conveyance losses, and emergency requirements (TCEQ §303.21.c).



When the first water allocations are made, each irrigator receives one acre-foot of water for every acre planted. According to Barrera, typical production practices allow for three irrigations per 1 ac-ft of water (i.e., one irrigation is considered to be 4 inches of water) (Barrera 2003a).

Once the first round of irrigations have taken place (or almost everyone has irrigated at least once), the Board reevaluates the amount of water left in the District's account. Depending on this amount, the Board may authorize an additional 8 inches to 12 inches of water to be added to each account. BID's current policy is to maintain one year's worth of water in its total District account at any given time (Barrera 2003a). This amount acts as a buffer during the year. Currently, this amounts to 14,000 ac-ft (Barrera 2003a).

### No-Charge Water

No-charge water is the excess flow of water in the Rio Grande that is determined by the Watermaster, usually due to rainfall, and is made available at what is termed no-charge pumping. No-charge pumping is when excess water can be pumped from the river at "no charge" to the district's surface water account (Stubbs et al.). Currently, BID takes advantage of no-charge water availability to refill resacas (Barrera 2003a). Very little of this water ever makes it to producers' fields, because of the resacas' seepage, evaporation rate, and large surface areas. Recharging the resacas serves as a water source in times of a drought when water allocations from the Watermaster are uncertain. Holding the additional water (i.e., no-charge water) in the resacas represents an indemnity for the District. The additional water also provides beautification for the residents of the City of Brownsville; however, BID has no legal obligation for this effort (Barrera 2003b).<sup>27</sup>

No-charge water is administered by the TCEQ Watermaster. When the Watermaster determines that there is potential no-charge water that can be made available to water right holders, the Watermaster sends out a notice to all holders and allocates the water based on a first-come, first-serve basis. For example, if it is determined that there is a minimum of 45 cfs of water to be released as no-charge and BID has the capacity within their system to store the water, the General Manager can respond to the notice and begin pumping when notified by the Watermaster.

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<sup>27</sup> As discussed in the previous 'Urban Areas' section on **page 23**, BID is considering transferring ownership of certain resacas to PUB in exchange for contractual rights to pump water out of the resaca and into BID's system. Such a transaction would reduce the District's need to use no-charge water for the purpose of maintaining the water levels in resaca's for the benefit of beautification.

## Transfer Options

Under §303.51-303.55 of the TCEQ Rules and Regulations, any owner of water rights may contractually sell all or part of their annual authorized water amount. This does not mean that they sell the actual water right, but rather the water attached to that right for the authorized year. In order for a contractual sale, also known as a transfer, to take place, the seller must comply with the following rules:

1. The sale of the water must be for the same purpose of the original water right (e.g., an irrigation water right, if transferred, must be used for irrigation, but not municipal, domestic or industrial). If the intended use differs from that of the original right, the seller must apply to amend the water right permanently to that of the intended use;
2. There is no change in the original water right of the seller or purchaser, even if the diversion point, diversion rate, or place of use is different;
3. The seller must actually own the water right;
4. All of these requirements must be met before the transfer can be made;
5. No contract approval is necessary if the transfer occurs within the district and the district's delivery system is used; and
6. The seller cannot sell more than what they own.

If all of the above requirements are met and the Watermaster approves the application, the contracted amount is then transferred into the purchaser's account. Once the purchaser is in possession of the water (i.e., in their account), they are not allowed to resell that amount and must use the purchased amount first before any other water within their account (TCEQ §303.51).

There are two different types of water transfers, in-district and out-of-district. As discussed previously, farmers are allocated water on January 1 of the planning year and reallocated water throughout the year.<sup>28</sup> The water that is allocated to a farmer's individual account is not allowed to be resold within the District or outside of the District by the account holder (Barrera 2003a). The water within a farmer's account must be used by the first of the next year (January 1) or be redistributed to actual water users (Barrera 2003a). This prevents individuals from hoarding water within their accounts. BID does sell additional water outside of the District.<sup>29</sup>

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<sup>28</sup> See previous 'Allocation Procedures' section on **page 27**.

<sup>29</sup> This is discussed further in the 'District Revenue and Sales' section on **page 31**.

*District Revenue and Sales*

Irrigation districts have multiple ways of generating revenue. They have the ability to tax land within the district, raise bonds, and set variable charges for water, transportation fees, penalty fines, flat rate fees, etc. Prior to January 2004, BIDs fee structure included most of these revenue-generating methods. BID has increased its rates and changed its fee structure for the first time since 1992 (Barrera 2003b). BIDs pricing structure is summarized in **Table 4**.

**TABLE 4. Brownsville Irrigation District’s Pricing Table, 2004** (Barrera 2004).

	<u>In-District</u>	<u>Out of District</u>
<i>Irrigation</i>		
• Flat Rate	\$18.00 per acre	NA
• Variable Rate	\$6.00 for first 4 inch, \$2.00 per inch above 4 inches	Varies depending on supply and demand
<i>Lawn-Watering</i>		
• On Resaca	\$90.00 per year (unlimited use)	NA
• Off Resaca	\$60.00 + \$18.00 (flat rate) per year (limited use)	\$86.00 per year (limited use)
<i>Municipal</i>	NA	Based on current contracts
<i>Other</i>		
• Delivery Charge	NA	\$45.00 per acre foot

The BID assesses irrigators within the District an annual flat-rate maintenance and operations fee of \$18.00 per irrigated acre (**Table 4**), plus a variable rate charge of \$6.00 for the first approximated 4-inches, plus an additional \$2.00 per acre-inch for any additional water applied beyond the initial 4-inches (**Table 4**). For the first acre-foot of water applied, this equates to an irrigation charge of \$40.00 (i.e., \$18.00 + \$6.00 + (\$2.00 x 8 inches)); which would equal \$4,000 for 100 acres.<sup>30</sup> Further, for residences adjoining a

<sup>30</sup> This current cumulative assessment (i.e., for the first 100 acres) is substantially higher than previous years’ rates which equaled \$1,115 for the first 100 acres. That is, most previously, the BID assessed a \$20.00 flat (or base) rate per acre for the first acre and \$5.00 per acre for subsequent acreage. Thereafter, a variable rate charge of \$6.00 per acre for the first approximated 4-inches, plus an additional \$2.00 per acre-inch for any additional water applied beyond the initial 4-inches was assessed. For the first acre-foot of water applied, this would have equated to an irrigation charge of \$42.00 (i.e., \$20.00 + \$6.00 + (\$2.00 x 8 inches)), with subsequent water priced at \$27.00 per acre-foot (i.e., \$5.00 + \$6.00 (\$2.00 x 8 inches)). [Continued at the bottom of page 32.]

resaca, the District charges \$90.00 per year for unlimited use, while residences not adjoining a resaca are charged differently (**Table 4**) and incur limited-use restrictions. For water delivered outside the District (but using the District's delivery system), a \$45.00 per acre-foot delivery charge is made.

### Irrigation Water Accounts

Water-use within BID is entirely metered, meaning every farm gate opening has a meter attached to it that measures the amount of water that is delivered to the field. The farmer purchases meters from either the manufacturer or the District at a discount. Depending on the size (i.e., from 4 to 10 inches), meters cost between \$450 and \$800 each (Barrera 2003a). The Canal Rider reads meters at the farm gate after a farmer irrigates to determine the total amount of water used and the total amount owed per watering.

The variable amount charged by the District has increased in past years as technology has increased. Five years ago, one watering for furrow irrigation was \$8.00 per 6 inches (or one flood watering) (Barrera 2003a). Now, because of metering, BID has been able to monitor waterings at a more precise rate, allowing them to measure water-use in inches, rather than in feet. The current pricing system is \$6.00 for the first 4 inches and \$2.00 per inch for the excess above the first 4 inches (Barrera 2003a). This increase in price and decrease in allocation has proven to be a very useful conservation tool (Barrera 2003a). With such precise measurements used to charge and allocate water, farmers have an incentive to conserve water or pay the price (Barrera 2003b).

Providing delivery of irrigation water to farmers within the District's boundaries is the first priority of BID. There are other options, however, after obligations to the farmers within the District have been met, to generate additional revenue. For example, one additional service that BID can provide is allowing farmers who own their own water rights to use BID's infrastructure to pump and deliver their water for a fee. This fee is known as a delivery charge and is currently set at \$45.00 per ac-ft. Currently, the only customer that BID pumps and delivers for outside of the District is PUB.

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The current flat and variable rates assessed by BID differ from recent years' rates as multiple changes have been made. First, in August 2003 the BID Board of Directors voted to eliminate a long-standing tax that had been in place since the 1960s when the District issued bonds to pay for the large 1969 BOR project that placed most of the canal infrastructure underground. Since that bond had since been paid off, the Board felt collecting the specific, line-item tax was no longer prudent. Second, the \$5.00 per acre charge (i.e., subsequent flat-rate) and the \$6.00 per acre (i.e., variable rate for first 4-inches) were combined and had an additional \$7.00 per acre fee added, resulting in the current \$18.00 flat-rate maintenance and operations assessment. In summary, the BID modified its rate structure, which resulted in a net increase in the cost of agricultural irrigation water.

### Municipal Water Accounts

Another revenue source is selling residual<sup>31</sup> water to other irrigation districts and municipalities within the Valley. BID has no municipalities within its borders, but the Public Utilities Board (PUB) of Brownsville is located to the immediate west of the District and services the City of Brownsville. PUB owns its own water rights and infrastructure. Though BID does not provide all of PUBs water (i.e., BID is a supplemental supplier), a contract exists between the two parties. BID provides PUB with 4,260 ac-ft per year. This is a set amount for which PUB pays BID regardless of the amount used. This provides BID with a small amount of fixed revenue throughout the year. Currently, this contract is up for renewal and is subject to change within the next year (Barrera 2003b).

### Lawn-Watering Accounts

Separate from selling water to PUB, BID has approximately 480 lawn-watering accounts (Slovak). Lawn-watering accounts are established for residents that are both inside and outside of the District boundaries. Lawn-watering accounts allow residents to connect to waterlines for the purpose of watering their lawns. There are three types of lawn-watering accounts: one for those living along a resaca and two for those not living along a resaca.

The first type of lawn account is for those living in the District, and along a resaca. These residents are charged \$90.00 per year and allowed to pump at any time.

For those residents who are not living on a resaca, but are still within the District and able to tap into the system, the charge is \$60.00 per year (in addition to the flat rate fee of \$18.00). This allows these residents to flood irrigate their yards, about twice a month on a specified day. If a resident is opening their valve on a day that is not allowed, two warnings are given before the District disconnects them from the system. To be reconnected, the resident must pay the past due fees, as well as the reconnection cost of \$175 for reinstalling the hook up (Slovak).

The third type of account is for those that do not live along a resaca, and are able to tap into the District's system, but are outside of the District. Landowners whose land has been excluded from the District must pay an annual fee of \$86.00. The out-of-District accounts have the same operating procedures as those in the District.

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<sup>31</sup> Residual water refers to District water that remains after the needs of the District has been met.

The difference between these accounts lies in the location. Residents that are located along a resaca are able to pump at any time because runoff from the lawn will flow back into the resaca. Residents that are located elsewhere in the District have runoff that is lost from the system and are, therefore, allowed to pump less frequently (Slovak).

### Out of District Water Sales

In addition to delivering water to PUB, BID also sells residual water to other farmers and irrigation districts in the Valley. The residual water that the District is able to sell does not come from the District having too much water, but rather from the conservation efforts of the farmers (Barrera 2003a). Because the District conserves water, they are able to sell the residual water at a higher price to farmers outside of the District, or to other irrigation districts (Barrera 2003b). This practice allows the District to not have to raise prices when operating costs increase, such as a higher cost of fuel (Barrera 2003b). The selling of residual water does not constitute a large percentage of the total budget; however, it varies from year to year. If there is significant local rainfall, there is little to no demand for additional water. Conversely, during the times of drought, the selling of residual water has proven to be a good additional source of revenue. The price of the residual water varies depending on the market demand and supply. It is also important to distinguish that the selling of residual water differs from the selling of water rights. The selling of residual water is a one-time transaction; in contrast the sale of a water right is permanent.

The Board of Directors sets budgetary estimates, rates, and fees with any changes. According to §58.304 of the Texas Water Code, it is the Board's responsibility to estimate the total operating and maintenance budget for the next 12 months. The major components of a district's budget are (a) operating and maintenance expenses, (b) capital debt services, and (c) building of capital-reserve funds. Further, the operating and maintenance expenses must not comprise less than one-third or more than two-third of the total annual assessments against all land in the district (Texas Water Code §58.305). The effect of the cited legislation is to prevent the district from accumulating excessive reserves and/or incurring excessive capital debt. The current increase in flat rate charges by BID represents their compliance with this rule due to increases in operating and maintenance costs (Barrera 2003b). The Board of Directors also has the right to change and set rates for water-delivery to cities and towns as they see fit (Texas Water Code §58.319), as well as rates within the district.

### *Other Special Districts*

Drainage within the BID area is the responsibility of the District if it is agricultural-related. Run-off from fields and pastures is captured in ditches owned and maintained by BID. Due to urban growth and the halting of water-delivery services to small areas of the District, it often becomes questionable as to who should maintain drainage within these areas. BID management asserts it cannot afford the expense associated with cleaning and maintaining ditches that are no longer part of the District, or does not benefit irrigation customers. If a residential neighborhood borders an agricultural field, then BID will continue to maintain run-off removal from the field area. BID has no legal responsibility, however, to maintain any ditch after it has been removed from the District's boundary and taken out of agricultural use (Barrera 2003b). Cameron County Drainage District #1 (CCDD#1) is located in the northern 50% of BID. They are responsible for drainage needs within that area. The remaining southeastern 50% remains unmanaged by any drainage district (with the exception of agricultural-related areas that are maintained by BID). A proposed election is scheduled that, if approved, would allow for CCDD#1 to take over the southeastern portion of the District (Barrera 2003b). For the past four years, BID has progressed from the northern-most part of the District to the southern-most, cleaning ditches. Upon completion of this cleaning effort, areas that do not belong to the District and are not agricultural in nature will no longer be cleaned by BID (Barrera 2003b).

Drainage within the City of Brownsville is handled by BID through the resaca system (Slovak). Heavy rains in the area, which cause resaca levels to rise, are pumped (by BID) into the underground pipe system and into the ship channel at the Port of Brownsville. Because of the monitoring system that BID has in place, they are able to calculate the total amount of water that is pumped as drainage. The Head Canal Rider controls the monitoring of BID's resacas. If a large storm system is approaching and is expected to produce a large amount of rain, the Head Canal Rider, in advance, begins to lower the levels of the resacas and pumps water into the ship channel (Slovak). The accuracy in predicting weather conditions and knowing when to lower resaca levels can be difficult and costly to BID (Slovak). That is, these early precautions are often necessary, but if the expected storm system does not arrive or does not produce as much rainfall as predicted, then the volume of water pumped into the ship channel cannot be regained (Slovak).

## *Conservation Efforts*

The current metering activities, as well as having almost the entire irrigation system in underground pipe, makes the BID water-delivery system highly efficient. Unlike other irrigation districts that have large, open, unlined, earthen canals that incur considerable seepage and evaporation losses, BID's losses primarily come from the open resaca system.

Another conservation tool is the adoption of drip and sprinkler systems by farmers within the District. These are modern, advanced-technology field systems that are designed to be more water efficient. These systems are on-farm conservation techniques that must be privately adopted by individual farmers. BID does not offer any additional discounts for farmers that use conservation techniques on-farm. The only financial benefit comes in the decreased amount of water these farmers use, decreasing their total water bill. Currently, BID has only one grower that uses the drip system on 10 acres of agriculture land. Because of the resacas that BID utilizes, the system is charged most of the time (Slovak). This helps solve the problem of push water<sup>32</sup> required to move the small amount of water needed by drip and sprinkler systems. Therefore, farmers and growers that utilize additional conservation efforts on-farm within the District do not actually put a strain on the system contributing to additional water loss as seen in some other irrigation districts.

## *Chapter Summary*

This chapter discussed the operating practices of BID. The foundation of the BID operations is the Board of Directors and overall organizational hierarchy. Secondly, the discussion of allocation procedures (inside and outside) of the District describes how the District handles its water once it is diverted from the Rio Grande, as well as how no-charge water and water transfers are handled. In the case of BID, no-charge water is used to replenish resacas, and water transfers can only occur to outside parties by the District, when residual water is available. Exactly how an irrigation district sells and distributes its water plus other revenue-making activities were discussed. PUB of Brownsville and Cameron County Drainage District number 1 are other special water districts that operate in close proximity to BID. These districts provide services that impact the operating procedures of BID. Finally, BID encourages conservation activities within the District to help ensure that future water needs can be met.

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<sup>32</sup> Push water is water that fills a district's delivery system and is used to propel (or transport) "other water" from the river-side diversion point to municipalities (Rister et al.).



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## Conclusion

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The Brownsville Irrigation District represents only one of the 29 irrigation districts in the Lower Rio Grande Valley. Though they follow the State and International guidelines, as do all Valley irrigation districts, they operate in a unique and discrete way that separates them from other Valley irrigation districts. BID is not the only district to utilize resacas, GIS and SCATA technologies, underground pipe, meters or other conservation tools; however, the combination and manner in which these tools are employed is what makes BID distinctive.

This report illustrated a brief history of BID and how those activities played a key role in forming the makeup of the District, as well as how it operates today. The report was developed to be one part of a broader picture in helping to explain some of differences in operating practices between irrigation districts in the Valley. The objective is to provide insight into separate irrigation districts in order to allow for future evaluation across multiple districts, gaining insight on implications of alternative conservation tools.

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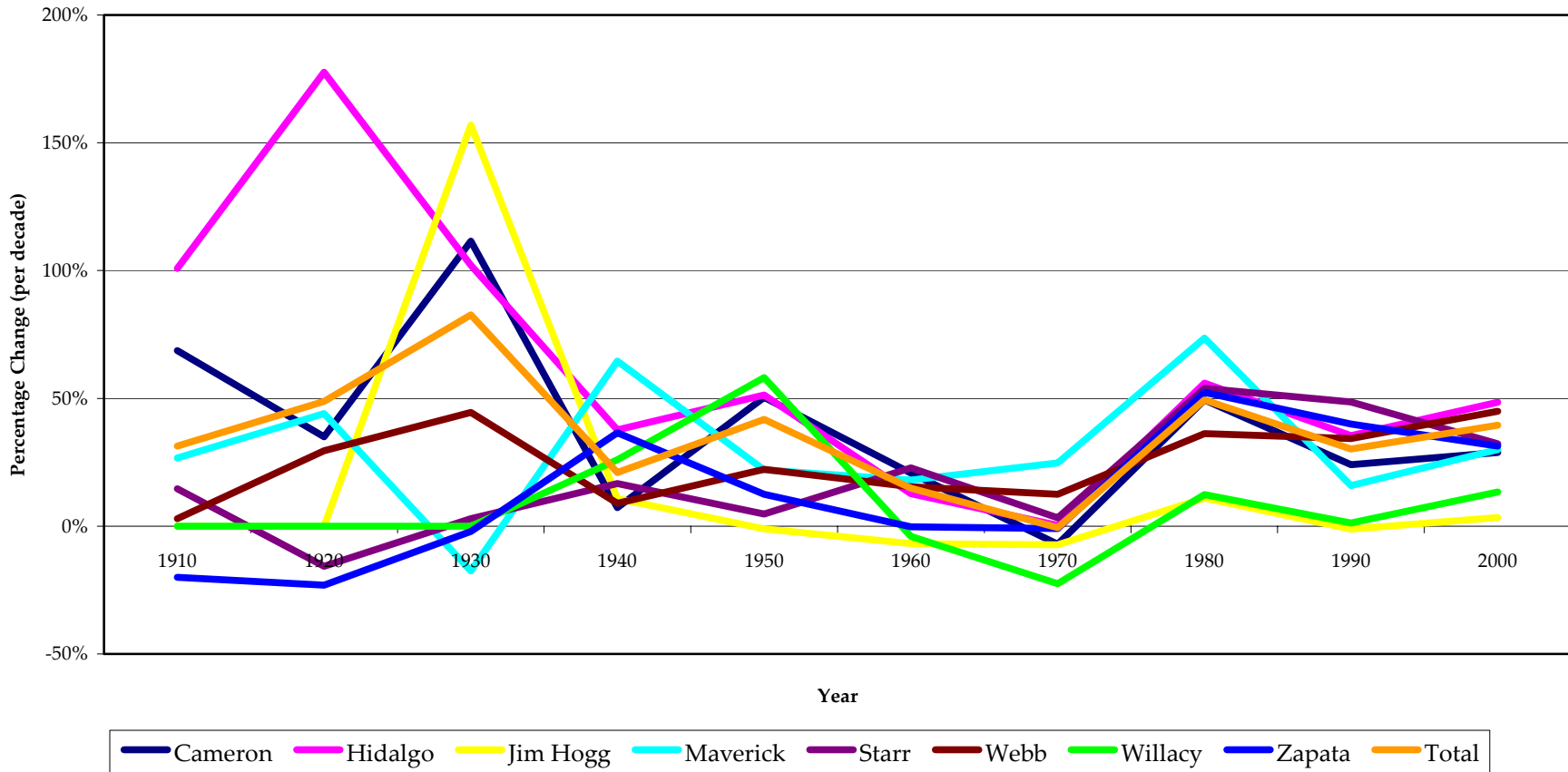
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## **Appendices**

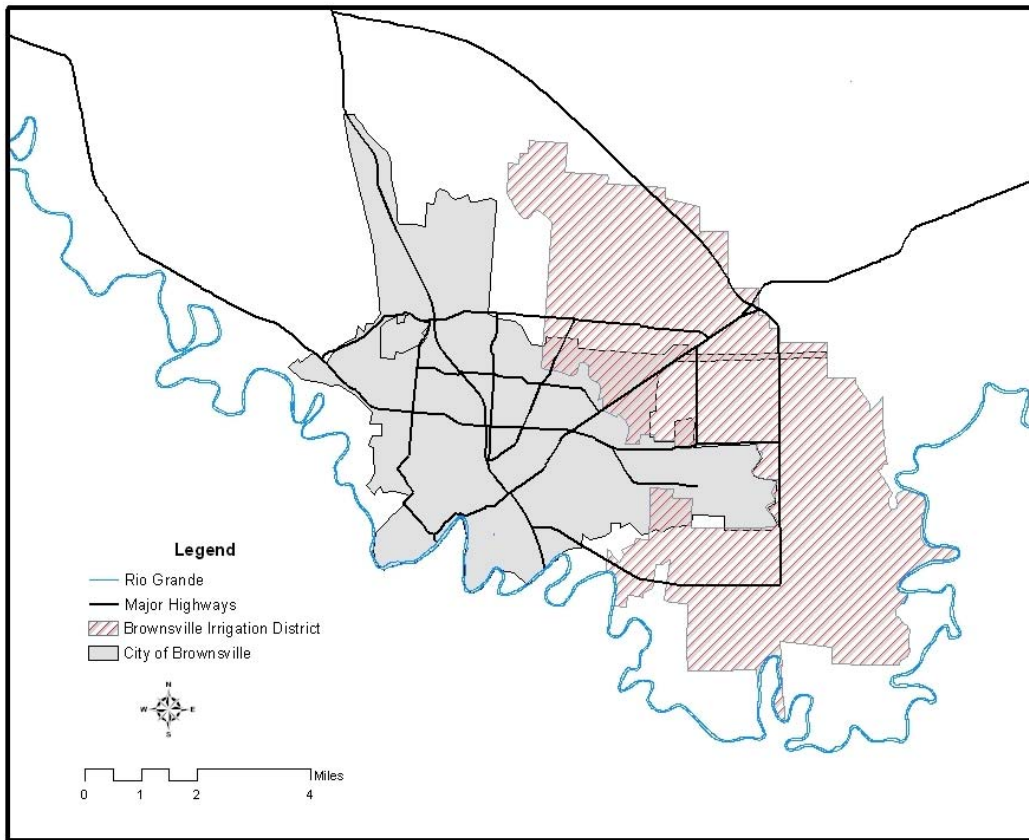
## Appendix A: Additional Figures.



**FIGURE A1. Graphical Representation of Lower Rio Grande Valley Population, by County, as a Percentage Change of Growth Per Decade, 1900-2000 (Forstall).**

Name	Water Interests Represented	Association Represented
Terms Expiring August 31, 2004		
Charles Browning, Jr.	DMI	North Alamo WSC
Robert Burkhart	DMI	City of Harlingen
Rudy Atkinson	Industrial	AEP
Bill Green	Irrigation	Santa Cruz ID
Benton Beckwith	Irrigation	Beckwith Farms
Sonny Hinojosa ( <b>Secretary</b> )	Irrigation	HCID #2
Frank White	Irrigation	H&CCID #9
Vidal Davila	Recreation	National Parks Service
Terms Expiring August 31, 2005		
Orville Ballard ( <b>Vice-Chair</b> )	Recreation	Falcon
Wayne Halbert ( <b>Chair</b> )	Irrigation	Harlingen ID
Sharon Williams	Nature	US FWS
James R. Elium	Municipal	Olmito Water Supply
Jed A. Brown	Irrigation/Industrial	Killam Corp., Laredo
Brenda Paez	Mining	Alice Southern Equipment
Jimmy Paz	Nature	National Audubon Society
<b>Alternate</b>		
Bruce Hardwicke		
<b>Ex-Officio</b>		
Carlos Rubinstein, Rio Grande Watermaster		

**FIGURE A2. Rio Grande Watermaster Advisory Committee Appointments, 2004 and 2005 (Hinojosa).**



**FIGURE A3. Overview Map of the City of Brownsville, Texas, 2003 (Richards).**

<u>Position</u>	<u>Individual</u>
President	Joe Medrano
Vice-President	Tomas Perez
Secretary	Leonard Loop
Member	Ralph Baker
Member	Juan Olvera

**FIGURE A4. Brownsville Irrigation District’s Board of Directors, 2004 (Barrera 2003c).**



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## Appendix B: Additional Tables.

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**TABLE B1. Lower Rio Grande Valley Population, by County, 1900-2000 (Forstall).**

<b>Counties</b>	<b>1900</b>	<b>1910</b>	<b>1920</b>	<b>1930</b>	<b>1940</b>	<b>1950</b>	<b>1960</b>	<b>1970</b>	<b>1980</b>	<b>1990</b>	<b>2000</b>
Cameron	16,095	27,158	36,662	77,540	83,202	125,170	151,098	140,368	209,727	260,120	335,227
Hidalgo	6,837	13,728	38,110	77,004	106,059	160,446	180,904	181,535	283,229	383,545	569,463
Jim Hogg	NA <sup>a</sup>	NA <sup>a</sup>	1,914	4,919	5,449	5,389	5,022	4,654	5,168	5,109	5,281
Maverick	4,066	5,151	7,418	6,120	10,071	12,292	14,508	18,093	31,398	36,378	47,297
Starr	11,469	13,151	11,089	11,409	13,312	13,948	17,137	17,707	27,266	40,518	53,597
Webb	21,851	22,503	29,152	42,128	45,916	56,141	64,791	72,859	99,258	133,239	193,117
Willacy	NA <sup>b</sup>	NA <sup>b</sup>	NA <sup>b</sup>	10,499	13,230	20,920	20,084	15,570	17,495	17,705	20,082
Zapata	4,760	3,809	2,929	2,867	3,916	4,405	4,393	4,352	6,628	9,279	12,182
<b>Total</b>	<b>65,078</b>	<b>85,500</b>	<b>127,274</b>	<b>232,486</b>	<b>281,155</b>	<b>398,711</b>	<b>457,937</b>	<b>455,138</b>	<b>680,169</b>	<b>885,893</b>	<b>1,236,246</b>

a Jim Hogg County was organized in 1913, out of parts of Duval and Brooks Counties. The census population information was not available for Jim Hogg County until 1920.

b Willacy County was organized in 1921, out of parts of Kennedy, Hidalgo, and Cameron Counties. The census population information was not available for Willacy County until 1930.

**TABLE B2. Lower Rio Grande Valley Population, by County, as a Percentage Change of Growth Per Decade, 1900-2000 (Forstall).**

<b>Counties</b>	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990	2000
Cameron	NA	68.7%	35.0%	111.5%	7.3%	50.4%	20.7%	-7.1%	49.4%	24.0%	28.9%
Hidalgo	NA	100.8%	177.6%	102.1%	37.7%	51.3%	12.8%	0.4%	56.0%	35.4%	48.5%
Jim Hogg	NA	NA <sup>a</sup>	NA <sup>a</sup>	157.0%	10.8%	-1.1%	-6.8%	-7.3%	11.0%	-1.1%	3.4%
Maverick	NA	26.7%	44.0%	-17.5%	64.6%	22.1%	18.0%	24.7%	73.5%	15.9%	30.0%
Starr	NA	14.7%	-15.7%	2.9%	16.7%	4.8%	22.9%	3.3%	54.0%	48.6%	32.3%
Webb	NA	3.0%	29.6%	44.5%	9.0%	22.3%	15.4%	12.5%	36.2%	34.2%	44.9%
Willacy	NA	NA <sup>b</sup>	NA <sup>b</sup>	NA <sup>b</sup>	26.0%	58.1%	-4.0%	-22.5%	12.4%	1.2%	13.4%
Zapata	NA	-20.0%	-23.1%	-2.1%	36.6%	12.5%	-0.3%	-0.9%	52.3%	40.0%	31.3%
<b>Total % Change From Previous Year</b>	NA	<b>31.4%</b>	<b>48.9%</b>	<b>82.7%</b>	<b>20.9%</b>	<b>41.8%</b>	<b>14.9%</b>	<b>-0.6%</b>	<b>49.4%</b>	<b>30.2%</b>	<b>39.5%</b>

a Jim Hogg County was organized in 1913, out of parts of Duval and Brooks Counties. The census population information was not available for Jim Hogg County until 1920.

b Willacy County was organized in 1921, out of parts of Kennedy, Hidalgo, and Cameron Counties. The census population information was not available for Willacy County until 1930.

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## Appendix C: Illustrative Photographs of Key Infrastructure.<sup>33</sup>

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**EXHIBIT C1. Brownsville Irrigation District's Intake Pipe at the Rio Grande, 2003.**

(Note: the arrow indicates location of a floating barrier and submersed screen to prevent, respectively, water hyacinth and hydrilla from entering the intake pipe and blocking the pumps.)

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<sup>33</sup> Exhibits C1-C8 were photographed by Megan Stubbs.



**EXHIBIT C2. Two 45-cfs Pumps with Motors, Brownsville Irrigation District Rio Grande diversion pumping station, 2003.**



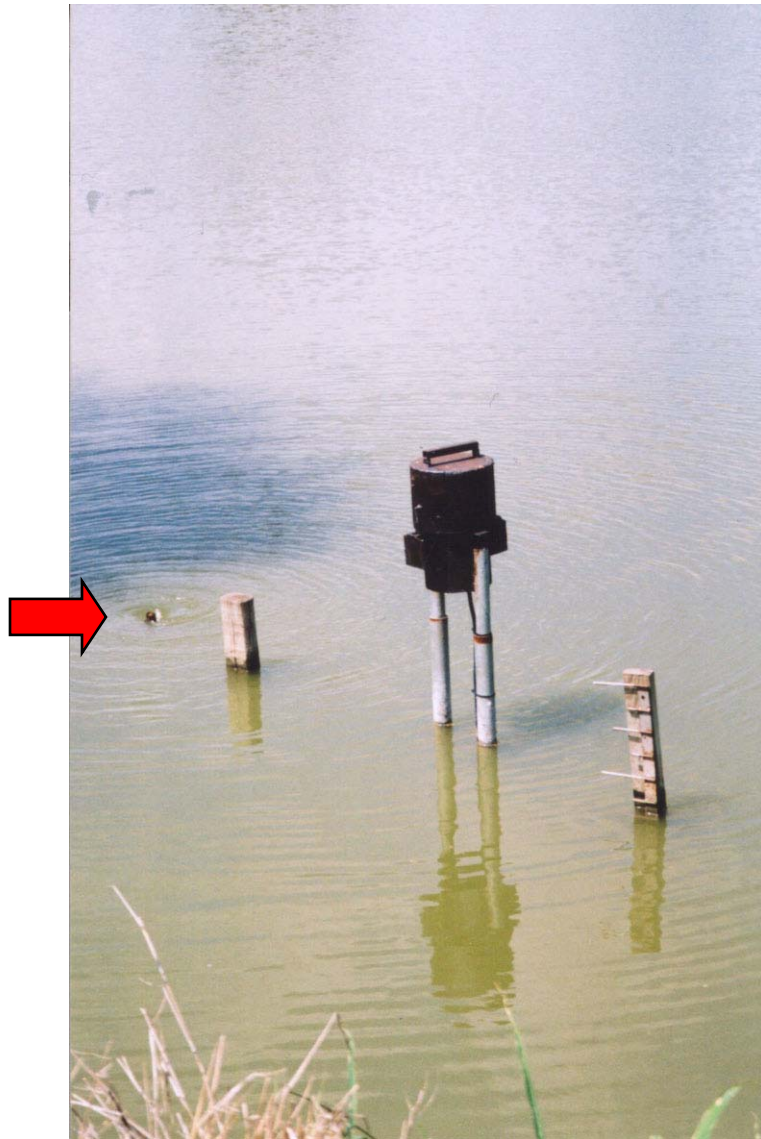
**EXHIBIT C3. One 95-cfs Pump with Motor, Brownsville Irrigation District Rio Grande diversion pumping station, 2003.**



**EXHIBIT C4. Main Canal Behind Pump House** leading to the measuring meters, 2003. (Note: the photo was taken during a period when no pumping was occurring).



**EXHIBIT C5. Two 52-inch Pipes Housing the Flow Meters, 2003.** (Note: the Main Canal is located in the background).



**EXHIBIT C6. Resaca Sensor Located at Pump Number 11, 2003.** (Note: the water ripples indicated by the arrow implies that the pump is running and water is being moved into the pipe gravity flow system).



**EXHIBIT C7. Pump Number 11 Located Along Resaca De La Guerra, 2003.**



**EXHIBIT C8. Pipe Balloon** that is used to stop the flow of water within a pipe, usually for the purpose of maintenance, 2003.



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## Appendix D: Excerpts of Texas Water Code<sup>34</sup>, TCEQ Rules<sup>35</sup>, and the 1944 Water Treaty.<sup>36</sup>

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The following is a verbatim reproduction of selected sections of the Texas Water Code (Texas Legislature Online). The sections represented here are those previously cited within the text.

### SUBCHAPTER C. ADMINISTRATIVE PROVISIONS

#### **§58.071. Board of Directors**

*The governing body of a district is the board of directors, which shall consist of five directors. Added by Acts 1977, 65th Leg., p. 1537, ch. 627, § 1, eff. Aug. 29, 1977.*

#### **§58.072. Qualifications**

*To be qualified for election as a director, a person must be a resident of the state, be the owner of record of fee simple title to land in the district, be at least 18 years of age, and owe no delinquent taxes or assessments to the district. Section 49.052 does not apply to a district governed by this chapter.*

*Added by Acts 1977, 65th Leg., p. 1537, ch. 627, § 1, eff. Aug. 29, 1977.*

*Amended by Acts 1995, 74th Leg., ch. 715, § 32, eff. Sept. 1, 1995.*

### SUBCHAPTER E. ELECTION PROVISIONS

#### **§58.222. Eligibility to Vote**

*Notwithstanding the Election Code and any other law, a landowner or the landowner's registered representative under this subchapter is entitled to one vote in an election conducted by a district only if the landowner:*

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<sup>34</sup> Source: Texas Legislature Online

<sup>35</sup> Source: Texas Commission on Environmental Quality 2003

<sup>36</sup> Source: U.S.-Mexico Treaty for Utilization of the Waters of the Colorado and Tijuana River and of the Rio Grande

*(1) owns at least one acre of irrigable land located within the district's boundaries that is subject to an assessment for maintenance and operating expenses under Sections 58.305(a) and (b);*

*(2) is entitled to receive and use irrigation water delivered by the district through the district's irrigation facilities; and*

*(3) satisfies all other requirements for voting prescribed by this subchapter.*

*Added by Acts 2001, 77th Leg., ch. 107, § 1, eff. Sept. 1, 2001.*

## **SUBCHAPTER G. WATER CHARGES AND ASSESSMENTS**

### **§58.304. Board's Estimate of Maintenance and Operating Expenses**

*The board, on or as soon as practicable after a date fixed by standing order of the board, shall estimate the expenses of maintaining and operating the irrigation system for the next 12 months. The board may change the 12-month period for which it estimates the expenses of maintaining and operating the irrigation system by estimating such expenses for a shorter period so as to adjust to a new fixed date and thereafter estimating the expenses for 12-month periods following the adjusted fixed date.*

*Added by Acts 1977, 65th Leg., p. 1537, ch. 627, § 1, eff. Aug. 29, 1977.*

*Amended by Acts 1997, 75th Leg., ch. 789, § 3, eff. Sept. 1, 1997.*

### **§58.305. Distribution of Assessment**

*(a) Not less than one-third nor more than two-thirds of the estimated maintenance and operating expenses shall be paid by assessment against all land in the district to which the district can furnish water through its irrigation system or through an extension of its irrigation system.*

*(b) The assessments shall be levied against all irrigable land in the district on a per acre basis, whether or not the land is actually irrigated. The board shall determine from year to year the proportionate amount of the expenses which will be borne by water users.*

*(c) The remainder of the estimated expenses shall be paid by assessments against persons in the district who use or who make application to use water. The board shall prorate the remainder as equitably as possible among the applicants for water and may consider the acreage each applicant will plant, the crop he will grow, and the amount of water per acre he will use.*

*Added by Acts 1977, 65th Leg., p. 1537, ch. 627, § 1, eff. Aug. 29, 1977.*

### **§58.319. Charge to Cities and Towns**

*If a district supplies untreated water, the charge for the use of the water and the time and manner of payment shall be determined by the board or fixed by the contract made with the board.*

*Added by Acts 1977, 65th Leg., p. 1537, ch. 627, § 1, eff. Aug. 29, 1977.*

## SUBCHAPTER N. ADDING AND EXCLUDING TERRITORY AND CONSOLIDATING DISTRICTS

### **§58.708. Notice of Hearing on Applications**

*The board shall give notice of the hearing on the applications by publishing the time, place, and nature of the hearing one time in a newspaper published in a county in which all or part of the district is located. The newspaper must have been published regularly for more than 12 months preceding the date of the publication of the notice and must have circulation in the district. The notice shall be published not less than 10 days nor more than 20 days before the date of the hearing.*

*Added by Acts 1977, 65th Leg., p. 1537, ch. 627, § 1, eff. Aug. 29, 1977.*

### **§58.709. Hearing Procedure**

*The board shall hear all interested parties and all evidence in connection with the applications.*

*Added by Acts 1977, 65th Leg., p. 1537, ch. 627, § 1, eff. Aug. 29, 1977.*

### **§58.710. Board's Resolution to Substitute Land**

*If the board finds that all the conditions provided for the exclusion of land and inclusion of other land in the district exist, it may adopt and enter in its minutes a resolution to exclude land which is nonagricultural or nonirrigable in a practicable manner and include land which may be irrigated from the facilities of the district in a practicable manner.*

*Added by Acts 1977, 65th Leg., p. 1537, ch. 627, § 1, eff. Aug. 29, 1977.*

### **§58.713. Right to Serve New Land Included in District**

*The district has the same right to furnish water service to the included land that it previously had to furnish service to the excluded land. The mere inclusion of a larger total acreage than that excluded does not give the district the right to irrigate a larger total acreage or to appropriate a larger quantity or volume of public water for irrigation than the district would have had the right to irrigate or to appropriate before the exclusion and inclusion of the land.*

*Added by Acts 1977, 65th Leg., p. 1537, ch. 627, § 1, eff. Aug. 29, 1977.*

The following is a verbatim reproduction of selected sections of the Texas Commission on Environmental Quality Rules and Regulations (Texas Commission on Environmental Quality 2003). The sections represented here are those previously cited within the text.

## **SUBCHAPTER B : WATERMASTER-REGULATORY FUNCTIONS**

### **§303.11. Records of Diversions--General.**

*(a) The watermaster shall locate, number by river mile or other method, and rate as to capacity all authorized diversion facilities on the Texas bank along the Rio Grande and tributaries, and the owner or operator thereof shall be advised in writing of these facts. When a permanent diversion facility is replaced at the same location or when any changes in rating are made, the diverter shall immediately inform the watermaster prior to diversion. Any change in the location of the diversion facilities and place of use on the Middle or Lower Rio Grande shall be made pursuant to §295.71 of this title (relating to Applications to Amend a Permit) and §295.158(c) of this title (relating to Notice of Amendments to Water Rights), not requiring mailed and published notice. Any change in the location of the diversion facilities and place of use on the Upper Rio Grande and tributaries to the Rio Grande shall be made pursuant to §295.71 of this title (relating to Applications to Amend a Permit) and §295.158(c) of this title (relating to Notice of Amendments to Water Rights), not requiring mailed and published notice; or §295.158(b) of this title (relating to Notice of Amendments to Water Rights), requiring mailed and published notice.*

*(b) Each diverter shall request written certification from the watermaster prior to diverting water by identifying the specific certificate of adjudication to be used and the pump number of the pump to be used. When a diverter orders water for a nondiverter, the diverter may request written certification under such diverter's certificate of adjudication or under the certificate of adjudication of the nondiverter to which the diverter is delivering water, but shall report the amount of water diverted for the nondiverter as provided in §303.12(d) of this title (relating to Mainstem Middle and Lower Rio Grande). Certifications will be granted only for diversion from authorized diversion points associated with that water right. Certifications for irrigation water rights will be granted only for delivery of water to the authorized tract(s) covered by the water right or approved contractual sale. Certifications are limited to a maximum diversion period of one calendar month on the mainstream of the Lower and Middle Rio Grande and to one year on the Upper Rio Grande and all tributaries of the Rio Grande.*

*(e) Each diverter shall install and maintain measuring devices at the authorized point of diversion which will provide for accurate measurement and accounting of the quantities of water diverted. The installation, maintenance, and operation of measuring devices by the diverter shall be subject to approval of the watermaster. The diverter must ensure the accessibility of the measuring device, so it can be conveniently and safely located and checked by the watermaster.*

*The diverter shall be liable for all expenses incurred in the acquisition, installation, maintenance, and operation of measuring devices.*

**§303.12. Records - Mainstem Middle and Lower Rio Grande.**

*(e) Diversions shall be charged against the appropriate accounts as follows.*

*(1) A diverter shall be charged with the actual amount diverted, without being penalized, if the total diversion is within plus or minus 10% of the amount requested pursuant to certification.*

*(3) If the quantity of water diverted is more than 110% of the amount requested pursuant to certification, then the diverter will be charged with the actual amount of water diverted and the provisions of §303.31 of this title (relating to General) will apply.*

**SUBCHAPTER C: ALLOCATION AND DISTRIBUTION OF WATERS**

**§§303.21 - 303.23**

**Effective April 26, 2001**

**§303.21. Accounts-Amistad/Falcon Reservoirs.**

*(b) When there is adequate water to do so, the watermaster shall maintain the following accounts:*

*(1) a reserve of 225,000 acre-feet of water for domestic, municipal, and industrial uses;*

*(2) an operating reserve of 75,000 acre feet; and*

*(3) the accounts for irrigation uses and all other uses.*

*(c) The operating reserve is necessary to cover losses of water charged to the United States.*

*These losses are the result of seepage, evaporation, and conveyance; emergency requirements; and adjustments of amounts in storage as may be necessary by finalization of provisional computations by the International Boundary and Water Commission.*

*Adopted April 4, 2001 Effective April 26, 2001*

**§303.22. Allocations to Accounts.**

*(a) Allocations shall be based on water in the usable storage of Falcon and Amistad Reservoirs. Such storage shall be computed as the total storage in Amistad and Falcon Reservoirs as reported by the International Boundary and Water Commission on the last Saturday of each month, less the amount of water in dead storage, which is water behind the dams that cannot be released due to hydrologic restrictions. To determine the amount of water to be allocated to the various accounts, computations shall be made in the following sequence:*

*(1) from the amount of water in usable storage, deduct 225,000 acre-feet to re-establish the reserve for municipal, domestic, and industrial uses;*

*(2) from the remaining storage, deduct the total end-of-month account balances for all Lower and Middle Rio Grande irrigation and mining allottees;*

*(3) from the remaining storage, deduct 75,000 acre feet for the operating reserve;*

(4) after the deduction of the operating reserve, the remaining water will be allocated to the Class A and Class B accounts.

**SUBCHAPTER F: CONTRACTUAL SALES**  
**§§303.51-303.55**

**§303.51. General Policy.**

*Verified owners of water rights in the Middle and Lower Rio Grande with the right to call on releases from the Amistad-Falcon system may contract for the sale of all or part of their annual authorized amount of use to other water rights holders or their agents in the Middle and Lower Rio Grande as long as all of the contractual sales rules are complied with. The resale of purchased water is prohibited. The use of contract sale water by buyer will not go to the perfection of seller's appropriative right. All existing contracts shall be filed with the executive director in accordance with this section.*

**§303.52. General Filing Requirements.**

*(a) If the sale of water is for a purpose of use other than that authorized in the seller's water right, then the supplier must file an application to amend that right and have the right amended before any sale may be approved.*

*(b) If the use of water under the contract involves a change in the place of use, diversion point or diversion rate, an amendment to sellers or buyers water right is not required. Seller or buyer shall file a copy of the executed contract with the executive director for approval. Water diverted pursuant to this section shall be diverted from a diversion point and used on a tract of land identified in commission records in accordance with §303.53(b) of this title (relating to Documents Needed to File).*

*(c) The seller must be a verified owner of a water right. If the commission does not have adequate ownership records of the seller, then no sale may be approved by the executive director.*

*(d) All contracts must be filed with and approved by the executive director as complying with all the sections relating to contractual sales. No deliveries of sold water will be made by the watermaster until all requirements are met.*

*(e) The executive director will file the original approved contracts in the seller's permanent water right record and will send a copy of approved contracts to the watermaster.*

*(f) No contract approval is required for sales of water by a district when the district's distribution facilities are used to deliver the water to the buyer for purposes authorized by the district's water right.*

*(g) Seller can not use and/or sell in excess of his water right's annual authorized amount of use in any calender year.*

**§303.53. Documents Needed to File.**

(a) A contract of sale of water to be filed with the executive director in accordance with §303.52(d) of this title (relating to General Filing Requirements) shall indicate all of the following:

- (1) the specific certificate of adjudication or other water right under which the water is being sold;
  - (2) the specific certificate of adjudication or other water right under which the bought water is to be used;
  - (3) the name and address of the seller and buyer;
  - (4) the total quantity of water being purchased in acre-feet;
  - (5) the purpose of use for which the water is to be used;
  - (6) the cost of water to the buyer per acre-foot;
  - (7) the diversion point to which the buyer is requesting deliveries to be made;
  - (8) the effective date and termination date of the contract (contract period can not exceed one year) the acreage to be irrigated, if applicable; and
  - (9) the contract executed by all verified owners of the water right from which water is purchased.
- (b) The contract will be accompanied by an aerial photograph or United States Geological Survey topographic map with the location of diversion points and areas to be irrigated described thereon.
- (c) The executive director may require any additional information needed to approve the contract, including any agreements with diverters if the buyer is not pumping from his own diversion point and deeds of any tracts to be irrigated.

**§303.54. Responsibilities of Buyer and Seller.**

- (a) Both buyer and seller must comply with all Texas Water Commission rules and watermaster orders.
- (b) The buyer must obtain a certification from the watermaster before pumping.
- (c) The buyer and seller are solely responsible as to the resolution of conflict regarding the terms and conditions of a water contract sale.
- (d) The seller is responsible for reporting all sales of water on the yearly surface water use reports. The buyer must also report his use of purchased water separately from his water right on his yearly surface water use report.

**§303.55. Accounting for Contract Sale Water.**

- (a) The watermaster will transfer the full amount of water, or portion thereof, specified in an approved contract from the seller's to the buyer's account upon contract approval.
- (b) Upon transfer of contract sale water to buyer's account, subsequent use of water by buyer will be deducted from the contract water balance until the contract water balance equals zero or until the contract expiration date.

*(c) Any contract water balance remaining in buyer's account at the contract expiration date will be deducted from buyer's account and will be available for allocation to the system reserves and accounts according to §303.22 of this title (relating to Allocations to Accounts).*

*(d) Buyer may not sell any water via contract as long as his bought water balance is greater than zero.*

*(e) At no time will buyer's or seller's irrigation storage account exceed 1.41 times the water right holder's recognized amount in acre-feet.*



The following is a verbatim reproduction of selected sections of the 1944 Water Treaty (U.S.-Mexico Treaty for Utilization of the Waters of the Colorado and Tijuana Rivers and of the Rio Grande). The sections represented here are those previously cited within the text.

## **II -Rio Grande (Rio Bravo)**

### **Article 4**

*The waters of the Rio Grande (Rio Bravo) between Fort Quitman, Texas and the Gulf of Mexico are hereby allotted to the two countries in the following manner: A. To Mexico: (a) All of the waters reaching the main channel of the Rio Grande (Rio Bravo) from the San Juan and Alamo Rivers, including the return flow from the lands irrigated from the latter two rivers. (b) One-half of the flow in the main channel of the Rio Grande (Rio Bravo) below the lowest major international storage dam, so far as said flow is not specifically allotted under this Treaty to either of the two countries. (c) Two-thirds of the flow reaching the main channel of the Rio Grande (Rio Bravo) from the Conchos, San Diego, San Rodrigo, Escondido and Salado Rivers and the Las Vacas Arroyo, subject to the provisions of subparagraph (c) of Paragraph B of this Article. (d) One-half of all other flows not otherwise allotted by this Article occurring in the main channel of the Rio Grande (Rio Bravo), including the contributions from all the unmeasured tributaries, which are those not named in this Article, between Fort Quitman and the lowest major international storage dam. B. To the United States: (a) All of the waters reaching the main channel of the Rio Grande (Rio Bravo) from the Pecos and Devils Rivers, Good-enough Spring, and Alamito, Terlingua, San Felipe and Pinto Creeks. (b) One-half of the flow in the main channel of the Rio Grande (Rio Bravo) below the lowest major international storage dam, so far as said flow is not specifically allotted under this Treaty to either of the two countries. (c) One-third of the flow reaching the main channel of the Rio Grande (Rio Bravo) from the Conchos, San Diego, San Rodrigo, Escondido and Salado Rivers and the Las Vacas Arroyo, provided that this third shall not be less, as an average amount in cycles of five consecutive years, than 350,000 acre-feet (431,721,000 cubic meters) annually. The United States shall not acquire any right by the use of the waters of the tributaries named in this subparagraph, in excess of the said 350,000 acre-feet (431,721,000 cubic meters) annually, except the right to use one-third of the flow reaching the Rio Grande (Rio Bravo) from said tributaries, although such one-third may be in excess of that amount. (d) One-half of all other flows not otherwise allotted by this Article occurring in the main channel of the Rio Grande (Rio Bravo), including the contributions from all the unmeasured tributaries, which are those not named in this Article, between Fort Quitman and the lowest major international storage dam.*

*In the event of extraordinary drought or serious accident to the hydraulic systems on the measured Mexican tributaries, making it difficult for Mexico to make available the run-off of 350,000 acre-feet (431,721,000 cubic meters) annually, allotted in subparagraph (c) of paragraph*

*B of this Article to the United States as the minimum contribution from the aforesaid Mexican tributaries, any deficiencies existing at the end of the aforesaid five-year cycle shall be made up in the following five-year cycle with water from the said measured tributaries. Whenever the conservation capacities assigned to the United States in at least two of the major international reservoirs, including the highest major reservoir, are filled with waters belonging to the United States, a cycle of five years shall be Considered as terminated and all debits fully paid, where upon a new five-year cycle shall commence.*

### **Article 5**

*The two Governments agree to Construct jointly, through their respective Sections of the Commission, the following works in the main channel of the Rio Grande (Rio Bravo): I. The dams required for the Conservation, storage and regulation of the greatest quantity of the annual flow of the river in a way to ensure the continuance of existing uses and the development of the greatest number of feasible projects, within the limits imposed by the water allotments specified. II. The dams and other joint works required for the diversion of the flow of the Rio Grande (Rio Bravo). One of the storage dams shall be constructed in the section between Santa Helena Canyon and the mouth of the Pecos River; one in the section between Eagle Pass and Laredo, Texas (Piedras Negras and Nuevo Laredo in Mexico); and a third in the section between Laredo and Roma, Texas (Nuevo Laredo and San Pedro de Roma in Mexico). One or more of the stipulated dams may be omitted, and others than those enumerated may be built, in either case as may be determined by the Commission, subject to the approval of the two Governments. In planning the construction of such dams the Commission shall determine: (a) The most feasible sites; (b) The maximum feasible reservoir capacity at each site; (c) The conservation capacity required by each country at each site, taking into consideration the amount and regimen of its allotment of water and its contemplated uses; (d) The capacity required for retention of silt; (e) The capacity required for flood control.*

*The conservation and silt capacities of each reservoir shall be assigned to each country in the same proportion as the capacities required by each country in such reservoir for conservation purposes. Each country shall have an undivided interest in the flood control capacity of each reservoir. The construction of the international storage dams shall start within two years following the approval of the respective place by the two Governments. The works shall begin with the construction of the lowest major international storage dam, but works in the upper reaches of the river may be constructed simultaneously. The lowest major international storage dam shall be completed within a period of eight years from the date of the entry into force of this Treaty. The construction of the dams and other joint works required for the diversion of the flows of the river shall be initiated on the dates recommended by the Commission and approved by the two Governments. The cost of construction, operation and maintenance of each of the international storage dams shall be prorated between the two Governments in proportion to the*

*capacity allotted to each country for conservation purposes in the reservoir at such dam. The cost of construction, operation and maintenance of each of the dams and other joint works required for the diversion of the flows of the river shall be prorated between the two Governments in proportion to the benefits which the respective countries receive therefrom, as determined by the Commission and approved by the two Governments.*

#### **Article 6**

*The Commission shall study, investigate, and prepare plans for flood control works, where and when necessary, other than those referred to in Article 5 of this Treaty, on the Rio Grande (Rio Bravo) from Fort Quitman, Texas to the Gulf of Mexico. These works may include levees along the river, floodways and grade-control structures, and works for the canalization, rectification and artificial channeling of reaches of the river. The Commission shall report to the two Governments the works which should be built, the estimated cost thereof, the part of the works to be constructed by each Government, and the part of the works to be operated and maintained by each Section of the Commission. Each Government agrees to construct, through its Section of the Commission, such works as may be recommended by the Commission and approved by the two Governments. Each Government shall pay the costs of the works constructed by it and the costs of operation and maintenance of the part of the works assigned to it for such purpose.*

#### **Article 7**

*The Commission shall study, investigate and prepare plans for plants for generating hydro-electric energy which it may be feasible to construct at the international storage dams on the Rio Grande (Rio Bravo). The Commission shall report to the two Governments in a Minute the works which should be built, the estimated cost thereof, and the part of the works to be constructed by each Government. Each Government agrees to construct, through its Section of the Commission, such works as may be recommended by the Commission and approved by the two Governments. Both Governments, through their respective Sections of the Commission, shall operate and maintain jointly such hydro-electric plants. Each government shall pay half the cost of the construction, operation and maintenance of such plants, and the energy generated shall be assigned to each country in like proportion.*

#### **Article 8**

*The two Governments recognize that both countries have a common interest in the conservation and storage of waters in the international reservoirs and in the maximum use of these structures for the purpose of obtaining the most beneficial, regular and constant use of the waters belonging to them. Accordingly, within the year following the placing in operation of the first of the major international storage dams which is constructed, the Commission shall submit to each Government for its approval, regulations for the storage, conveyance and delivery of the waters of the Rio Grande (Rio Bravo) from Fort Quitman, Texas to the Gulf of Mexico. Such*

regulations may be modified, amended or supplemented when necessary by the Commission, subject to the approval of the two Governments. The following general rules shall severally govern until modified or amended by agreement of the Commission, with the approval of the two Governments: (a) Storage in all major international reservoirs above the lowest shall be maintained at the maximum possible water level, consistent with flood control, irrigation use and power requirements. (b) Inflows to each reservoir shall be credited to each country in accordance with the ownership of such inflows. (c) In any reservoir the ownership of water belonging to the country whose conservation capacity therein is filled, and in excess of that needed to keep it filled, shall pass to the other country to the extent that such country may have unfilled conservation capacity, except that one country may at its option temporarily use the conservation capacity of the other country not currently being used in any of the upper reservoirs; provided that in the event of flood discharge or spill occurring while one country is using the conservation capacity of the other, all of such flood discharge or spill shall be charged to the country using the other's. capacity, and all inflow shall be credited to the other country until the flood discharge or spill ceases or until the capacity of the other country becomes filled with its own water. (d) Reservoir losses shall be charged in proportion to the ownership of water in storage. Releases from any reservoir shall be charged to the country requesting them, except that releases for the generation of electrical energy, or other common purpose, shall be charged in proportion to the ownership of water in storage. (e) Flood discharges and spills from the upper reservoirs shall be divided in the same proportion as the ownership of the inflows occurring at the time of such flood discharges and spills, except as provided in subparagraph (c) of this Article. Flood discharges and spills from the lowest reservoir shall be divided equally, except that one country, with the consent of the Commission, may use such part of the share of the other country as is not used by the latter country. (f) Either of the two countries may avail itself, whenever it so desires, of any water belonging to it and stored in the international reservoirs, provided that the water so taken is for direct beneficial use or for storage in other reservoirs. For this purpose the Commissioner of the respective country shall give appropriate notice to the Commission, which shall prescribe the proper measures for the opportune furnishing of the water.

#### **Article 9**

(a) The channel of the Rio Grande (Rio Bravo) may be used by either of the two countries to convey water belonging to it. (b) Either of the two countries may, at any point on the main channel of the river from Fort Quitman, Texas to the Gulf of Mexico, divert and use the water belonging to it and may for this purpose construct any necessary works. However, no such diversion or use, not existing on the date this Treaty enters into force, shall be permitted in either country, nor shall works be constructed for such purpose, until the Section of the Commission in whose country the diversion or use is proposed has made a finding that the water necessary for such diversion or use is available from the share of that country, unless the Commission has

agreed to a greater diversion or use as provided by paragraph (d) of this Article. The proposed use and the plans for the diversion works to be constructed in connection therewith shall be previously made known to the Commission for its information. (c) Consumptive uses from the main stream and from the unmeasured tributaries below Fort Quitman shall be charged against the share of the country making them. (d) The Commission shall have the power to authorize either country to divert and use water not belonging entirely to such country, when the water belonging to the other country can be diverted and used without injury to the latter and can be replaced at some other point on the river. (e) The Commission shall have the power to authorize temporary diversion and use by one country of water belonging to the other, when the latter does not need it or is unable to use it, provided that such authorization or the use of such water shall not establish any right to continue to divert it. (f) In case of the occurrence of an extraordinary drought in one country with an abundant supply of water in the other country, water stored in the international storage reservoirs and belonging to the country enjoying such abundant water supply may be with-drawn, with the consent of the Commission, for the use of the country undergoing the drought. (g) Each country shall have the right to divert from the main channel of the river any amount of water, including the water belonging to the other country, for the purpose of generating hydroelectric power, provided that such diversion causes no injury to the other country and does not interfere with the international generation of power and that the quantities not returning directly to the river are charged against the share of the country making the diversion. The feasibility of such diversions not existing on the date this Treaty enters into force shall be determined by the Commission, which shall also determine the amount of water consumed, such water to be charged against the country making the diversion. (h) In case either of the two countries shall construct works for diverting into the main channel of the Rio Grande (Rio Bravo) or its tributaries waters that do not at the time this Treaty enters into force contribute to the flow of the Rio Grande (Rio Bravo) such water shall belong to the country making such diversion. (i) Main stream channel losses shall be charged in proportion to the ownership of water being conveyed in the channel at the times and places of the losses. (j) The Commission shall keep a record of the waters belonging to each country and of those that may be available at a given moment, taking into account the measurement of the allotments, the regulation of the waters in storage, the consumptive uses, the withdrawals, the diversions, and the losses. For this purpose the Commission shall construct, operate and maintain on the main channel of the Rio Grande (Rio Bravo), and each Section shall construct, operate and maintain on the measured tributaries in its own country, all the gaging stations and mechanical apparatus necessary for the purpose of making computations and of obtaining the necessary data for such record. The information with respect to the diversions and consumptive uses on the unmeasured tributaries shall be furnished to the Commission by the appropriate Section. The cost of construction of any new gaging stations located on the main channel of the Rio Grande (Rio Bravo) shall be borne equally by the two Governments. The operation and maintenance of all gaging stations or the cost of such operation and maintenance shall be apportioned between the two Sections in accordance with determinations to be made by the Commission.

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## Notes

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