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THE RIO GRANDE: A confluence of Waters, Nations & Cultures

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"Geography made us forced neighbors, history made us wary neighbors, may our will and vision of the future make us respectful and progressive neighbors."

Mexican President Carlos Salinas, 1990

The Rio Grande emerges from the San Juan Mountains in southern Colorado. Time and the forces of tectonics and erosion created the basin to steer melted snow and rain water south through the rift valley that dissects New Mexico, then southeast through the valleys and plateaus of Texas and Mexico, and ultimately onto the coastal plain. At the mouth of the Gulf of Mexico, this river, which gathers force and beauty for nearly 2,000 miles, finally loses itself in saltwater.

The Rio Grande (known as the Rio Bravo in Mexico) is a confluence of national interests, a coming together of two nations. It accepts the legacy each nation leaves and bears the price of what both nations take away. The river separates Mexico and the United States both literally and figuratively. Being a scarce and shared source of water for the region, the river and groundwaters have been at the center of dispute between the two nations more than once, and they have become a simmering point of contention in U.S./Mexico relations. Transboundary water conflicts have enormous consequences to both sides of the border and have become one of the central stumbling blocks in the North American Free Trade Agreement (NAFTA) negotiations. While the Rio Grande separates, it also unites, bringing together Mexican and American cultures and economies through the challenge of sharing the water resources equitably and protecting their sustainability.

The U.S. and Mexico have cooperated for many years on border environmental problems. The allocation of water from the Rio Grande is based on a long history of international agreements and treaties. As momentum builds for the NAFTA negotiations, many

questions have surfaced over the possible effects of increased trade on the economy *and* the environment in the border region. There is concern that the international regulatory and institutional framework now in place is not adequate to fully address existing or potential transboundary water resource issues resulting from increased trade. Researchers agree there may be a need for specific bilateral agreements dealing with issues such as funding the construction and operation of wastewater treatment plants, controlling hazardous wastes, limiting groundwater withdrawals, and improving data collection.

The transboundary water issues that confront the border region today are complex and interwoven. They require an understanding of the hydrology, the economies, the cultures, and the laws. Three of the most pressing problems are: increasing demands for water and the potential for water shortages; contamination of surface and groundwater by fecal coliform and nitrate due to inadequate wastewater treatment; and contamination from industrial discharge and agricultural runoff. Work done by Texas researchers has been important in describing and analyzing these problems.

Transboundary Water Conflicts

The Rio Grande was once a formidable river -- wild and free. Today, the Rio Grande is overused, diverted for many purposes, utilized as an open sewer by millions of people, and degraded by industrial wastes and agricultural runoff. By the time the Rio Grande flows meekly into the Gulf, the health and history of the river have been compromised. The condition of the Rio Grande is probably worst within the Texas-Mexico reach, where it provides water and means life to millions of people. There, the Rio Grande is neither plentiful nor clean (Cech and Essman, 1992).

Ironically, efforts to nurture the trade economy between Mexico and the U.S. have begun to call attention to the environmental problems along and beneath the river's banks. Some experts believe that the development of that increased U.S.-Mexico trade began worsening the quality of the Rio Grande in the first place. As trade across the border has evolved over the last 25 years, hundreds of "maquiladora" or "product assembly" plants have been built along Mexico's northern border. Most of these are export plants that are owned by U.S. companies. They have enticed thousands of Mexicans to migrate from rural areas to the northern border cities in search of jobs. The economic gains to both nations have been large. The U.S.-owned maquiladoras benefit from Mexican government incentives for companies that export most or all of their production and the plants have brought a sorely-needed boost to the Mexican economy. Experts believe that a free trade agreement would increase economic growth, degrade the environment, and stress natural resources (Ozuna and Quiroga, 1991). Issues concerning water quantity and quality will be critical parts of any agreement.

Growth so far has been unplanned and has occurred in spite of the constraints of limited water resources (Cech and Essman, 1992). The push for industrialization has brought about a tide of migration to the border region. Population growth has been so rapid in the border area that "colonias" which sprang up along the border as temporary towns quickly became permanent, growing settlements At the same time, the cities which straddle the

border have also expanded quickly. Increases in population escalated water requirements from basins where water resources were already scarce (Cech and Essman, 1992; Bath and Tanski, 1992). Neither nation has been able to keep pace with the increasing need for water and sewage treatment, so much of the basin suffers from water quality degradation. The border region faces a host of environmental problems characteristic of expanding urban areas where infrastructure and environmental enforcement have not kept up with rapid growth. Three critical water problems in the border area are:

**increasing demand for surface and groundwater creating water use conflicts and competition that could lead to groundwater depletion and reduced surface water flows;*

**fecal coliform and nitrate contamination of surface and groundwaters because of inadequate wastewater treatment*

**possible contamination of surface and groundwaters caused by agricultural runoff containing pesticides and industrial discharges containing organic chemicals.*

Competition for Scarce Water

One of the main issues confronting the basin is the scarcity of water. The Rio Grande has historically been utilized for irrigation. Mexico irrigates about 1.1 million acres within the basin and the U.S. irrigates about 993,000 acres (all but 98,000 of them in Texas). Population growth in the region along with increases in per capita water use have increased water consumption by cities and industries. During the 1980s, the population along the border increased by 27% (from 1.13 to 1.55 million) in the U.S. and by 23%, (from 1.45 to 1.88 million) in Mexico (Eaton and Hurlbut, 1992). Demand for water in the border region strains surface and groundwater resources. The Texas Water Development Board (TWDB) projects that by the year 2040, the Rio Grande and its tributaries and aquifers will fall about 273,985 acre feet (AF) per year short of being able to meet all the demands placed on them by users on the U.S. side of the river (TWDB, 1990).

Two international agreements apportion the river water. In 1906, the Convention for the Equitable Division of the Waters of the Rio Grande for Irrigation Purposes was signed. It requires the U.S. to provide Mexico with 59,985 AF of water per year downstream for the greater Ciudad Juarez area (Eaton and Hurlbut, 1992). In 1944, the two countries signed a treaty to cooperatively regulate and apportion the river water from Fort Quitman to the Gulf. The 1944 treaty also replaced the International Boundary Commission (IBC) with the International Boundary and Water Commission (IBWC). The IBC dated back to the 1853 Gadsen Treaty which gave the commission exclusive jurisdiction over all water and boundary questions. Today's IBWC has U.S. and Mexico sections, each with an appointed commissioner. It is empowered with broad authority, including the charge to regulate and conserve water, construct and operate dams for storage and electrical generation, oversee levee and floodway projects, construct water treatment plants, and address sanitation problems (McIntosh, 1990). It remains unclear whether the IBWC is responsible for *all* boundary area river water quality problems and if its regulatory

structure is well suited for dealing with the water problems exploding along the border today (Kelly et al., 1991). Groundwater management is not addressed in the 1906 Convention or the 1944 Treaty.

The Rio Grande is divided into three reaches in Texas. The upper reach runs from the New Mexico border to a point just above the Rio Conchos and is in a dry, arid climate. In this reach, flow in the river is so low that the cities of El Paso and Ciudad Juarez must increasingly utilize limited groundwater supplies (Eaton and Hurlbut, 1992). The middle reach of the river lies within the Edwards Plateau and runs from about Presidio/Ojinaga to just below the Mexican Rio San Juan. At the confluence of the Rio Grande and the Rio Conchos, the main stem of the Rio Grande has all but stopped flowing and is rejuvenated by the Conchos and other tributaries. The major diversions in the middle reach are for the cities of Del Rio/Ciudad Acuna, Eagle Pass/Piedras Negras, and Laredo/Nuevo Laredo. The lower reach of the Rio Grande is on the coastal plain and runs from below the Rio San Juan to the Gulf. It is largely diverted for irrigation on both sides of the border. Along the river, evaporative water losses from the river are roughly four to five times greater than average precipitation (*Eaton and Hurlbut,* 1992). In all, about 1.8 million AF of water flow into the Rio Grande from the U.S. and about 2 million AF from Mexico. Generally, the U.S. takes out more water than it replaces as wastewater return flows and uses more of the river's water than Mexico (Eaton and Hurlbut, 1992).

One innovative strategy being used to allocate surface waters in the basin is the TWC's Watermaster Program. This program keeps track of individual users and gauges the amount of water they withdraw. The program facilitates water marketing by informing buyers and sellers of available water and its price. As a result, some surface water has been reallocated from agricultural to urban uses.

Groundwater exists at many sites in the Rio Grande basin and groundwater use varies significantly. In many places, the aquifers are hydraulically connected to the river and fed by its flow. There, pumping from aquifers can amount to using river water. Estimates suggest that, in the future, groundwater withdrawals at some border sites may be twice as high as recharge rates.

Serious groundwater supply problems exist in the Hueco and Mesilla Bolson aquifers that underlie the El Paso/Ciudad Juarez area (Bath and Tanski, 1992) where groundwater consumption in 1985 was 80% greater than the aquifers' combined average natural recharge of about 24,318 AF per year (Eaton and Hurlbut, 1992).

Groundwater contamination prohibits extensive use of the resource in some parts of the basin. Much of the groundwater has naturally high salinities at deeper levels. Shallow groundwater is also vulnerable to contamination by untreated sewage, agricultural runoff, and industrial discharge (Eaton and Anderson, 1987). Aquifers that have outcroppings near the surface or are in direct hydraulic contact with the river are at greater risk of contamination.

Successful attention to border area water problems should include management of both the quantity and quality of shared groundwater resources. Such coordination has been difficult so far because: 1) the magnitude of the problems has outpaced efforts for comprehensive management; 2) Mexico has traditionally had less stringent environmental rules and has been lax to enforce them; and 3) the laws regulating groundwater differ fundamentally. In Mexico, as in most of the U.S., groundwater is treated as a common pool or public resource available for reasonable use but is managed and regulated by the government (Eaton and Hurlbut, 1992). In contrast, groundwater is regarded as private property with rights of absolute ownership in most of Texas. The result is that individuals can pump as much water as they want with relatively little regulation. This has the potential to negatively impact neighboring groundwater users (*Kaiser*, 1991). Until these differences can be resolved, it will be difficult to effectively manage the shared groundwaters.

Estimates of Groundwater Supplies and Anticipated Pumping in the Rio Grande Basin

Aquifer	Annual Recharge	1990	2000
Alluvium and Bolson (El Paso/Ciudad Juarez to Presidio/Ojinaga)	434.0	952.1	989.7
Edwards-Trinity (Del Rio/Cuidad Acuna)	776.0	776.0	776.0
Carrizo-Wilcox (Lardo/Nuevo Laredo)	644.9	828.7	828.7
Gulf Coast (McAllen/Reynosa to gulf)	1,229.8	1,229.8	1,229.8

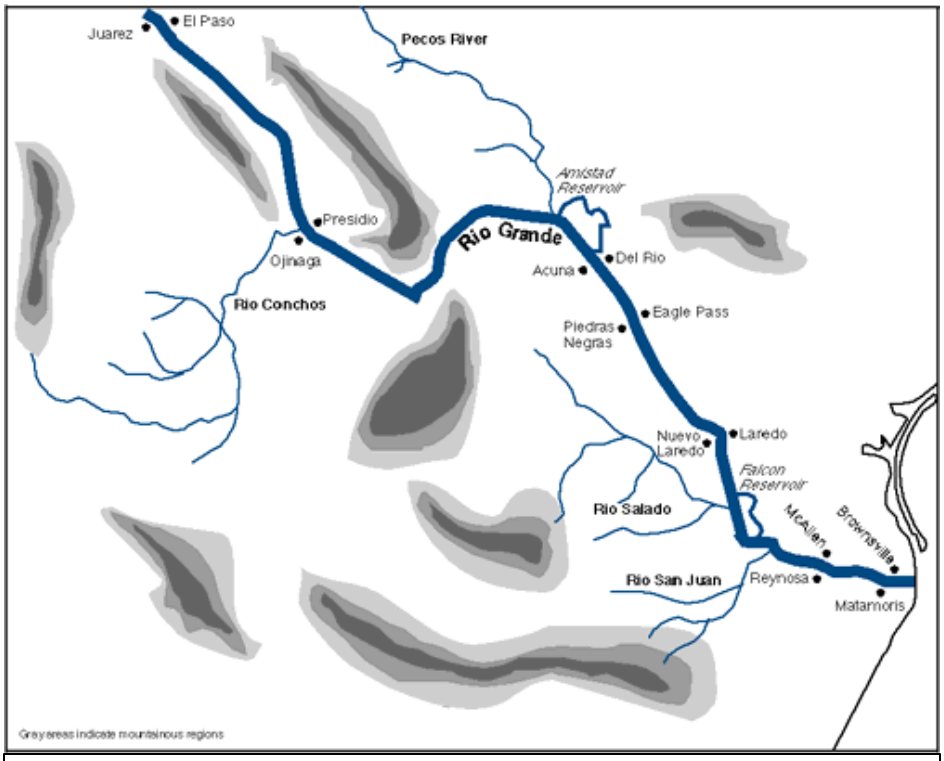
Contamination affects water supply

Water supply problems pose serious environmental, economic, and international relations issues for the region. These issues are greatly compounded by poor water quality in the river and groundwaters throughout much of the basin that has in effect reduced water supplies. The combination of scarce and contaminated water in a region can be devastating.

One of the major water quality problems in the basin stems from inadequate water and wastewater treatment. Untreated wastes that are pumped into the Rio Grande from cities along the border produce high levels of fecal bacteria and other contaminants that violate both Texas and Mexican standards (*Eaton and Hurlbut*, 1992). The water quality is poorest just below the urban areas, where discharges of millions of gallons of untreated or partially treated sewage occur often. In Texas, progress has been made to treat wastewater, but more needs to be done on both sides of the border. In Juarez and other sites in Mexico, untreated waste flows through "agua negra" or "black water" ditches

before they are used to irrigate crops or are discharged into the river (Cech and Essman, 1992). Downstream of Nuevo Laredo and Matamoros, fecal coliform counts in the Rio Grande are routinely 75 to 1000 times greater than Texas standards for drinking and recreation.

A major concern centers around the potential for contamination by fecal matter from raw or poorly treated sewage. High rates of diseases that are caused by fecal pollution such as gastrointestinal infections (especially hepatitis), skin infections, and dysentery are common along the border (Eaton and Hurlbut, 1992). Area health officials are also increasingly concerned about cholera outbreaks that have been reported as far north as Monterrey (Cech and Essman, 1992). Recent research also suggests that rates of chronic liver disease and cancer may be higher than normal along the border. This may result from toxic chemicals, pesticides and unsanitary conditions.



Water Quality Problem Areas along the Rio Grande/Rio Bravo (1986-89).

Gastrointestinal diseases are the leading causes of death among children in the border states of Mexico, with mortality rates as high as 60 per 100,000. During summer months, gastroenteritis is believed to be the major cause of infant death in Ciudad Juarez (Cech and Essman, 1992). The 1991 rates for hepatitis A in half the counties along the U.S. side of the border exceeded 30 per 100,000 compared to 9 per 100, 000 for the rest of the nation. The hepatitis A virus is transmitted by contact with fecally-contaminated objects or liquids. El Paso County has reported that 35% of children under age 8 have been infected with hepatitis A and 85 to 90% of residents have been infected by the time they are 35.

Colonias are an another source of groundwater contamination. Colonias are unincorporated, rural settlements of substandard housing, constructed on small,

unimproved lots. Many colonia residents have built their homes with discarded tires, cardboard, and insulation. Many colonia dwellings are single-wide or travel trailers. Some colonias have water service, but most do not. Most colonia homes use outhouses or inadequate septic systems to dispose of wastes. The TWDB recently estimated that there are 1,193 colonias with a population of about 280,000 in Texas. The cost to provide adequate water and wastewater service to Texas colonias may be as high as $9 billion . Needs in Mexico may be much greater (*Texas Center for Policy Studies,* 1992). So far, $355 million in grant money and low interest loans have been made available to construct water and wastewater treatment plants in cities and colonias along the border. Funding has come from TWDB, the EPA, and the U.S. Department of Agriculture.

Increased awareness of the public health and environmental conditions along the border area has prompted efforts to learn more about water quality in the region. The U.S. Environmental Protection Agency (EPA) is working with the Texas Water Commission (TWC) and the IBWC to conduct a comprehensive study of the water and sediment quality of the Rio Grande and the fish and other aquatic species that live in the river. The emphasis is to determine the type and amount of toxic substances that are in the river.

Violations of Texas standards for Fecal Coliform (by % of All Samples)

Site	%
El Paso/Juarez	32
Del Rio/Acuna	58
Eagle Pass/Piedras Negras	81
Laredo/Nuevo Laredo	94
Hidalgo/Reynosa	62
Brownsville/Matamoros	55

NOTE: Data are from *Challenges in Binational Management of Water Resources in the Rio Grande* (Eaton, 1992).

Environment vs. Profit

An alarming rate of birth defects and fish deformities along the border has led to concern that the river may be polluted by toxic chemicals. Conclusive data are unavailable, but a preliminary study by the TWC revealed that pesticides and heavy metals were found in some fish and that deformed fish were observed downstream of Laredo (TWC, 1992). A National Toxic Campaign Fund spot sampling of industrial discharge sites on the border showed that 75% of the sites were discharging toxic chemicals (Lewis et al., 1991).

The rate of birth defects in the Texas border counties is among the highest in the nation, especially for rare conditions such as anencephaly (in which infants are born with only a partially-formed brain or no brain at all). Texas does not maintain a birth defects registry, but a 1992 *Houston Post* article reported "30 documented cases of babies born without brains in Texas in as many months, most in Brownsville." The article added that 42 cases of anencephaly may have been identified in Matamoros during the same period. The article also suggested that rate of anencephaly in the Brownsville area was nearly double

the U.S. average from 1989 to 1991. Anecdotal evidence suggests that anencephaly and other defects occur more frequently along the Mexican border than in the interior. Some researchers suggest that these birth defects may be related to contamination originating from toxic industrial wastewaters and from pesticides carried in agricultural runoff, but caution that proof is lacking.

The maquiladora industry has increasingly come under fire as a possible source of toxic chemicals. Hazardous materials used by maquiladoras include a wide range of solvents (alcohols, freons, ketones, and aromatic hydrocarbons), acids and alkaline substances, and heavy metals. Although it is widely believed that the maquiladora generate significant levels of toxic waste, there is little data on how these wastes are actually disposed. The lack of discharge and disposal data has stymied systematic evaluations of the nature and extent of toxic wastes from maquiladoras.

Some researchers believe that pesticides utilized in agricultural production may also be a source of birth defects. Many agricultural crops are produced in the Lower Rio Grande Valley and pesticides are commonly used. TWC assessments suggest that some groundwaters in the Lower Rio Grande may be highly vulnerable to pesticide contamination (TWC, 1989), but many of these are shallow or perched water tables that are too saline to be used for irrigation.

Although there is some momentum for the need to reduce pesticide use in the Valley, a recent study by Ron Lacewell and colleagues at the Texas A&M University Agricultural Economics Department suggests that it may not now be feasible. Lacewell explored whether alternatives to pesticides now widely used to control pests and plant diseases can be cost-effective for farmers. Results show that banning the use of three commonly used pesticides that have a high potential to contaminate groundwater (atrazine, aldicarb and dicrotophos) would lessen the net income of farmers in the region by $3 million annually.

These water quality problems have been complicated by the fact that, historically, there has been disparity in environmental regulations and levels of enforcement between the two nations. For years, U.S. water pollution control rules were stricter than those in Mexico. That may have been one of the main reasons U.S. companies began locating their assembly plants across the border. In due course, Mexico brought its environmental regulations more in line with those in the U.S., but the level of regulation enforcement in Mexico has only recently been stepped up. SEDESOL (the Mexican counterpart to EPA) has, until recently, been loathe to shut down plants and factories (McIntosh, 1990). Growing concerns over human health, the environment, and international relations has prompted both governments to strengthen environmental regulations and their enforcement. Specific bilateral agreements on discharges and sharing of discharge data are being discussed.

University Research

Projects underway at universities throughout the state are researching and solving water problems along the border.

The Center for Housing and Urban Development in Texas A&M University's College of Architecture is beginning a multi-disciplinary initiative to improve quality of life in the colonias. The effort, funded by the Texas Legislature and coordinated by Kermit Black, will provide information and education for colonia residents on water quality, sanitation, and waste disposal. Anthony Tarquin of the Civil Engineering Department at the University of Texas at El Paso is developing low-cost, low-maintenance systems that can be utilized to treat wastewater treatment systems in colonias. The studies, which are funded by the Texas On-Site Wastewater Treatment Council, are aimed at providing sewage treatment for colonias and other areas in need of low-cost, low-maintenance, on-site treatment. Tom Woodfin of the Center for Urban Affairs Texas A&M University is developing automated mapping software to plot and interpret census data for the Laredo/Nuevo Laredo area. Outputs will include population, land use, housing, and infrastructure. Researchers at Texas A&M University are exploring the relationships between agriculture and water quality in the Region. Guy Fipps, an extension specialist with the Agricultural Engineering Department, has been working with Robert Wiedenfeld to monitor the level of nutrient use in the Lower Rio Grande Valley and to estimate their impact on water quality and runoff. Agricultural Economics researcher Ron Lacewell and his colleagues worked to estimate the economic impact that banning pesticides in the region could have on farm profitability. At the University of Texas LBJ School for Public Affairs, David Eaton and his colleagues have written extensively about policy issues that affect water quality and water management along the River. Teo Ozuna of Texas A&M's Agricultural Economics Department has been evaluating the effect of free trade agreements on the ecology of the Rio Grande. At the University of Texas School of Public Health in Houston, Irina Cech has been examining how the health of border residents are being affected by unsanitary conditions. The Texas Tech University School of Public Health in El Paso has been performing outreach health services for colonia residents and other residents in the region. Their studies have been valuable in providing long-term health data.

Can the Rio Grande be salvaged?

The Rio Grande, its tributaries, and nearby groundwaters are a scarce resource. They are shared by two nations whose needs and demands far outweigh what the basin can give. Water resources in the border region are pushed and pulled in all directions. Both nations need the water to sustain themselves along the border. But, in spite of their need for water, both nations may have lost sight of the importance of keeping their water resources clean. How can the basin be restored? Water conservation, better wastewater treatment, and bilateral agreements to manage water are all needed.

The U.S. and Mexico appear to be rising to the challenges presented by the Rio Grande, and taking more seriously the shared responsibility to protect both the quantity and quality of their joint water resources. With any luck at all, the Rio Grande will be a survivor, not a victim.

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