Part One
Regional Context

Climate

(National Weather Service) El Paso County is located at high elevation in the Chihuahuan Desert of West Texas. Consequently, the climate is arid with hot summers and cool winters, but 90°+ summer days are tempered by cool summer nights in the 60's. On average, there are 12-13 days with temperatures greater than 100°F. Average annual rainfall is 8.81 inches, which falls in a monsoonal pattern with 80% of the annual precipitation accumulating between April and October, mostly as high intensity thunderstorms. Normally, the first freeze occurs around November 13 and the last around March 21.

Geology

(Cornell 2001) About 35 million years ago, a system of extensional, or 'pull-apart' stresses began, generating one of the most important local geological features, the Rio Grande Rift. The North American Tectonic Plate is being pulled apart in this region by the rift that begins in Colorado, near Leadville, extends southerly through New Mexico to El Paso, and then dies out in Mexico. One product of the tensional forces and rifting has been the formation of numerous elongate basins, separated from one another by mountains. Local examples include the Hueco Mountains, the Hueco Bolson, the Franklin Mountains, and the Mesilla Bolson.

As the mountains uplifted, the mountain sediments began to accumulate in the basins, and this process continues to this day. Additional sediment was carried into the area by the ancestral Rio Grande which, for a few million years, emptied into Lake Cabeza de Vaca, a large, intermittent lake occupying the sites of the present-day basins. Eventually, the Rio Grande broke through the bolson wall, draining the lake and exposing the lakebed and the various accumulated sediments.

The accumulated sediments include river and lake sediments as well as aeolian deposits blown into the area from the southwest. These sediments are now known as the Fort Hancock Formation. The basins are deep structures with as much as 9,000 feet of sediment below the El Paso International Airport area of the Hueco Bolson, and as much as 12,000 feet of sediment under the Mesilla Valley. The width of the alluvial plain of the Rio Grande varies from a few hundred feet at the El Paso Narrows to broad valleys six to eight miles wide as the river courses through this region. Over time, the river has incised approximately 300 feet into the Bolson surface.

Impact of Human Settlement

Pre-settlement era: (Stotz 2000) The morphology of the river 500 years ago was very different from what we see today. Historically, the Rio Grande had a shallow, meandering, shifting channel with a sandy bottom, and the river was prone to periodic flooding. Descriptions of vegetation encountered in old documents suggest that high water tables were probably a common occurrence. In ponds, hydrophytes such as sedges and marsh grasses were common, and, depending on the length of time these ponds held water, tree species such as willow (*Salix* spp.) and cottonwood (*Populus deltoides* ssp. *wislizenii*) were present. Seepwillow (*Baccharis salicifolia*), cottonwood and willow grew along the river's edge and were occasionally washed out during spring floods. In mature plant communities, cottonwood and willow formed the overstory, with false-indigo (*Amorpha fruticosa*), yerba-mansa (*Anemopsis californica*) and saltgrass (*Distichlis spicata* var. *stricta*) scattered in the understory (Campbell and Dick-Peddie 1964). Thus, the historic river valley was characterized by a dynamic mosaic of habitat types.

Rio Grande cottonwood
Populus deltoides ssp. *Wislizenii*

Archeological evidence indicates that the Mesilla and El Paso valleys were inhabited as early as 10,000-6,000 B.C (Peterson et al. 1994), and it appears that an agricultural society existed in the area around 1000 A.D. (Kelley 1992). However, by the time when early Europeans first came to the area, as chronicled by the Rodriguez and Espejo expeditions of 1581 and 1582, no permanent farming settlements existed in these valleys, (Ackerly 1996; Everitt 1977).

A member of Ante's 1540 expedition described "the pleasant shade of the wide spreading trees which grew along the river banks…[and] grassy meadows" of the Rio Grande in the El Paso Valley, (Villagra 1933). An account of the Rodriguez expedition in 1581, described the valley below modern El Paso as "a valley of swamps, which extends over eight leagues," [about 21 miles] (Gallegos 1927).

Coming of permanent settlements & irrigation: Following the establishment of the Guadalupe Mission (in modern Ciudad Juárez) in 1659, settlements and irrigated agriculture developed quickly, altering the river morphology. After the Pueblo Revolt of 1680, refugees established settlements at Socorro and Ysleta, replicating the names of the communities they had lived in along the Middle Rio Grande of New Mexico. Such agricultural endeavors required irrigation structures such as ditches and water diversions. At that time, however, diversion structures were not permanent fixtures, because permanent fixtures could divert flood water into the fields. In 1773, an El Paso Valley resident described a diversion dam as follows:

> It is made of wattles, as the terrain of the river does not permit any other kind of fabrication, to say nothing of the trouble caused by its excessive floods and freshets, for it not seldom happened that after a dam had been built of stones, fagots, and stakes it was necessary to tear it down to prevent inundation of the town, (Hackett 1902).

Other sources described the eighteenth-century diversion structures as large baskets woven of willow wands which were filled with small rocks and placed into specific parts of the river channel during the irrigation season (Horgan 1954).

Besides the impact of irrigation by the permanent residents of the region, another major impact on the river and the adjacent areas came from the throngs of travelers making their way through the pass along the Rio Grande, from the early Spanish explorers to the Spanish missionaries and settlers traveling the Camino Real to Gold Rush 49ers traveling to California. Over the years, the diaries of the travelers document the degradation of the once lush vegetation in the Rio Grande floodplain. During the Gold Rush of 1849, two emigrant roads were established which passed through the El Paso Valley (Martin 1925). After 1849, the whole Rio Grande Valley, from Santa Fe to El Paso, was the half-way place on the overland trip where the emigrants coming via Missouri, Arkansas and Texas expected to lay in new supplies. Most parties rested for three to four weeks to build up the animals for the balance of the journey, and consequently, there was congestion at El Paso, Santa Fe, and every little village between the two places (Martin 1925). Many of these parties were quite large, such as one reported to contain 800 Americans and 300 Mexicans traveling in 300 wagons with 4,000 cattle and 300 mules. At least 4,000 emigrants (and all of their livestock) were reported camping in the vicinity of El Paso in 1849 (Martin 1925).

Historic conditions in the vicinity of Rio Bosque: In the El Paso Valley below San Elizario, Whiting noted that "This trail lies through a fine tract, heavily timbered – the trees are very large." In 1854 Bartlett (1965) wrote: "The Rio Grande Valley near El Paso, and generally in other places, is thickly timbered with cotton-wood. The trees sometimes grow to a large size. Mezquit is found on the borders between the plateau and the valley…cottonwood and the roots of the mezquit constitute the fuel of the country." He also reported that "in a small pond hard by our trail, we saw a flock of twenty-five huge white pelicans" and later that day, they "…came suddenly upon an old cut-off of the river; at the point we struck it, it was so boggy as to be impassable" (Bieber 1938).

Cottonwoods are typically described as being limited to areas along the banks of the river. For instance, in the lower El Paso Valley, Beale reported that "we came in sight of a grove of cotton-woods, which mark the line of the river" (Lesley 1949). The cottonwoods lining the river near El Paso "extend[ed] a few hundred yards on each side of the banks" in 1846 (Ruxton 1973). Where the river passes through the canyon upstream of the El Paso Valley, Magoffin (1926) observed, in 1847, that "cottonwood trees and willow bushes [are] scattered along [the river's] banks."

Goodding Willow
Salix gooddingii

An emigrant, traveling downstream of San Elizario during the month of September in 1849, reported passing a series of ponds (Eccleston 1950). When his party first entered the El Paso Valley to the south, he observed, "It was extremely boggy, and I met a man leading his horse and carrying a shovel. He had to dig his horse out." Eccleston also recorded traveling through "a handsome country. Large cottonwoods, with now and then a willow, adorned our path." Beale, near the southern end of the El Paso Valley in 1857, observed, "We found the river after groping some distance through a dense undergrowth of weeds, briars and willows..." (Lesley 1949).

Between 1892 and 1894, Mearns recorded vegetation characteristics at his mammal survey stations in the El Paso Valley. Near Ft. Hancock, he noted "Lines of cottonwood and willow mark the shifting courses of the river….The river flats are occupied by dense patches of arrowwood, flanked by the tornillo or screwbean and mesquite" (Mearns 1907).

Ground water hydrology

(U.S. IBWC and El Paso Water Utilities 2000) The ground water source for the Rio Bosque Wetlands Park is the shallow alluvium aquifer of the Rio Grande. The depth to ground water is as much as 100 feet below ground surface near downtown El Paso, but decreases to less than 10 feet below ground surface at the southeastern portion of El Paso County where irrigated agriculture continues to be practiced. The ground water flow generally follows the gradient of the river valley, which falls at a rate of about 3.5 feet per mile.

Recharge to the Rio Grande aquifer comes from irrigation water applied to fields, seepage from irrigation canals, seepage from the river, and infiltration following precipitation events. In the vicinity of Rio Bosque Wetlands Park, an important contributor to aquifer recharge is the adjacent Riverside Canal. Preliminary studies at the park indicate that depth to ground water is as little as three feet below the ground surface in the areas close to the Riverside Canal during the irrigation season, but declines dramatically during the winter when the Riverside Canal is dry. In areas remote from the canal, depth to ground water has been measured to be as great as 16 feet below the surface during the dry season.

Well-depths and ground water contour maps indicate that irrigation and ground water levels are closely linked. In the 1950s, 1960s, and 1970s, drought conditions caused water levels to drop, but they returned to normal when river flows and irrigation diversions returned to normal. Such links will be affected by the plans of El Paso County Water Improvement District No. 1 (EPCWID) to concrete line the Riverside Canal in the future to reduce seepage loss. We expect that the concrete-lining will significantly affect the ground water in the park.

The quality of the water in the shallow alluvium aquifer is relatively brackish with total dissolved solids (TDS) ranging from 1,000 to 3,000 parts per million (ppm). In most areas the TDS is lower near the Rio Grande, where fresh water seeps into the aquifer diluting the salty water.

Surface water hydrology

(Crawford et al. 1993) The headwaters of the Rio Grande are in the San Juan Mountains of southern Colorado. The river flows over 2,000 miles through New Mexico and along Texas' southern border to the Gulf of Mexico, draining an area of 247,600 square miles. Between 1889 and 1915, prior to the impoundment of water at Elephant Butte Reservoir, there were nine years during which flooding events with flows in excess of 10,000 cubic feet per second (cfs) were recorded, and the river's average peak flow was about 8,500 cfs. Since 1916, the river's average peak flow has been only 4,100 cfs, and only twice have peak flows in excess of 10,000 cfs been recorded. In the years prior to 1889 when stream gauges were installed, flooding events were reported in the El Paso/Juárez area in 1828, 1872, and 1874. Based on descriptions of the extent of flooding ("water extended all of the way across the valley"), it is estimated that the 1828 event may have had a flow in excess of 100,000 cfs.

In 1916, Elephant Butte Dam was completed and, over the last 86 years, the Rio Grande has been managed for the delivery of irrigation water. Consequently, water is released from the upstream reservoirs only in the irrigation season, which runs from mid-February to mid-October, leaving the river in southern New Mexico and west Texas with meager wintertime flows that consist primarily of agricultural return flows and sewage effluent.

Between 1934 and 1938, the International Boundary and Water Commission (IBWC) built the Rio Grande Rectification Project between El Paso and Ft. Quitman, Texas. Its purposes were to stabilize the international boundary in the El Paso-Juárez Valley and to provide flood protection. The project involved channelizing that reach of the river, thereby reducing its length from 155 miles to 86 miles. One of the river meanders that the project eliminated passed through what is today Rio Bosque Wetlands Park.

Today, the channel of the Rio Grande is immediately southwest of the park. The river has little direct impact on the park, because diversion dams near downtown El Paso divert the bulk of its flow into irrigation canals, leaving only a small amount in the river channel. However, a large irrigation canal (Riverside Canal) runs adjacent to the park, and seepage from that canal positively affects the ground water of the park.