THE RELOCATION OF EL PASO'S STONEWASHING INDUSTRY AND ITS IMPLICATIONS FOR TRADE AND THE ENVIRONMENT

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El Paso, Texas once was considered the denim stonewashing capital of North America. With its abundant, relatively unskilled, and low-wage workforce, El Paso long had attracted labor-intensive industries, especially the apparel industry. With the invention and rise in popularity of stonewashed denim clothing in the late 1980s, El Paso's apparel industry diversified to include stonewashing, a water-intensive activity, as part of the garment finishing process. As the industry scrambled to develop stonewashing technology, some large denim apparel companies implemented vertically integrated "package" operations to include stonewashing, while others contracted with smaller independent operations for finishing work. After the industry's meteoric rise, an exodus of finishers from El Paso took place in the late 1990s, going from a peak of over two dozen facilities in 1993 to only a few garment finishers today. At its peak, the garment finishing industry employed thousands of people and consumed immense quantities of water for stonewashing.

The apparel industry has been undergoing profound changes. Often termed a "sunset industry" in the United States, globalization has made its mark on the industry. Beginning in the 1970s, members of the industry began to look for locations affording a competitive edge, such as the Pacific Rim and Latin America. The advent of the North American Free Trade Agreement (NAFTA) in 1994 put the spotlight on Mexico for an industry already on the move. Among others, the sister cities of Torreón, Coahuila, and Ciudad Lerdo and Gómez Palacios, Durango began to attract more garment finishing operations. Facing increasing price competition, El Paso's garment

finishers were eager to reduce costs, particularly labor costs, making relocation to Mexico an attractive option. As finishers left, they relieved pressure on El Paso's water supply. They were often forced to secure their own water supply for their new facilities in Mexico, and provided varying degrees of wastewater pretreatment.

No matter where the stonewashing industry is located, it remains highly water-intensive. As populations grow in North America, competition for water resources increases, particularly in arid regions of the southwestern United States and northern Mexico. During the debate over NAFTA, several observers argued that the agreement would encourage a movement of industry away from the United States-Mexico border and that accompanying infrastructure development would deconcentrate industry throughout Mexico, relieving pressure on border environmental resources.

This study examines the expansion and contraction of the stonewashing industry and the environmental impact of the industry in El Paso and its relocation sites. The examination revolves around four hypotheses. First, several factors contributed to the stonewashing firms' decisions to relocate, including rule changes under NAFTA, imposition of water reuse requirements in El Paso, international relocation trends in the apparel industry, and the future availability of water in El Paso. Second, the departure of the stonewashing industry from El Paso alleviated pressure on border water resources, particularly the Hueco Bolson aquifer. Third, as the industry relocated, it incorporated water saving processes into construction of new facilities. Finally, water saving processes incorporated into new foreign locations constituted a beneficial environmental impact relative to practices previously

employed at United States locations. (Not all of these hypotheses were confirmed.) Based on the four hypotheses, the study's goals were to:

- *Identify the factors involved in companies' decisions to relocate operations, including specific NAFTA components.*
- *Analyze the net environmental impact of industry out-migration on water resources in El Paso and in the relocated sites, and if relocation alleviated pressure on border environmental resources.*
- *Determine what, if any, changes companies made in water use efficiency and discharge practices as they built facilities in their new locations.*

Research for the study was carried out from May to September 2000. During this period, interviews were conducted with representatives of three garment finishing operations with stonewashing facilities remaining in El Paso. All three also had sewing or stonewashing facilities in Mexico. Additional interviews were conducted with representatives of the municipal water utility in El Paso, city officials, and state and federal environmental agency representatives. El Paso water consumption records from 1990 to 2000 were analyzed for 27 garment finisher water utility accounts. In addition, regional and federal water officials in Mexico were interviewed. Related literature and research findings provided additional information.

The Stonewashing Process

The stonewashing process gives denim garments a "worn in" look. Stonewashed blue jeans, lighter in color and softer in feel than unwashed denim,

became popular with consumers in the 1980s. Consumers demanded greater variety than the original, stiff, indigo-colored jeans. Jeans manufacturers responded with new finishing processes, such as stonewashing and acidwashing, as well as overdying, which produced bold new colors for denim products. Some processes fell victim to the fickle tastes of the fashion market. Stonewashed denim products, however, especially blue jeans, remain a staple of clothing stores around the world.

The apparel industry changes seasonally and annually based on fashion trends. Fashion usually dictates changes in the cut and style of clothes, but in the case of stonewashing, it added a new technological layer to the industry. As the stonewashed fashion trend emerged, the apparel industry already established in El Paso scrambled to develop the technology to produce the sought-after garments, and in the process became an industry leader.

Large industrial washing machines were modified to process the stiff, indigo-laden denim. A mixture of chemicals, pumice stones, and water were added to the machines as the garments went through a series of washes. Municipal water utility officials and the industry were learning as they went along to develop mechanisms to filter out pumice stones and to remove remaining dye and chemicals. Different wastewater pretreatment mechanisms had to be developed each time the industry tried a different type of process to create the stonewashed look dictated by current fashion.

Undyed denim is nearly white in color. For production of blue jeans it is dyed with an indigo-based dye, coloring the fabric dark blue. The faded and "worn in" look of stonewashed denim is produced by the abrasion of pumice stones against the fabric during the stonewashing process. The abrasion of the stones removes the surface

bound indigo dye, revealing the much lighter interior of the fabric. The random movement of stones during washing ensures that the indigo dye is not completely removed, providing the slightly faded look of stonewashed jeans. The abrasion of the fabric during stonewashing also reduces the life of the garment, which contributes to maintaining consumer demand for the denim products.

The pumice stones used in the process originally came from Mexico or the southwestern United States. They varied in size over time, but typically have been no larger than half a fist. Along with the product, the stones are worn down by the process. The abrasion of the stones creates a sediment that passes along with the used wash water after completion of the process. Pumice stones used in stonewashing have a finite lifetime that varies according to product being washed.

Finishing processes vary. Some garment finishers use cellulase enzymes in the stonewashing process. The enzymes facilitate the abrasion of the fabric during stonewashing, reducing the amount of pumice stones required. Additionally, some finishers use pellets or perlite to produce the stonewashed look. Perlite is made from sand. Acidwashing was a popular process in which pumice stones were impregnated with a bleaching agent, often potassium permanganate, before stonewashing to give garments a distressed look. Each process required a different mix of chemical inputs and different ways to treat the wastewater. Recently, denim finishers have begun to produce sandblasted jeans. Sandblasting is a dry process that is performed before stonewashing and produces a uniform fade in targeted areas.

Stonewashing is a water-intensive process. It is achieved through a series of washings, with each requiring fresh water. Most garment finishers in El Paso used

drinking-quality water from the city's municipal water supply in the stonewashing process. In relation to overall water demand in El Paso, the quantity of water consumed by garment finishers was significant. Among thousands of municipal and industrial water customers, just 25 garment finishers accounted for five percent of El Paso's average daily water demand in 1993.[1] In an arid region with a growing population and dwindling water supply, El Paso's garment finishing industry was consuming a significant portion of municipal drinking water to produce stonewashed blue jeans.

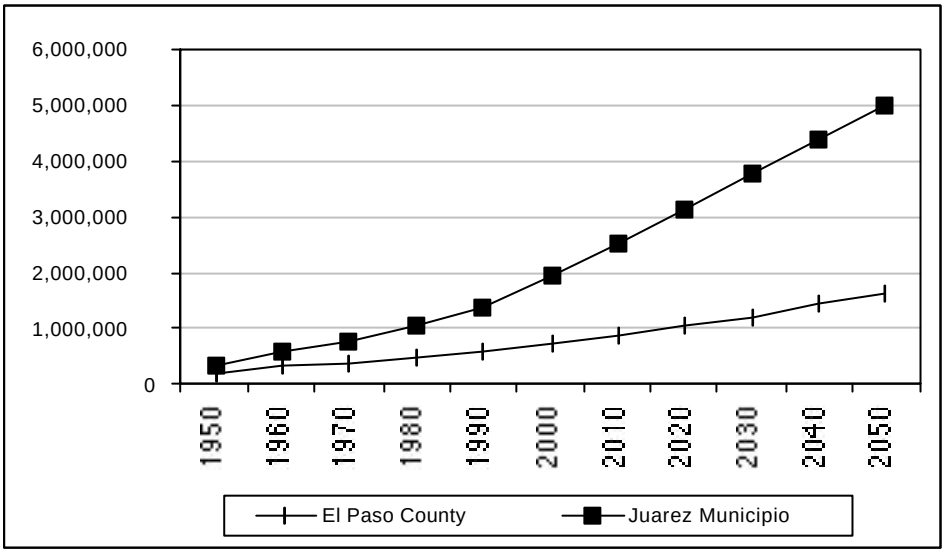
El Paso

El Paso is located in the far western tip of Texas, at the crossroads of the international border with Mexico and the state borders of New Mexico and Texas. It is a city with a heritage born of two countries. El Paso lies just across the Rio Grande river valley from Ciudad Juárez, its Mexican sister city. Geographically separated only by the river's seasonally-shifting flows, the economic and social links between the cities are conduits for international relationships across a much broader region. This bustling cross-border metropolis, in fact, forms the world's largest international border community.

The main population centers in the region, El Paso and Ciudad Juárez, are growing rapidly. El Paso County's population was estimated to be 732,000 in 2000, a 24 percent increase since 1990 (Hamlyn 1997). Estimates put the population of Juárez Municipio at 1,204,000 in 2000, an increase of nearly 44 percent since 1990 (Hamlyn

1997). The combined population of the two cities is projected to reach over 5 million in 2050 (Figure 1).

Figure 1
El Paso County and Juárez Municipio
Population Projection, 1950-2050



Source: (Hamlyn 1997)

El Paso sits at the foot of the Franklin Mountains. Across the river valley are Ciudad Juárez and the Cerro Cristo del Rey mountains. The pass between these two mountain ranges, through which the Rio Grande flows, gives the city its name. The Rio Grande, fed by snowmelt from the southern Rockies, approaches El Paso from the northwest and flows southeasterly to the Gulf of Mexico.

The region is in the northern portion of the Chihuahuan Desert. Vegetation is generally "desert scrub, including creosote bush and tarbush, pinyon-oak-juniper woodlands, and desert grasslands" (El-Hage and Moulton 1998: 1). Average annual rainfall is less than 9 inches, while the average annual evaporation rate exceeds 150

inches per year (El-Hage and Moulton 1998:4). Most of the precipitation falls during brief but occasionally intense summer thunderstorms. During the summertime, daytime temperature hovers in the 90-100° F range, but temperatures exceeding this range are not uncommon. Winters are mild. January and February are the coolest months with average temperatures in the mid-40°s F.

Water Resources

Although El Paso sits on the banks of the Rio Grande, historically most of its municipal and industrial water supply has come from underground aquifers. Since early in the 20th century, river water from the Rio Grande has been diverted primarily for agriculture. These two resources, groundwater and surface water, are precious commodities in a region of scant rainfall (Schmandt, Stolp, Ward, and Rhodes 1999).

El Paso's groundwater is supplied by two underground aquifers, the Hueco Bolson and Mesilla Bolson. El Paso Water Utility (EPWU) operates numerous wells in both, which pump groundwater to quench the thirst of a rapidly growing city. Consequently, freshwater from these aquifers is being withdrawn faster than it can be replenished. Depletion of freshwater reserves is projected to occur before 2050:

> The probable 'life' of the aquifers in the region vary, but most forecasts anticipate that the freshwater within the Hueco Bolson, principal aquifer serving the cities of El Paso and Juárez, will be depleted during the first half of the next [current] century.
>
> (Hamlyn 1997: 6)

On the eastern side of the Franklin Mountains, the Hueco Bolson is beneath most of El Paso and extends south and southeasterly into Mexico and along the Rio Grande. The Mesilla Bolson is on the western side of the Franklin Mountains and

generally is beneath Mexico and the state of New Mexico, although a portion of the aquifer falls within the Texas border.

In 1999, El Paso pumped over 51,000 acre-feet* of water from the Hueco Bolson, accounting for 39% of the city's water supply.[2] Wells in the Mesilla Bolson provided over 22,000 acre-feet, 17% of the city water supply.[3] Groundwater supplies are further taxed by Ciudad Juárez, which draws 100% of its municipal and industrial water supply from the Hueco Bolson. Unfortunately, annual recharge lags far behind the rate of withdrawal. The Hueco Bolson has been estimated to recharge at a rate of 6,000 acre-feet per year and the Mesilla Bolson at a rate of 18,000 acre-feet per year (Preston, Coker, and Mathews 1998).

One estimate predicts exhaustion of freshwater in the Hueco Bolson by 2025 (EPWU 1999).[4] Facing such projections, El Paso has looked to the surface water of the Rio Grande as well as water conservation and reuse measures to help meet its water demand.

In 1999, El Paso withdrew over 57,000 acre-feet of water from the Rio Grande, accounting for approximately 44% of its water supply.[5] The amount of water flow in the Rio Grande fluctuates according to the season. River water is impeded upstream from El Paso at Elephant Butte and Caballo Reservoirs in New Mexico, where its release is determined by the irrigation season. Surface water quality is better in El Paso during the growing season when river flow is higher (IBWC 1998; Schmandt, Stolp, Ward, and Rhodes 1999). During the winter months, the Rio Grande at El Paso is primarily irrigation return flow. Increased salinity levels in the river water from

* An acre-foot denotes the volume necessary to cover an acre one foot deep.

bank return flow exceed Texas' maximum permissible levels for potable water production.[6] Consequently, surface water treatment plants in El Paso operate only during the seven or eight months per year when the river water is of sufficient quality for treatment. Water quality in the Rio Grande is too poor for treatment during the remainder of the year.[7]

Economy

Business and social linkages tie together the economies of El Paso and Ciudad Juárez. El Paso is the second busiest international port of entry for truck crossings from Mexico (Texas Perspectives 1999: 4). Citizens often cross the border daily, commuting to work in El Paso from their homes in Ciudad Juárez.

Twin-plant "maquiladora" production has characterized the El Paso/Ciudad Juárez economy in recent decades and is symbolic of the region's economic integration.[†] Juárez is home to one-third of the maquiladoras along the United States-Mexico border. The approximately 330 maquiladoras in Ciudad Juárez employ nearly 200,000 people (Fullerton 1998). Many maquiladora executives and upper management live in El Paso and commute to Ciudad Juárez. Maquiladora facilities attracted companion operations to El Paso, such as warehousing and distribution centers. It is estimated that maquiladora production created over 25,000 jobs in support industries, such as retail sales, banking, and transportation in El Paso (Fullerton 1998).

[†] The 1965 Border Industrialization Program encouraged U.S. companies to build assembly plants in northern Mexico. Under the program hazardous waste produced during the process was required to be returned to its country of origin.

Unemployment rates in El Paso have been higher than in Texas as a whole, and than the rest of the nation since 1993. There is some evidence that El Paso is shifting toward a more service-based economy, however. The services sector was El Paso's largest employment sector in 1998, followed by wholesale and retail trade, government, and manufacturing.[8] The services sector added 12,000 jobs from 1994 to 1999, a 25% increase. Wholesale and retail trade and government sectors grew less than 10 percent during the time period, while employment in the manufacturing sector declined 11 percent. (Fullerton 1998)

Wages in El Paso are lower than in the rest of Texas. According to one study, "El Paso's average wage is 73 percent that of Texas and has fallen by 3 percentage points since 1990" (Texas Perspectives 1999: 8). In 1997, per capita income was $15,216 for El Paso and $23,707 for the State of Texas (Texas Perspectives 1999: 8). Per capita income in the United States was $19,541 in 1997 (U.S. Census Bureau 1999: xii).

As the apparel and stonewashing industries left El Paso, the city looked to attract other businesses. Efforts were made to lure industries that were not heavy water users. Corporate call centers, in particular, are one of the clean, yet labor intensive, industries that have moved to El Paso. Seeking a bilingual work force, it would appear that the call centers were able to employ many of the workers displaced by the garment industry. However, according to Roberto Franco, El Paso's Director of Economic Development, many of the new jobs coming into El Paso required a generally high set of skills.[9]

Factors Contributing to Relocation

Several factors may have contributed to El Paso garment finishers' decisions to relocate their facilities. Globalization has deeply affected the entire apparel industry, resulting in a significant trend toward international relocation among all facets of the industry. Additionally, rule changes under NAFTA altered previous tariff restrictions on reimportation of finished garments from Mexico, allowing finishing work to be performed in Mexico. Changes in El Paso's water and wastewater regulations also may have played a role in the stonewashing industry's relocation. It is also possible that shifts in market demand affected finishers' relocation decisions. This section of the study reviews these factors.

Globalization and the Apparel Industry

Globalization has deeply affected the apparel industry. Technological advancements in communication and transportation have brought areas of the world closer together, allowing multinational firms to operate production facilities all over the world. Trade liberalization as well as relaxation of foreign investment restrictions also have facilitated international production. Low barriers to entry in the apparel industry, its heavy reliance on unskilled labor, and the frequency of arms-length contract relationships have put it in the forefront of globalized industries. The apparel industry stands out as, "one of the most globalized industries in the world today" (Bonacich, Cheng, Chinchilla, Hamilton, and Ong 1994: 13).

Competitive pressures in the apparel industry have increased.[10] The growth of discount retail and mass-market stores with low overhead and low prices have increased price competition among apparel manufacturers. As retailers have moved

from making large seasonal orders to nearly continuous restocking, manufacturers have had to be prepared to quickly meet unexpected inventory demands. Additionally, the increase in the number of new style lines introduced as well as the number of lines retired indicates an increase in new fashion products with shorter life-spans, forcing manufacturers to implement production systems able to respond quickly to product changes.

Increased competitive pressures in the apparel industry have placed a high priority on reducing production costs. In the labor-intensive apparel industry, reduction of labor costs can produce significant savings. According to Mark Mittelhauser, an economist in the U.S. Bureau of Labor Statistics, the apparel industry has sought out international locations with economic conditions conducive to such cost savings:

> The search for lower production costs has led to rapidly growing textile and apparel production in less developed countries such as China, Mexico, and Indonesia. According to the U.S. International Trade Commission, roughly half of the total productive capacity in the apparel industry has shifted from developed countries to less developed countries over the past three decades. . . The primary advantage these nations have over the United States is the lower costs of labor.
>
> (Mittelhauser 1996: 18)

El Paso garment finishers acknowledged the trend toward production in developing nations. One finisher asserted that "the whole world is opening up" and saw the stonewashing industry's departure from El Paso as "inevitable."[11]

Connection to NAFTA

El Paso's garment finishing industry was part of a coproduction relationship between the United States and Mexico. Coproduction is, "a system whereby part of

the manufacturing process is performed in the United States and part in another country" (Voldez 1988: 393). Mexico's coproduction relationship with the United States dates back to 1965 when the Government of Mexico instituted its Border Industrialization Plan (Baerresen 1971). The plan aimed to foster economic development in Mexico, largely by attracting foreign investment in manufacturing facilities. It allowed 100 percent foreign ownership of coproduction facilities in Mexico and duty-free importation of materials and equipment necessary for establishing operations with the requirement that the finished products could not be sold in Mexico. These facilities, called maquiladoras or maquilas, essentially function as assembly plants for products ranging from electronics and automobiles to toys and apparel.

Capital investment and job growth increased in northern Mexico as U.S. companies built maquiladoras. According to March 2000 figures from an industry journal, 3521 maquiladoras in northern Mexico employed 1,242,779 workers (Twin Plant News, 2000: 54-55). The maquiladoras have contributed new physical infrastructure, such as roads, housing, and industrial parks, income for workers, and a multiplier effect throughout the border economy (Herzog 1999: 5). This growth, however, has not been without environmental repercussions (Herzog, 1999: 6-7).

For labor-intensive industries, such as the apparel industry, coproduction in Mexico was particularly enticing. Mexico's minimum wage rates were competitive with wages in many Asian nations, making it attractive to United States apparel industry firms under pressure from global competition. Apparel producers could reduce labor costs by utilizing maquiladora production facilities in Mexico. An

additional advantage of production in Mexico relative to Asia or other parts of Latin America was its greater proximity to facilities in the United States, reducing turn-around time and transportation costs.

Preferential tariff treatment under United States customs laws provided additional incentives for coproduction in Mexico. Under Item 807 of the Tariff Schedules of the United States (TSUS), goods assembled in Mexico from source materials made in the United States were subject to duties only on the portion of the product's value added during assembly abroad. The duty was assessed upon "the full value of the imported article, less the cost or value of such products of the United States" (U.S.C. §1202). Thus, import duties were assessed only upon the amount of value added to the product during manufacturing operations performed in Mexico.

For apparel manufacturers engaged in coproduction, this meant that fabrics had to be entirely formed and cut in the United States before they were shipped to Mexico for assembly. In the case of blue jeans, cotton from the United States was woven into denim, dyed, and cut into components for assembly before shipping to Mexico. The cut components were then exported to Mexico, where they were allowed temporary duty-free entry. In Mexican maquiladoras, the cut denim was assembled into jeans. After assembly, the jeans were ready for reimportation to the United States.

Prior to 1987, the assembled jeans were reimported to the United States under TSUS Item 807. However, with the United States' adoption of the Harmonized Tariff Schedule (HTS) in 1987, TSUS Item Number 807 became HTS Heading 9802.00.80 (U.S. Customs Service 1997).[12] Qualifications for preferential tariff treatment

remained the same under the new heading. Articles qualifying for 807, and subsequently 9802, treatment were defined as:

> Articles assembled abroad in whole or in part of fabricated components, the product of the United States, which (a) were exported in condition ready for assembly without further fabrication, (b) have not lost their physical identity in such articles by change in form, shape or otherwise, and (c) have not been improved in condition abroad except by being assembled and except by operations incidental to the assembly process such as cleaning, lubricating and painting.
>
> (U.S.C. §1202; HTSUS 9802.00.80)

Articles qualifying for preferential tariff treatment under the 807 or 9802 program were subject to an import quota.[13] In addition, articles that had undergone finishing processes in Mexico were not eligible for preferential tariff treatment under 807 or 9802. As a consequence, after assembly in Mexico, jeans were reimported to the United States for stonewashing before being shipped for sale. Many garment finishers in El Paso performed stonewashing work on jeans reimported under the 807 or 9802 program.

The passage of the North American Free Trade Agreement (NAFTA) in 1994 altered the rules that had governed the coproduction of stonewashed goods. It did away with the previous provisions, under 807 and 9802, which had required finishing processes, such as stonewashing, to be performed in the United States in order for goods to receive preferential tariff treatment. NAFTA also eliminated duties and quotas on reimported goods that had undergone assembly, as well as stonewashing and other finishing processes in Mexico (U.S. Customs Service 1997: 31).

NAFTA's Rule Change

B. Trade between Mexico and the United States

10. In addition, on January 1, 1994, the United States shall eliminate restrictions or consultation levels on textile and apparel goods that are assembled in Mexico from fabrics wholly formed and cut in the United States and exported from and reimported into the United States under:

(a) U.S. tariff item 9802.00.80.10; or

(b) Chapter 61, 62 or 63 if, after such assembly, those goods that would have qualified for treatment under 9802.00.80.10 have been subject to bleaching, garment dyeing, stonewashing, acidwashing or permapressing.[‡]

Thereafter, notwithstanding Section 5, the United States shall not adopt or maintain prohibitions, restrictions or consultation levels on textile and apparel goods of Mexico that satisfy the requirements of subparagraph (a) or (b) or the requirements of any successor provision to U.S. tariff item 9802.00.80.10.

Source: NAFTA, Annex 300-B, Appendix 3.1, B, 10.

The removal of restrictions requiring finishing work to be performed in the United States in order to receive preferential tariff treatment opened up Mexico as a viable location for stonewashing operations. For the United States apparel industry, the elimination of duties and removal of import quotas highlighted Mexico as an advantageous site to locate operations. With the passage of NAFTA, producers of stonewashed garments were free to carry out or contract for stonewashing work in Mexico without being subject to import duties upon reimportation. In this manner, rule changes under NAFTA may have shifted a competitive advantage in the apparel industry between the United States and Mexico, affecting relocation decisions by El Paso stonewashing firms.

Local Regulatory Change

[‡] Chapters 61, 62, and 63 in refer to USTS chapters encompassing articles of apparel and

In recognition of the region's need to develop more sustainable water use, El Paso passed a water conservation ordinance in 1991 for large and very large water users. The thrust of the ordinance was to encourage water conservation through reduction, reuse, and recycling. Large water users were considered, "any person who uses an average of ten thousand gallons per day or more from the water supply system" (El Paso Municipal Code 15.13.050-A). Those using an average of 100,000 gallons per day (GPD) or more were considered very large water users. Most garment finishers in El Paso fell into these categories. From a sample of 24 garment finishers operating in El Paso in 1991, eight met the conditions for large water users, 14 met the conditions for very large water users, and two used an average of less than 10,000 GPD.[14]

The ordinance required all new very large water users and existing very large water users seeking new service or expansion of service to submit a water conservation plan before connection or expansion of service. Existing very large water users not seeking expansion of service were effectively "grandfathered" from this requirement. The plan had to demonstrate that "reasonable diligence" would be used to avoid waste and achieve water conservation. Additionally, the plan had to include a report relating water consumption to recycling potential, including, "techniques and technologies that will reduce the consumption of water, reduce the loss or waste of water, improve the efficiency in the use of water, or increase the recycling and reuse of water" (El Paso Municipal Code 15.13.050-B). Based upon the

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clothing accessories, as well as other made up textile articles.

plan, El Paso's Public Service Board (PSB) would approve, deny, or take other action on the application for connection or expansion of service.

Large water users were required to submit a water conservation plan regardless of whether or not they were applying for new service or expansion of service. Large water users consuming an average of more than 25,000 GPD were required to submit a water conservation plan within six months of April 1, 1991. Large water users consuming an average of more than 10,000 and less than 25,000 GPD were required to submit a water conservation plan within a year of April 1, 1991. All approved water conservation plans were to be revised every five years. After approval, water users had five years to implement water conservation plans.

Most garment finishers submitted plans by the deadline and completed implementation by 1997. According to EPWU's Environmental Compliance Manager, John Balliew, it is unlikely that El Paso garment finishers would have implemented water conservation practices without passage of the 1991 ordinance.[15] At the time, conservation equipment was unavailable for direct purchase by the industry. Garment finishers were forced to pay for development of their own water conservation systems.

Water prices for very large water users in El Paso changed during the 1990s. In 1995, the PSB instituted a block-rate pricing structure for very large water users.[16] Water prices were assessed according to the user's water consumption during each month. Depending upon consumption, the user fell into the first through fourth block. Water rates increased with each block.

El Paso Block Rate Pricing Structure

Block	Consumption	Price per ccf[§]
Block 1	0 ccf to 5,000 ccf	$0.86
Block 2	5,001 ccf to 15,000 ccf	$1.06
Block 3	15,001 ccf to 30,000 ccf	$1.21
Block 4	Over 30,000 ccf	$1.98

Source: Public Service Board of the City of El Paso, Rules and Regulations No. 5, Section 1(G), 8 December 1999.

The block rate pricing structure increased water costs overall for garment finishers in El Paso and discouraged high water usage by increasing the per unit cost along with consumption. One El Paso garment finisher cited the move to block water rates as a factor in the firm's decision to relocate.[17]

Market Forces

Since blue jeans became popular in mass markets during the 1950s, the market for denim has followed a pattern of extreme peaks and troughs for most of its history (Rozelle, Isaacs, Elliot, McMurry, and Barker 1995). These cyclical gyrations abated somewhat in the 1990s as product innovations made denim a staple of the fashion world. The early part of the 1990s witnessed a boom in denim sales before experiencing a slowdown in late 1993 (Ozzard 1993; Clune 1994). Muted sales continued until 1995 and 1996 when the market again showed consecutive annual growth.[18] Increasing price competition among major labels characterized 1997 (Ozzard 1997). Through 1999, denim sales appeared flat (Malone 1999).

[§] ccf denotes 100 cubic feet, 1 ccf = 748.052 Gallons (U.S.)

Among garment finishers in El Paso, feelings were mixed on the impact of downturns in the denim market. One finisher reported that the denim market had taken a 20 to 25 percent hit from increased consumer interest in non-denim pants, such as khaki twills.[19] Another finisher, however, downplayed the impact of the denim market on his business, estimating that his company's sales were up 40 percent in 2000 and 1,000 percent since 1990.[20]

Environmental Implications

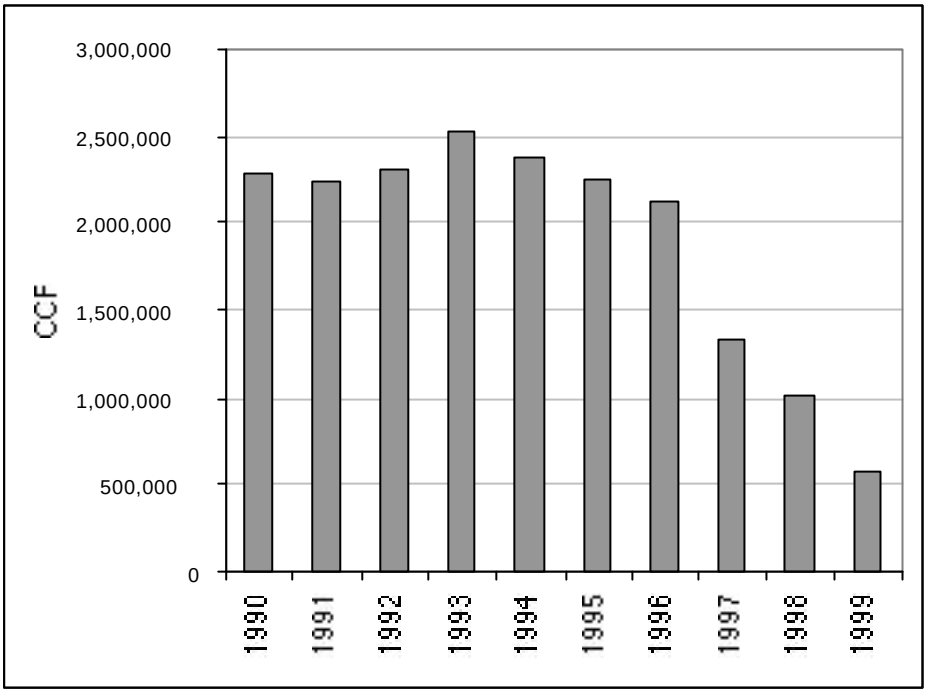
Water use by the stonewashing industry in El Paso declined from 1990 to 2000. This section of the study reviews evidence from water consumption data of the industry's decline in water use and reports interview findings on the industry's track record in meeting water quality discharge requirements.

Quantity

The water usage analysis was based on water consumption records for 27 garment finishing accounts from 1990 to 2000.[21] Not all accounts maintained water service during the entire period. Some accounts opened after the beginning of the period, while others closed before its end. The 27 finishing accounts analyzed are representative of El Paso's stonewashing industry from 1990 to 2000.

Total annual water usage peaked in 1993 at over 2.5 million hundred-cubic feet (ccf), representing an average of approximately 5.2 million gallons per day (GPD) that year. From 1993 through 1999, total annual water consumption declined 77 percent, including a 38 percent drop from 1996 to 1997 and a 42 percent drop from 1998 to 1999. Figure 2 shows the change in total annual water consumption during the period.

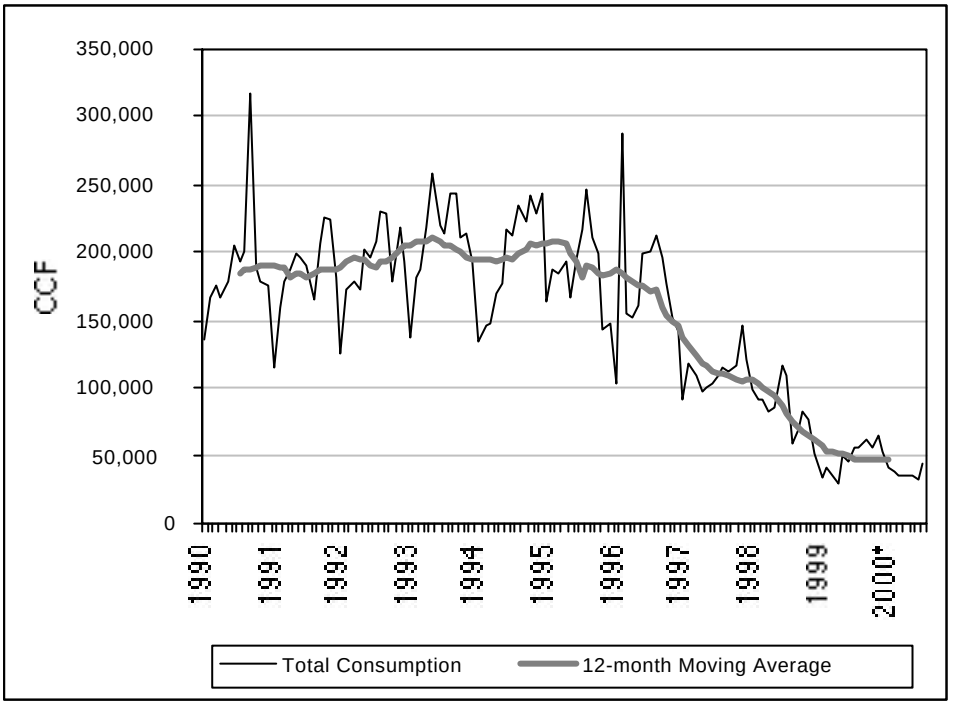
Figure 2
Total Annual Garment Finisher Water Consumption, 1990-1999



Source: EPWU.

Accordingly, monthly consumption figures show a marked decrease during the time period. Figure 3 shows total water consumption by month. The monthly consumption totals vary more widely than the annual totals. A 12-month moving average is used to show the trend over time.

Figure 3
Total Garment Finisher Consumption by Month, 1990-2000

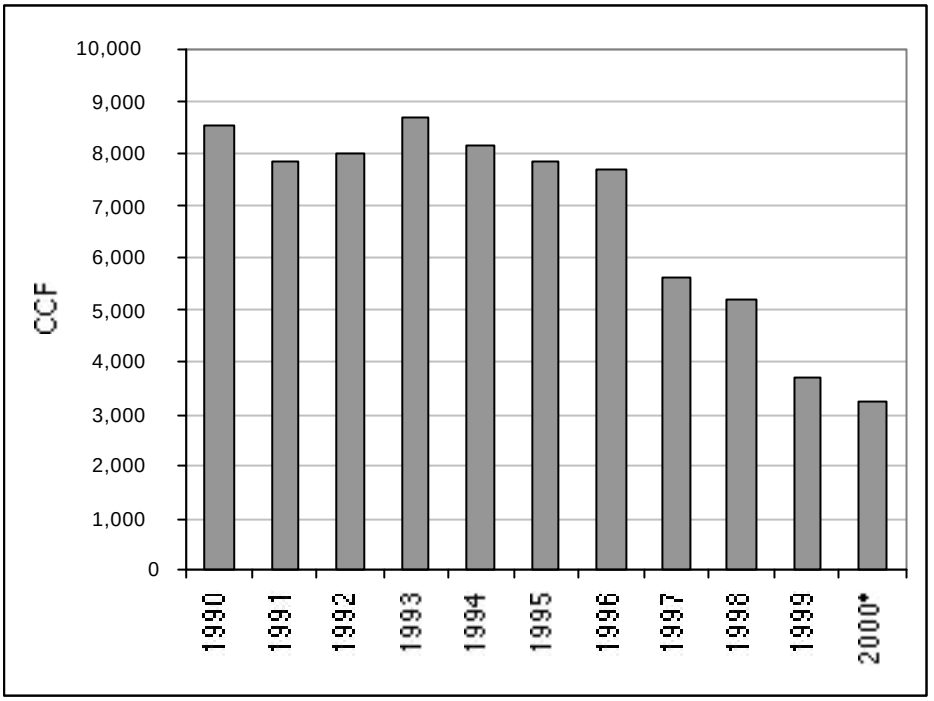


Source: EPWU. *Jan.-July

The decline in water consumption is not solely attributable to the decrease in the number of firms using water as they moved away. Water consumption per account also decreased during the study period. Figure 4 shows the annual decrease in average monthly consumption among active water accounts.[**] After its peak in 1993, average monthly use began to decrease annually through 2000, including a 27 percent drop from 1996 to 1997 and a 29 percent drop from 1998 to 1999. Between 1993 and 2000, average monthly use decreased 62 percent.

[**] Some firms maintained accounts, but were not consistently drawing water.

Figure 4
Average Monthly Garment Finisher Water Consumption by Year, 1990-2000



Source: EPWU. *Jan.-July

In 1993, the stonewashing accounts analyzed were drawing approximately 5.3 million GPD, accounting for approximately five percent of average daily water demand for all of El Paso.[22] By 1999, this had declined to about 1.2 million GPD, accounting for approximately one percent of average daily water demand.[23] Both the outmigration of stonewashing firms and a reduction in water consumption by remaining firms were responsible for the decrease. Peaks in both total consumption and average consumption occurred in 1993. Significant drops in total and average consumption occurred in 1997 and 1999.

Quality

Industrial wastewater users in El Paso are required to comply with PSB wastewater discharge standards, federal pretreatment regulations, and applicable state laws when releasing wastewater into El Paso's wastewater system (40 CFR 403). Industrial users, defined as "any person who contributes, causes or permits the contribution of industrial wastewater into El Paso's wastewater system, except from a vehicle," include stonewashing operations in El Paso (PSB 1999). Significant industrial users must obtain a discharge permit from the PSB before releasing wastewater into the system. Assuming a ten percent loss in the finishing process, 19 of the 27 finishing accounts would have qualified as Significant Industrial Users in 1993.[24]

To meet wastewater discharge requirements, finishers pass wastewater through onsite pretreatment systems before releasing it into El Paso's wastewater system. Construction, operation, and maintenance of pretreatment systems are the responsibility of the industrial user. According to Cindy Edgar, EPWU Pretreatment Engineer, the primary discharge violations among stonewashing operations were:[25]

- colored discharge (dye or coloring agent remaining in wastewater);
- discharge of stones or pumice material;
- unacceptable pH levels; and
- discharge of solids in quality or volume not representative of normal discharge.

Color discharge was evaluated according to the American Dye Manufacturer's Index (ADMI). Wastewater color concentrations in excess of 300 ADMI units were in violation of discharge requirements. Stones in wastewater discharge were prohibited

as solids or viscous substances that may obstruct flow. Wastewater having a pH below 5.5 or above 10.5 was prohibited.

As the stonewashing industry developed new finishing processes in response to fashion trends, so did its need to develop industrial pretreatment. Initially, this translated into devising filter systems for removing pumice, lint, dyes, and chemicals from the wastewater. Without existing equipment, the industry relied on trial and error to develop pretreatment systems. Each new finishing process brought new challenges. Pumice stones, for example, sank to the bottom of wastewater settling tanks. Therefore, filters to trap and remove the pumice were placed at the bottom of tanks. When the industry began to experiment with perlite, however, they found that it floated. Firms then had to install filters at the top of wastewater settling tanks in addition to the bottom filters. John Balliew recounted opening up city manhole covers in El Paso to find a layer of perlite floating atop the wastewater.

When fashion trends introduced overdyed jeans, garment finishers again encountered new challenges. The indigo dye molecules used to achieve the traditional denim fabric color are relatively large. Color filters in denim finishing plants had been built accordingly. The dyes used to produce overdyed jeans in colors such as red, brown, and green, contained a much smaller molecule which passed through the color filters. Balliew said that EPWU received calls from El Paso residents concerned over quantities of red water being discharged into the waterways and that utility workers sometimes found colored water pouring into municipal wastewater treatment facilities.

The cost of industrial wastewater pretreatment by the stonewashing industry was ongoing in El Paso. It varied depending on the type of finishing processes and the

company's ability to install state of the art pretreatment systems. As new finishing techniques were developed and new trends emerged, the industry quickly had to develop pretreatment processes to handle new chemicals, dyes, and other inputs.

Pretreatment systems varied among finishers.[26] Larger finishers spent upwards of $750,000 to install sophisticated pretreatment systems. Smaller finishers often could not afford more elaborate pretreatment systems, which meant that they were not able to perform processes such as overdying.

According to Cindy Edgar, the stonewashing industry was unprepared to meet wastewater discharge requirements in the initial stages of growth. El Paso's remoteness from other concentration points of the apparel industry in the United States contributed to stonewashing firms' difficulties in obtaining access to up-to-date research and development for pretreatment. As the industry grew, however, environmental compliance increased.

As the stonewashing industry matured, more sophisticated equipment emerged. Initially, washing machine operators had simply "eyeballed" water, pumice, and chemical inputs into the stonewashing process. Such variance in the stonewashing formula led to a less than uniform product. As stonewashing became a staple of the denim industry, however, more sophisticated equipment was developed and formulations were standardized. Newer automated equipment used less water, created a more uniform product, lowered production costs, and reduced chemical use.

Industry Insight

To gain insight into the industry perspective on the relocation of El Paso's garment stonewashing industry, interviews were conducted with executives from three garment finishers remaining in El Paso.[27] The facilities of the interviewees in El Paso ranged from full-service finishing operations to minimally staffed plants marked for closure. All of the businesses interviewed also operated facilities in Mexico. The authors sought to conduct more industry interviews both in El Paso and in Mexico, but were unable to attain access to other industry representatives willing to be interviewed.

All of the finishing operations interviewed had maintained facilities in El Paso at least since 1985. Two of the finishers had operated laundry facilities in El Paso prior to 1980. The duration of their facilities in Mexico varied. One finisher reported establishing sewing operations in Ciudad Juárez, Mexico in 1980. Another had operated a finishing facility in Mexico since 1995, and a sewing operation prior to 1994. The other firm established finishing operations in Mexico in 1999.

Although all interviewed firms performed stonewashing work, business operations ran the gamut. One firm produced private label denim products entirely through in-house operations. The firm maintained its own design staff, as well as cutting, sewing, and finishing operations. Another firm performed finishing work through contracts with large retailers like Levi Strauss & Co, Tommy Hilfiger, and Guess?. Its facilities were able to perform a number of finishing processes in addition to stonewashing.

Overall, the industry executives downplayed the importance of water and wastewater issues and the cost of environmental compliance in relation to overall business costs as major considerations in their decision to relocate. When asked what

factors may have led El Paso stonewashing firms to relocate, a common theme among the finishers' responses was reducing labor costs. Finishers compared the cost of doing business in El Paso to business costs in Mexico in their responses. They perceived operation costs excluding labor as not much costlier in El Paso. Rent and utilities costs were considered higher in Mexico than in El Paso. Opinions on the price of water for business in Mexico differed. Some felt water was more expensive in Mexico, while others felt it was cheaper. However, two finishers pointed to additional costs for construction of water treatment systems necessary for performing finishing work. Finishers felt that although operation costs excluding labor were somewhat lower in Mexico than in El Paso, the primary reason stonewashing firms relocated to Mexico was to benefit from reduced labor costs.

All three finishers felt that NAFTA's rule changes to accept finishing processes performed in Mexico played a role in stonewashing firms' decisions to relocate operations. However, they believed that without passage of NAFTA, El Paso's stonewashing industry would have relocated anyway. According to one finisher, NAFTA helped keep the industry close to the United States: "They would have gone anyway. Why give it away to the rest of the world?"[28] Another finisher felt that the industry's relocation would have been less severe without NAFTA. The other felt that NAFTA had helped speed the relocation process along. In his opinion, the industry would have moved anywhere with a stable government and cheap labor. In addition, he felt lower transportation costs were an advantage for Mexico because of its proximity to the United States.

When asked how NAFTA's rule changes had affected business, one finisher replied, "we've been very fortunate."[29] He cited his firm as one of three or four major garment finishers in the country, and the only major garment finisher remaining in El Paso. "I've always believed there would be a market for totally made in the U.S.A [products]," he remarked.[30] Another finisher reported that NAFTA initially had affected his firm's business negatively. They laid off 400 people from their El Paso operations and began to set up operations in Mexico. According to the finisher, the costs they incurred from letting people go and starting new operations were made doubly hard by increased price competition in the aftermath of NAFTA. In the long run, however, he felt they were doing very well with NAFTA and that it had worked for them in a positive way. Since passage of NAFTA, he had been able to increase his finishing business in El Paso by buying up other finishing operations that had gone out of business.

Finishers' reactions to El Paso's water situation differed. Seeing the potential for future water shortages, one finisher had moved operations outside of the city's limits and drilled wells pumping brackish water to secure a water supply for his company. After treatment, the company reused its wastewater for irrigated agriculture. Another El Paso finisher, however, had made no technical modifications to improve water usage efficiency. In regards to the role of El Paso's water supply in his business decisions, he responded, "we're getting what we need."[31]

One finishing operation that did not grant an interview, was in the process of relocating to an industrial park built by the PSB that partially relied on treated wastewater for its water supply. Relocation to the park enabled businesses to forgo

additional water reuse requirements. The PSB provided water to the industrial park at half the price of that supplied to other industrial users.

The water and wastewater infrastructure in Mexico was generally judged inferior for relocated stonewashing facilities. In regard to the municipal infrastructure at the site of one of his firm's finishing operations, one executive remarked, "the infrastructure there is absolutely atrocious."[32] In his experience, the municipal infrastructure had not been capable of supporting large size stonewashing operations. The company had to pay for water infrastructure improvements to ensure a consistent water supply to its facility. The municipal wastewater system consisted of one main underground collector from which untreated wastewater was pumped for irrigation. When asked about his firm's development of industrial wastewater pretreatment in its Mexican facilities, the same executive indicated that in his view Mexico had not yet developed rigorous pretreatment enforcement procedures. His firm, he implied, was waiting to install wastewater pretreatment systems until compliance was required by Mexico. Another finisher developed a wastewater reuse system similar to that in their El Paso facility in which wastewater was treated and then used for irrigation on the company's land. The company engaged in agricultural production on its irrigated land to recoup expenses. Implementation of this system required purchasing a large amount of land.

Relocation to Mexico

Information gathered through industry interviews indicated that a number of stonewashing operations relocated to the tri-city region of Torreón, Gómez Palacios,

and Ciudad Lerdo, located in Northwestern Mexico, 850 kilometers south of El Paso. The number of jeans manufacturers in the three cities, collectively referred to as La Laguna, increased dramatically in the 1990s.[33] One study found the number of jeans manufacturers in La Laguna grew from two in 1993 to ten in 1998 (Gereffi and Martinez 1998). The number of pairs of jeans produced in La Laguna increased from 500,000 in 1993 to 4.5 million per week in 1998 (Gereffi and Martinez 1998).

Preliminary census data for 2000 indicate a population of 529,093 for Torreón, 272,806 for Gómez Palacios, and 112,272 for Lerdo (INEGI 2000).[34] Together, the population of the three cities is approximately half the combined population of El Paso and Ciudad Juárez. Jobs in the apparel and textile industry as a percentage of total employment grew from five to fourteen percent between 1993 and 1998 (Gereffi and Martinez 1998). In absolute terms, employment in the apparel and textile industry increased from 12,000 in 1993 to 70,000 in 1998, supplanting the automobile industry as the largest manufacturing sector in the region (Gereffi and Martinez 1998).

The region's landscape of multi-stemmed cacti, yucca and shrubs is characteristic of the Mexican Chihuahuan Desert (WWF 1999: 341). Torreón and Gómez Palacios are separated by the Río Nazas, a dry river that flows only during periods of heavy rain or other overflow conditions. The Río Nazas originates 280 kilometers upstream from Torreón and Gómez Palacios. Two reservoirs, Lázaro Cárdenas - also known as "El Palmito" - and Francisco Zarco - also known as Las Tórtolas - regulate flow of the river above the sister cities. River water is used exclusively for agricultural irrigation.

The region's groundwater comes from the Comarca Lagunera. According to Ing. Martín G. Rodríguez Lara, regional manager of Mexico's National Water Commission (CNA), extraction exceeds recharge of the aquifer and within the next 20 years, water needs are expected to double.[35] Water from the aquifer for three cities is pumped at a rate of approximately 77 million GPD from 106 wells. The majority of this water, approximately 84 percent, is used for agriculture and ranching. Of the remaining 16 percent, 10 percent is for municipal potable water, four percent for domestic watering, and two percent for industrial use.[36]

As firms relocated to the region, they brought water reuse technology developed in their previous United States locations to Mexico.[37] This constituted a technology transfer as firms relocated to the region. Gereffi and Martinez assert that the transfer has been "spurred by increasing environmental preservation efforts by the Mexican government" (1998).

Torreón has 15 privately owned wastewater facilities located throughout the municipio. According to Rodríguez, these facilities work under an agreement with the public utility to treat municipal wastewater at a rate of 2.7 million GPD and reuse the water to irrigate green spaces. The city of Torreón has begun construction of a municipal wastewater treatment plant consisting of a lagoon system to handle municipal and industrial discharge. The plant's approximately 43 million GPD treatment capacity is anticipated to serve municipal growth through the year 2020. Gómez Palacios and Lerdo also have initiated construction of municipal wastewater treatment plants.

Mexican environmental laws and regulations governing water and wastewater are similar to those in the United States. Three different standards (Normas Oficiales Mexicanas) exist on the national level governing different aspects of wastewater discharge: NOM-001-ECOL-1996, NOM-002-ECOL-1996, NOM-003-ECOL-1997. The Law for Ecological Equilibrium and Environmental Protection (la Ley del Equilibrio Ecológico y de Protección Ambiental) applies on the state level. On the municipal level, the Rules and Regulations for Ecology and Environmental Protection (Reglamento de Ecología y Protección al Ambiente) is used.

The authors were not able to acquire specific information on Mexico's requirements for industrial wastewater pretreatment, including reporting and testing requirements. However, based on a number of interviews with experts directly involved in binational water and wastewater issues, enforcement and compliance with Mexico's wastewater laws varies considerably from city to city.[38]

Officials with CNA did indicate that there have been wastewater discharge violations by the stonewashing industry and that in each case penalties were applied in accordance with established regulations. Violations by the stonewashing industry in the tri-city region were similar to those in El Paso, including violations of total suspended solids, chlorides, color, solids, and toxic and corrosive substances.

Results &Conclusions

From a North American perspective, both Mexico and the United States will continue to face growing demand for freshwater to meet human and environmental

needs. Wherever the stonewashing industry is located, it remains a water-intensive industry based on fashion demand.

In the debate that preceded the passage of NAFTA, some argued that in the long-run, aspects of NAFTA encourage industry relocation to areas with poor environmental compliance. Others argued that by opening North American markets, industries would move away from maquiladoras concentrated along the United States-Mexico border and spread throughout Mexico. As industries and accompanying environmental infrastructure spread, they argued that pressure and resources for environmental compliance in Mexico would increase. In its relocation to the Torreón, Gómez Palacios, and Ciudad Lerdo region, the stonewashing industry appears to have followed this paradigm, however, the net environmental impact of its relocation is less clear.

Overall, some of the hypotheses were strongly supported by the research, however, others were less conclusive. Rule changes under NAFTA and changing trends in the increasingly globalized apparel industry played a role in the stonewashing industry's movement out of El Paso and into Mexico. Interviewees also suggested that water reuse requirements and the future availability of water in El Paso did not prove to be significant factors in businesses' decisions to relocate. The departure of the stonewashing industry alleviated pressure on border water resources, particularly the Hueco Bolson aquifer that provides water to El Paso and Ciudad Juárez. As the industry relocated, water use efficiency coincidentally improved in El Paso and Mexico as a result of automated technology and the desire to create a more uniform product. Efficiency improvements did not appear to be a result of concern over future

availability of water resources. Evidence of improved environmental impact was inconclusive. However, the apparent lack of industrial pretreatment regulatory enforcement in Mexico is an area of concern. Progress in this area could significantly improve environmental protection.

Relocation Factors

Elements of NAFTA had an impact on the denim stonewashing industry in El Paso. Globalization and the apparel industry's shift toward developing nations were also important factors in the industry's relocation. Under competitive pressure in the increasingly globalized apparel industry, El Paso's garment finishers were looking for locations affording a competitive advantage. The advent of NAFTA created trade conditions favoring relocation to Mexico over other Latin American or Asian countries. The removal of tariffs and quotas specific to the apparel industry appears to have given Mexico an advantage in attracting the industry over other countries. Mexico's proximity to the United States also ensured timely and cheaper delivery of goods over other Latin American and Asian countries.

Interviewees said, that lower labor costs in Mexico were the overriding factor in industry decisions to move operations out of the United States and into Mexico. Reduction of labor costs was a significant means of lowering production costs in order to remain competitive. The industry's pursuit of reduced labor costs gave Mexico a competitive advantage to garner the lion's share of the relocated garment stonewashing industry.

Other factors, namely water reuse requirements and the potential for future water shortages in El Paso, seemed to have little or no impact in the industry's decision

to relocate, or were of minor importance relative to labor costs.[39] Neither was the cost of water and other utilities a predominant factor in the industry's decision to relocate. These represented a relatively small cost in the production equation. However, as companies set up finishing operations in Mexico, most had to develop their own water supply infrastructure, creating an initial expense. Industry interviews also revealed that other utilities, namely electricity, were more expensive and less reliable in the cities where the industry relocated to in Mexico.

The industry became more water efficient as it developed more sophisticated equipment and standardized processes. The impetus behind these changes, however, appeared to be based on producing a more uniform product and reducing the cost of production. Although the net effect was lower water use by the industry, the driving force for the changes was not concern over future water supply or the desire to conserve water resources in the Hueco Bolson. One industry executive interviewed indicated that the move toward more efficient water use also helped them come into compliance with El Paso's water reuse ordinance, but that this was an added benefit of production efficiency, not the driving force.

Changes in Production

Pre-NAFTA Denim Apparel Industry Production Chain

Insert Figure 5

Figure 5 shows the denim apparel industry production chain prior to implementation of NAFTA. Prior to NAFTA, the USTS 807 and USHTS 9802 programs gave preferential tariff treatment to garments assembled in Mexico from

materials produced in the United States. In an attempt to remain competitive, the denim apparel industry opened new sewing facilities to assemble garments in Mexico, and subsequently reduced labor costs. The same preferential treatment was not extended to garment finishing. Many of these operations were located in El Paso.

Post-NAFTA Denim Apparel Industry Production Chain

Insert Figure 6

After passage of NAFTA, denim finishing processes moved to Mexico (Figure 6). NAFTA's removal of tariff and quota restrictions on finishing work performed in Mexico, arguably were factors in contributing to the flight of the apparel industry. El Paso apparel industry firms found it economically advantageous to more fully integrate operations in Mexico or to develop partnerships with Mexican companies. With the national minimum wage in Mexico at approximately $5 per day, plus benefits, firms were able to lower production costs in order to remain competitive with other parts of the world. However, given the capital investment required to build new operations, some companies unable to compete went out of business entirely.

Of the firms interviewed, only one still performed all of its finishing work in El Paso. The others were in the process of either entirely relocating their finishing operations or engaging in joint ventures to operate finishing facilities in Mexico while maintaining operations in El Paso. Although marketing and distribution in the denim apparel industry remain in the United States, companies have been able to successfully integrate assembly and finishing processes in Mexico.

Benefits and Costs

An examination of the benefits and costs associated with the relocation of El Paso's stonewashing industry to Mexico reveals the influence of several factors in terms of net results.

Benefits and Costs of Stonewashing Industry Relocation

El Paso	
Benefits	Costs
• Reduced pressure on border water resources • Reduced industrial water use • Reduced load on municipal wastewater systems • Stonewashing industry void filled by less water-intensive industries	• Loss of jobs
Mexico	
Benefits	Costs
• Reduced pressure on border water resources • Pressure for environmental improvement • Job creation • Expanded infrastructure	• Increased pressure on water resources • Increased pollution from inadequate industrial wastewater pretreatment

El Paso

In terms of border water resources, the expansion of the stonewashing industry in the early 1990s increased water demand and temporarily introduced additional pressures on EPWU wastewater treatment plants as the industry scrambled to develop adequate pretreatment. The industry's subsequent contraction in El Paso removed

numerous large and very large water users, thereby decreasing pressure on the dwindling resources of the Hueco Bolson, a key underground aquifer that straddles the border. This clearly points toward an environmental benefit for the El Paso/Ciudad Juárez border region.

Water use in El Paso by the stonewashing industry was affected in two ways as the industry moved south. First, of the accounts analyzed, the number of firms drawing municipal water decreased from 25 at the industry's peak in 1993 to fewer than 15 in 2000. Second, as technology improved and firms had to comply with El Paso's water reuse requirements, the remaining firms consumed less water. Combined, this translates to an approximately 4 million GPD decrease in average water consumption since the industry's peak. This is equivalent to the average municipal use of approximately 25,000 people.[40] Considering predictions of the Hueco Bolson being exhausted by 2025, this is not an insignificant amount.

El Paso benefited from a decrease in industrial demand on its dwindling freshwater resources. Municipal wastewater treatment in El Paso also benefited from reduced maintenance and upkeep costs associated with removing pumice buildup and floating perlite in wastewater systems.

El Paso's leaders had not sought out the stonewashing industry. It had emerged in El Paso by historical accident, the offshoot of a long established apparel industry that, in responding to market demand, discovered a new source of revenue. In its absence and in that of the apparel industry in general, El Paso's economic development planners focused on attracting less water-intensive industries to fill the void.

The costs to El Paso, however, were significant. The loss of jobs in the stonewashing industry was compounded by its occurrence during the overall flight of El Paso's apparel industry. Wages for workers in the apparel industry in El Paso, including garment finishing, ranged from $7-$10 per hour with benefits. The industry had provided relatively well-paid jobs for workers, often women, many of whom were unskilled and spoke little or no English. The arrival of new industries in the wake of the apparel industry's departure did not necessarily ensure new employment for these workers. Employment in El Paso's new industries generally required a higher level of skills than those of the displaced workers.

Mexico

It is possible that the industry's relocation will bring increased pressure for environmental improvement in Mexico. Increased international trade and foreign investment in Mexico likely has increased public scrutiny of environmental regulation, both from abroad and at home. As the arrival of new industries further taxes Mexico's environmental resources, regulators could face increased pressure to enforce environmental regulations. NAFTA arguably has increased awareness and financial and technical resources to encourage creation of adequate water and wastewater systems in Mexico, particularly in the border region.

As the stonewashing industry built finishing facilities in the region, they brought with them industrial water conservation technology and made municipal infrastructure improvements in their new locations. The technology transfer resulting from water reuse practices led to improved water efficiency by the stonewashing industry. Many finishing operations provided municipal infrastructure improvements,

such as extending water service to nearby neighborhoods, as they constructed manufacturing facilities. There is a direct public health link between the provision of potable drinking water and improved health.

Finally, The Torreón, Gómez Palacios, and Ciudad Lerdo region benefited from job creation due to the arrival of the stonewashing and other industries.

Parallels can be drawn between environmental conditions in El Paso/Ciudad Juárez and Torreón/Gómez Palacios/Lerdo. Both regions are in the arid Chihuahuan Desert. While the population of the tri-city region is approximately half of that in El Paso/Ciudad Juárez, both rely heavily on groundwater resources being extracted at a greater rate than they are recharged. In addition, both regions are situated on rivers whose natural flows have been altered by dams. Unless considerable efforts are made to strike a balance among competing municipal, industrial, agricultural, and ecological interests, both regions face the prospect of water shortages.

Information from interviews indicates that enforcement of industrial wastewater discharge regulations for the stonewashing industry varies. Thus, some of the companies that have relocated to Mexico may not yet have incorporated effective industrial pretreatment processes. This likely will become more of an issue as more municipalities in Mexico develop municipal water and wastewater collection and treatment infrastructure. The most commonly used wastewater systems rely on bacteria to treat municipal wastewater. Without pretreatment, wastewater discharge by the garment finishing industry with abnormal pH levels or containing chemicals runs the risk of destroying the bacteria necessary for wastewater treatment and could cause

the facility to fail. Therefore, municipalities have a vested interest in the quality of industrial wastewater discharge.

The need for stronger industrial wastewater pretreatment enforcement in the stonewashing industry is an area of particular concern that should be addressed to protect water resources and affected flora and fauna. As Mexico makes a concerted effort to improve municipal environmental infrastructure, industry will need to install and improve wastewater pretreatment systems.

Research Note

The authors were able to conduct interviews with three industry representatives, all of whom represented operations with facilities in El Paso and in Mexico. Additional information was gathered through interviews with an EPWU employee who formerly worked for a now closed stonewashing operation in El Paso. Original plans were to conduct up to six interviews, however, a number of industry representatives were unwilling to grant interviews. The authors did not have access to wastewater discharge violation records for El Paso. Water usage and wastewater discharge information for Mexico was unavailable to the authors outside of personal interviews with industry and government representatives.

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[1] In 1993, the stonewashing accounts analyzed were drawing approximately 5.2 million GPD, average daily water demand was 105.9 million GPD. See note 21.
[2] See El Paso Water Utilities (EPWU), *Water Resources: Present And Future Sources Of Water Supply*, http://www.epwu.org
[3] Ibid.
[4]See also EPWU, *Water Resources*.
[5] Ibid.
[6] First, sulfate concentration climbs above 300mg/l, then Total Dissolved Solids (TDS) increases to over 1000mg/l. These are maximum permissible levels under Texas' regulations for potable water production, see Texas Administrative Code, Title 30, Rule 290.113.
[7] See EPWU, *Water Resources*.
[8] Services accounted for 24.13% of employment, wholesale and retail trade (23.93%), government (20.74%), manufacturing (16.50%) (Fullerton 1998).
[9] Roberto Franco, interview by authors, El Paso, Texas. 27 July 2000
[10] The following paragraph draws from U.S. Dept. of Labor, "Dynamic Change in the Garment Industry," http://www.dol.gov/dol/esa/public/forum/report.htm
[11] Interview no. 1, interview by authors, 26 July 2000, El Paso, Texas.
[12] Under the Harmonized Tariff Schedule, the first six digits of the ten digit HTS number are harmonized among countries participating in international trade. For instance, denim cloth falls under HTS code 5209.42 regardless of its origin or destination. Each nation determines its import duties for the HTS headings. Countries are free to further specify products and duties using the remaining four digits of the HTS code.
[13] One of the finishers referred to import quotas as being a "big problem." If finishers contracted with a Mexican facility that depleted its quota limit by year-end, the finisher was forced to pay full import duties on the remainder of goods imported from the facility for the year. This led finishers to contract with multiple suppliers in Mexico to ensure back up if a particular supplier hit their quota limit. Interview no. 3, interview by authors, telephone, Austin, Texas, 28 July 2000.
[14] Water use in 1991 among finishing operations using 100,000 gallons per day (GPD) or greater was 306,697 GPD. Water use among finishing operations using between 10,000 and 100,000 GPD was 27,113 GPD. See note 21
[15] John Balliew, interview by authors, El Paso, Texas. 26 July 2000
[16] The PSB adopted increasing block rate for very large users on 14 June 1995. However, increasing block rates for other categories of users have been in existence since the 1970s.
[17] Interview no. 3, interview by authors, telephone, 28 July 2000, Austin, Texas.
[18] According to private sector market research, the denim bottoms market grew 12% in 1995, and 5.1% in 1996, see Anonymous, "Bottoms Up," *Women's Wear Daily* 173, no. 44 (1997): 14.
[19] Interview no. 2, interview by authors, 27 July 2000, El Paso, Texas.
[20] Interview no. 1.
[21] Water consumption data and list of finishing accounts provided courtesy of EPWU.
[22] See EPWU, *Selected Financial and Statistical Data*, available at http://www.epwu.org
[23] Ibid.
[24] Stipulations for classification as a Significant Industrial User are enumerated in PSB 1999, however, discharging an average of 25,000 GPD or more automatically qualifies one as a Significant Industrial User. According to Cindy Edgar, EPWU Pretreatment Engineer, wastewater discharge can be estimated to be approximately 10% less than water consumption for garment finishers, Cindy Edgar, interview by authors, El Paso, Texas, 27 July 2000.
[25] Cindy Edgar, interview.
[26] This paragraph drawn from remarks by Cindy Edgar.

[27] The following section is based on interviews conducted by the authors in El Paso, Texas during July 26-27, 2000 and by telephone from Austin, Texas on July 28, 2000.
[28] Interview no. 1.
[29] Interview no. 2.
[30] Ibid.
[31] Interview no. 1.
[32] Interview no. 3.
[33] Many of these facilities were "full-package" operations performing multiple production processes such as milling, cutting, assembly, finishing, and design. The number of clients of La Laguna's jean manufacturers also increased during this time.
[34] See also http://www.inegi.gob.mx/.
[35] Fax communication from Ing. Jaime Tinoco Rubi, International Coordinator, National Water Commission, 7 September 2000, containing information provided by Ing. Martín G. Rodríguez Lara, Regional Manager, National Water Commission.
[36] Ibid.
[37] This paragraph drawn from research conclusions by Gereffi and Martinez 1998.
[38] Based on two interviews from sources requesting anonymity but who are directly involved in the development of municipal water and wastewater infrastructure in the U.S.-Mexico border region.
[39] Ironically, though, the largest downturn in the El Paso stonewashing industry in 1997 coincided with the EPWU's deadline for implementing the 1991 water conservation ordinance.
[40] Assuming EPWU system-wide consumption of 160 gpcd.