

1. Study Authority

The authority for this analysis is the Flood Control Act of 1936, dated 22 June 1936 passed by the 74th Congress 2nd session. This act gave the Secretary of War the authorization to perform preliminary examinations and surveys for flood control. Specific appropriation language from the 2002 Conference Report is as follows:

“The conferees have provided \$100,000 for the Nueces River and Tributaries, Texas, project for a reconnaissance study of recharge structures located on the Edwards Aquifer Recharge Zone in the Nueces River Basin.”

2. Study Purpose

The purpose of this reconnaissance phase study is to determine if there is a Federal interest for the Corps to participate in a cost-shared feasibility phase study with potential non-Federal sponsors in order to pursue more detailed studies of water resource problems in the Nueces River Basin. The reconnaissance study has resulted in the finding that there is a Federal interest in continuing the study into the feasibility phase and that an environmentally sustainable holistic watershed approach to managing the water resources of the Nueces River Basin is possible. The purpose of this Section 905(b) Analysis is to document the basis for these findings and establish a preliminary scope for the feasibility phase. The Section 905(b) Analysis is used as the chapter of the project management plan that presents the reconnaissance overview and formulation rationale.

3. Location of Study Area / Congressional District

The Nueces River Basin is located within the boundaries of the U.S. Army Corps of Engineers Ft. Worth and Galveston Districts. Figure 3-1 shows the location of the basin, and a detailed map showing the extent of the study area is shown in Appendix A.

3.1 Location of Study Area

The study area is the Nueces River Basin located in South Central Texas and includes portions of the Texas Hill Country in the upper end of the watershed, the Brush Country in the central portion of the basin and the Coastal Plains in the lower end of the basin (Figure 3-1). The Nueces River Basin encompasses an area of approximately 17,000 square miles, and includes all or parts of the following 24 counties: Atascosa, Bandera, Bee, Bexar, Dimmit, Duval, Edwards,

Frio, Jim Wells, Karnes, Kerr, Kinney, La Salle, Live Oak, Maverick, Medina, McMullen, Nueces, Real, San Patricio, Uvalde, Webb, Wilson and Zavala. The major urban area associated with this basin is the City of Corpus Christi (2000 census population 277,450), which is located near the mouth of the Nueces River in both the Nueces River Basin and also the Nueces-Rio Grande Coastal Basin. Many small communities are located throughout the basin. A more complete description of the Nueces River Basin can be found beginning in section 5.5, page 7.

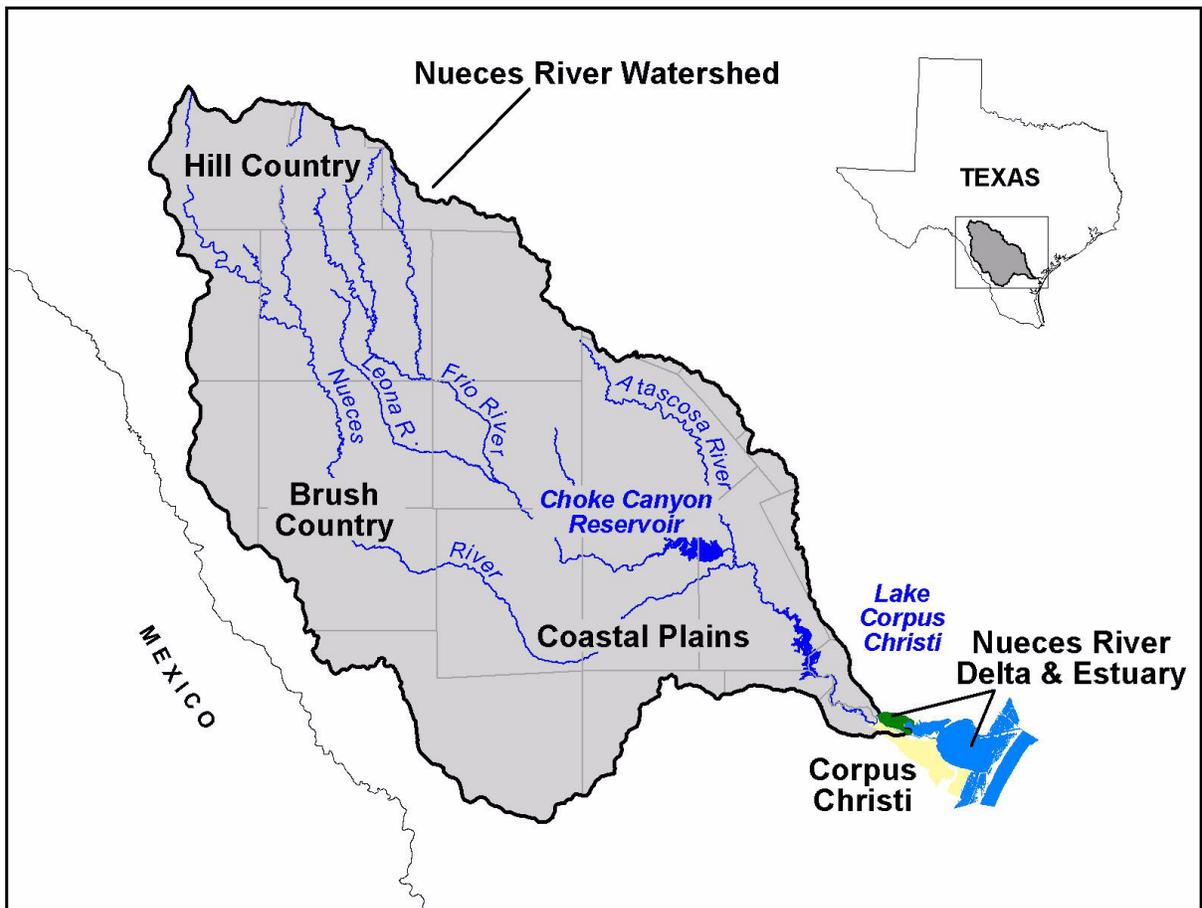


Figure 3-1. Location Map of the Nueces River Basin

3.2 Congressional Districts

The study area lies within the following Texas Congressional Districts:

- Texas Congressional Districts 14 (Honorable Ron Paul), 15 (Honorable Ruben Hinojosa), 20 (Honorable Charles A. Gonzalez), 21 (Honorable Lamar Smith), 23 (Honorable Henry Bonilla), and 28 (Honorable Ciro D. Rodriguez).
- The U.S. Senators from the State of Texas are the Honorable Kay Bailey Hutchison and the Honorable Phil Gramm.

4. Prior Reports and Existing Projects

Numerous studies and reports have been performed in this region by government agencies and various local sponsors. These reports have covered a variety of water resource related issues, and are listed here:

- U.S. Army Corps of Engineers, “Survey Report on The Edwards Underground Reservoir Guadalupe, San Antonio, and Nueces River and Tributaries, Texas,” Edwards Underground Water District, December, 1964.
- U.S. Bureau of Reclamation (USBR), “Nueces River Project, Texas, Feasibility Report,” U.S. Department of the Interior, July, 1971.
- USBR, “Runoff: Nueces River Basin,” Texas Basins Project, U.S. Department of the Interior, June, 1959.
- USBR, “Rincon Bayou Demonstration Project,” U.S. Department of the Interior, September, 2000.
- U.S. Geological Survey (USGS), “Streamflow Losses Along the Balcones Fault Zone, Nueces River Basin, Texas,” Water-Resources Investigations Report 83-4368, Austin, Texas 1983.
- USGS, “Conveyance Characteristics of the Nueces River, Cotulla to Simmons, Texas,” Water-Resources Investigations Report 83-4004, Austin, Texas 1983.
- HDR Engineering, Inc. (HDR), et. al., “Nueces River Basin Regional Water Supply Planning Study – Phase I,” Vols. 1, 2, and 3, Nueces River Authority (NRA), City of Corpus Christi, Edwards Underground Water District (EUWD), South Texas Water Authority and Texas Water Development Board, May 1991.
- HDR, et. al., “Nueces River Basin Regional Water Supply Planning Study – Phase III – Recharge Enhancement,” NRA, et. al., November 1991.
- HDR and LBG-Guyton Associates (LBG), “Reconnaissance-Level Geohydrologic Evaluation of the Nueces River Basin, Edwards Aquifer Recharge Enhancement Projects,” EUWD, August and November 1993.
- HDR, et. al., “Edward Aquifer Recharge Enhancement Project, Phase IVA, Nueces River Basin,” EUWD, June 1994.
- HDR, et. al., “Trans-Texas Water Program, West Central Study Area – Phase 1 Interim Report,” Volume 4, San Antonio River Authority (SARA), et. al., November 1995.
- HDR, “Combined Impacts of Frio, Sabinal, Hondo, and Verde Recharge Enhancement Projects on Downstream Water Rights,” Nueces River Basin, Edward

- Aquifer Recharge Enhancement Project, Phase IVB, Technical Memorandum, EUWD, December 12, 1995.
- HDR, “Evaluation of Diversion Alternatives from the Nueces River to the Dry Frio River for Edwards Aquifer Recharge Enhancement,” Nueces River Basin, Edward Aquifer Recharge Enhancement Project, Phase IVB, Technical Memorandum, EUWD, August 12, 1996.
 - HDR and Paul Price Associates, “Edwards Aquifer Recharge Enhancement, Lower Frio River Project,” environmental survey report prepared for EUWD, January 1997.
 - HDR, et. al., “Trans-Texas Water Program, West Central Study Area – Phase II Edwards Aquifer Recharge Analyses,” San Antonio River Authority, et. al., March 1998.
 - Orlando, Paul S., Jr. “Analysis of Salinity Structure and Stability for Texas Estuaries.” U.S. Department of Commerce. National Oceanic and Atmospheric Administration. 1991.
 - South Central Texas Regional Water Planning Group, “Regional Water Plan,” Vols. I, II, and III, prepared by HDR et. al., January 2001.
 - Coastal Bend Regional Water Planning Group, “Regional Water Plan,” Vols. I and II, Prepared by HDR et al, January 2001.

5. Plan Formulation

Throughout the Corps study process, from reconnaissance to feasibility, six basic steps are set forth in the Water Resource Council’s Principle and Guidelines. The six planning steps are: 1) specify problems and opportunities, 2) inventory and forecast conditions, 3) formulate alternative plans, 4) evaluate effects of alternative plans, 5) compare alternative plans, and 6) select recommended plan. The iterations of the planning steps typically differ in the emphasis that is placed on each of the steps. The specific objective of this process is to identify potential water resource projects in the Nueces River Basin that have a Federal interest and that are technically and economically feasible, environmentally acceptable, and supported by the local sponsor.

5.1 Federal Objectives

One Federal Objective of water and related land resources planning is to contribute to National Economic Development (NED) consistent with protecting the nation’s environment, pursuant to national environmental statutes, applicable executive orders and other Federal planning requirements. Contributions to NED include increases in the net value of the national output of goods and services, expressed in monetary units. Contributions to NED are the direct net benefits that accrue in the planning area and the rest of the nation.

Ecosystem Restoration is a co-equal Federal objective for the Corps of Engineers. This objective is to contribute to the nation's environmental quality through ecosystem restoration. Contributions to the National Ecosystem Restoration (NER) account are measured by changes in the amount and value of habitat that a plan contributes locally, regionally, and nationally.

5.2 Public / Local Sponsor Concerns

No public meetings were held during this 905(b) analysis study; however, significant input was gathered from potential local sponsors associated with the Nueces River Basin. The City of Corpus Christi and the Nueces River Authority (NRA) identified several items that they were interested in seeing included in this report. These items include issues of ecosystem restoration including sustaining freshwater inflows to the Nueces Delta and Estuary, flood damage reduction, ecosystem restoration in Hill Country Streams, water quality and water supply. The San Antonio Water System (SAWS), the Guadalupe Blanco River Authority (GBRA) and the San Antonio River Authority (SARA) expressed their interest in the benefits of ecosystem restoration by enhancing springflows and streamflows and water supply associated with Edwards Aquifer recharge enhancement projects as well as potential flood damage reduction benefits. Other potential sponsors include the Edwards Aquifer Authority (EAA), Texas Parks and Wildlife Department (TPWD) and other local entities in the basin.

5.3 Planning Objectives including Problems and Opportunities

The national objectives of NED and NER are specific goals applicable to water resource planning studies. These planning objectives reflect the problems and opportunities and represent desired positive changes in "without project" conditions. Specific planning objectives of this study are as follows:

- To preliminarily screen potential projects in order to determine Federal interest;
- To identify projects that could reduce flood damages in the 100-year floodplains of the study area;
- To maintain adequate freshwater inflow to bays and estuaries;
- To enhance ecosystem values of the study area by:
 - water quality improvement features including wetland restoration,
 - nurturing habitat for selected aquatic species unique to the region, and

- revegetating selective riparian and wetland areas with native plant species that have high wildlife habitat value and a capacity to improve water quality in runoff;
- To increase the productivity of river deltas and estuaries of the region through ecosystem restoration projects;
- To examine previously identified alternatives for potential benefits including ecosystem restoration and/or flood damage reduction;
- To increase recharge to the Edwards Aquifer creating more springflows for endangered species and critical ecosystems and to enhance water supplies; and
- To provide multipurpose benefits with all alternatives examined, including but not limited to recreation, economic, and environmental.

Problems and Opportunities

Problems and opportunities associated with the water resources in the region in terms of possible Federal interest are summarized below:

Problems:

- Residents are susceptible to flooding along the Nueces River and its tributaries.
- The degradation of the ecosystem of the Nueces River Delta from lack of freshwater inflows.
- Worsening droughts along with pumping of the Edwards Aquifer reduces springflow and stream flow to critical habitats of several endangered species.
- Selected stream segments are suffering from the effects of human activity as well as from exotic aquatic plants that are destroying the natural ecosystems.
- The Nueces Basin is experiencing serious water shortages from worsening droughts as each of the last three major droughts in the basin have produced less runoff than previous droughts.

Opportunities:

- To study structural and non-structural alternatives to reduce the damages associated with flooding events in the basin.
- To restore the ecosystem of the Nueces River Delta with innovative alternatives that provide the opportunity for increased freshwater inflows.
- To construct Edwards Aquifer recharge enhancement projects in the Nueces River Basin, which will increase the volume and reliability of springflows and streamflows to the benefit of endangered species.
- To develop ecosystem restoration projects in affected stream segments to return them to a more “natural” state.
- To develop innovative multipurpose projects that provide flood damage reduction and/or ecosystem restoration in conjunction with water supply benefits.

5.4 **Planning Constraints**

Planning constraints include restrictions that should not be violated in the planning process. The following constraints or limitations were identified to direct plan formulation efforts such that beneficial impacts would be maximized and adverse impacts would be minimized:

- The identification of plans that reduce flood damages and costs in one area should not result in measurable adverse flood impacts in another area. Unavoidable flood impacts to other areas must be mitigated.
- The identification of plans must avoid adverse impacts to significant cultural resources; and if avoidance is not feasible, then adverse impacts to cultural resources must be minimized. Unavoidable adverse impacts to cultural resources must be mitigated.
- The identification of plans must avoid adverse impacts to significant ecological resources; and if avoidance is not feasible, then adverse impacts to ecological resources must be minimized. Unavoidable adverse impacts to ecological resources must be mitigated.
- The identification of plans should strive to avoid adverse aesthetic and visual impacts to the potential project locations.
- The identification of plans should strive to avoid areas that are known or suspected to be contaminated and/or contain hazardous, toxic, and radioactive waste.
- Total annual benefits must equal or exceed total annual costs for a plan to be in the Federal interest and implementable by the Corps.
- Plan formulation considerations must be generally acceptable to the public and non-Federal sponsorship.
- Non-Federal Sponsorship must be identified prior to the initiation of the Feasibility Phase.

5.5 **Nueces River Basin Overview**

The study area covers 17,000 square miles in south Texas and includes a highly complex environment of ground water and surface water interactions. Streams throughout the basin cross no less than three major aquifer recharge zones, and two lesser aquifer recharge zones. The most significant of these is the Edwards Aquifer recharge zone, where an average of 326,000 acre-feet per year (acft/yr) entered the aquifer during the 1934 through 1989 historical period.¹ Other major aquifer outcrops, according to the Texas Water Development Board, include the Carrizo-Wilcox and the Gulf Coast-Goliad Sand (Figure 5-1). These recharge zones significantly affect

¹ HDR Engineering, Inc., “Nueces River Basin, Regional Water Supply Planning Study – Phase I,” Nueces River Authority, et al., May 1991.

channel loss rates and delivery of water from upstream to downstream locations. Figure 5-1 contains four maps of the Nueces River Basin that contain information regarding physical and hydrologic features and characteristics of the basin.

Streams in the Hill Country are characterized by spring fed, perennially flowing streams that drain from the Edwards Plateau. These streams typically lose their baseflow to the Edwards Aquifer recharge zone. (See Figures 5.1B and 5.1C) Leona Springs, which receives a significant portion of its flow from the Edwards Aquifer, is the only major spring located in the Nueces River Basin located downstream of the Edwards Aquifer recharge zone. (See Figure 5.1D)

Scrub brush and rangeland dominate the landscape, and even the major streams typically have very limited or no flow once they are out of the Hill Country and downstream of the Edwards' recharge zone.

The Nueces River Basin ecosystems include the Edwards Plateau or Hill Country, the South Texas Brush Country and the Gulf Coast Prairies and Marshes. Because the basin is located along many migratory flyways, birds comprise a major portion of the wildlife population of the area. For example, the area offers birds unique nesting and forage resources including coastal prairies, wetlands, and riverine ecosystems. The threatened Brown Pelican and the endangered Whooping Crane use the Coastal Bend's natural resources both seasonally and year-round. The basin is also home to other state and federally listed endangered and threatened species. These listed species include amphibians, reptiles, mammals, and vascular plants (Table 5-1). Common types of wildlife found in the area include white-tailed deer, raccoons, ringtails, gray foxes, coyotes, beaver, bobcats, and several species of skunks. Wintering songbirds such as robins and cedar waxwings may also be found.

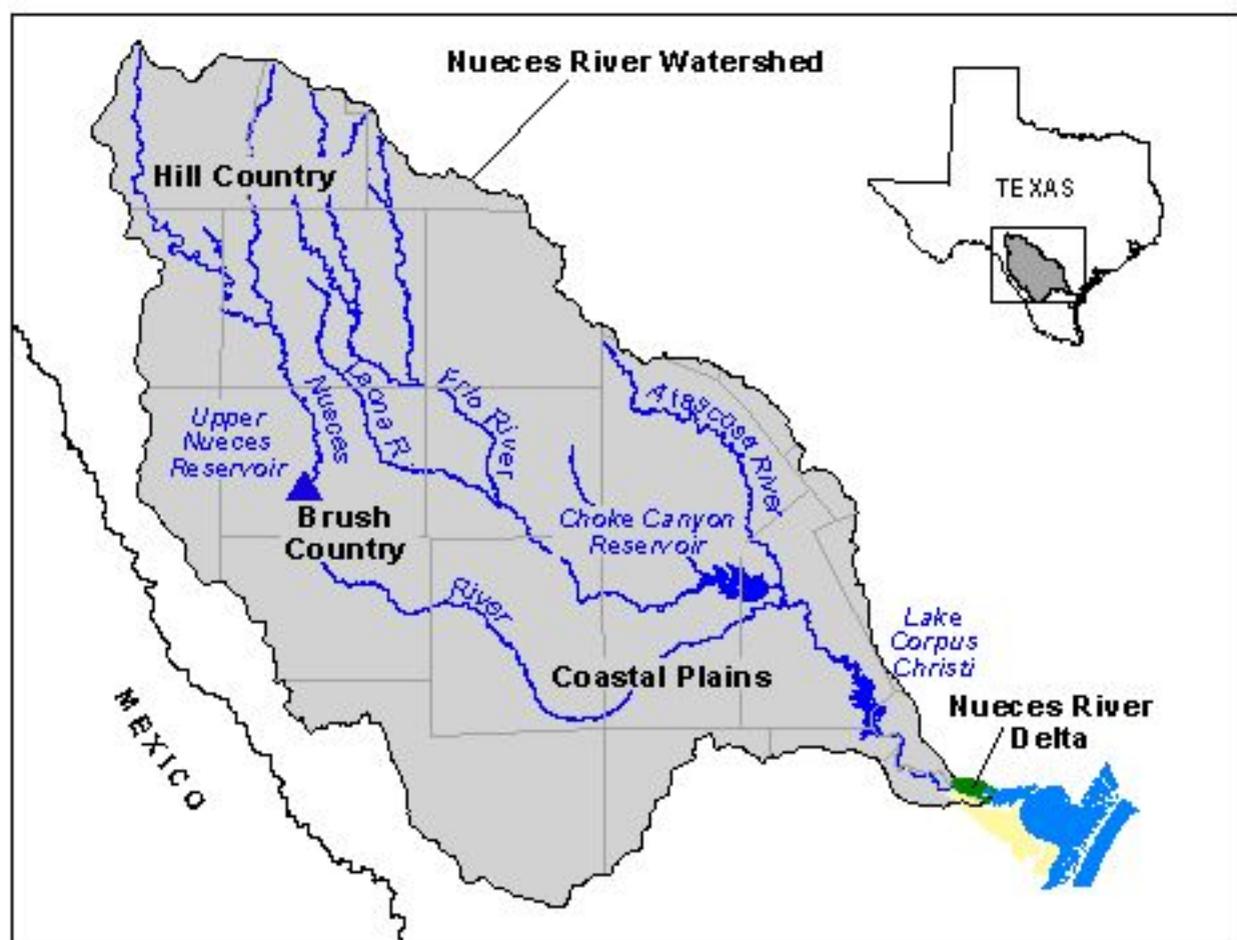


Figure A - Significant Reservoirs in the Basin

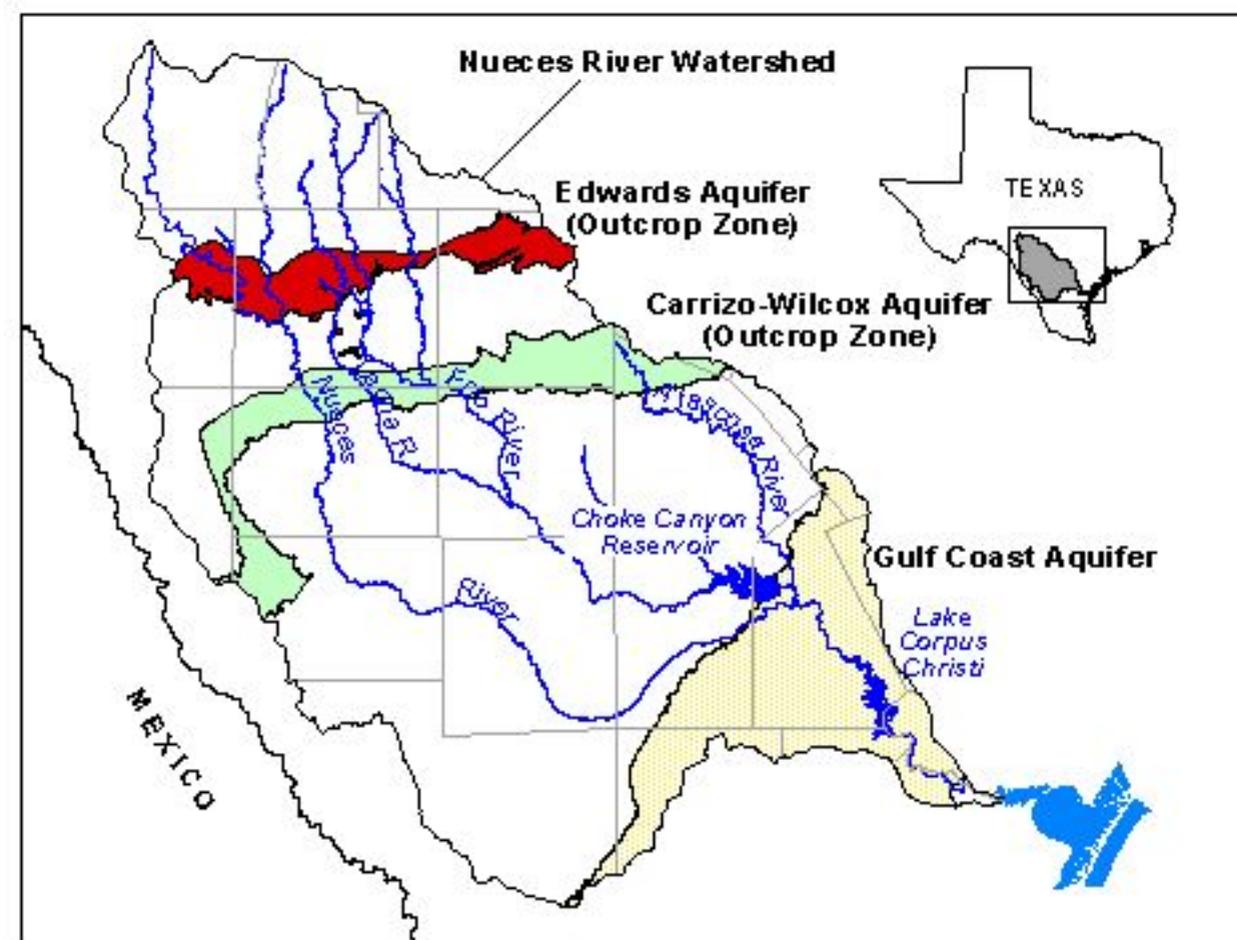


Figure B - Major Aquifer Recharge Zones in the Basin

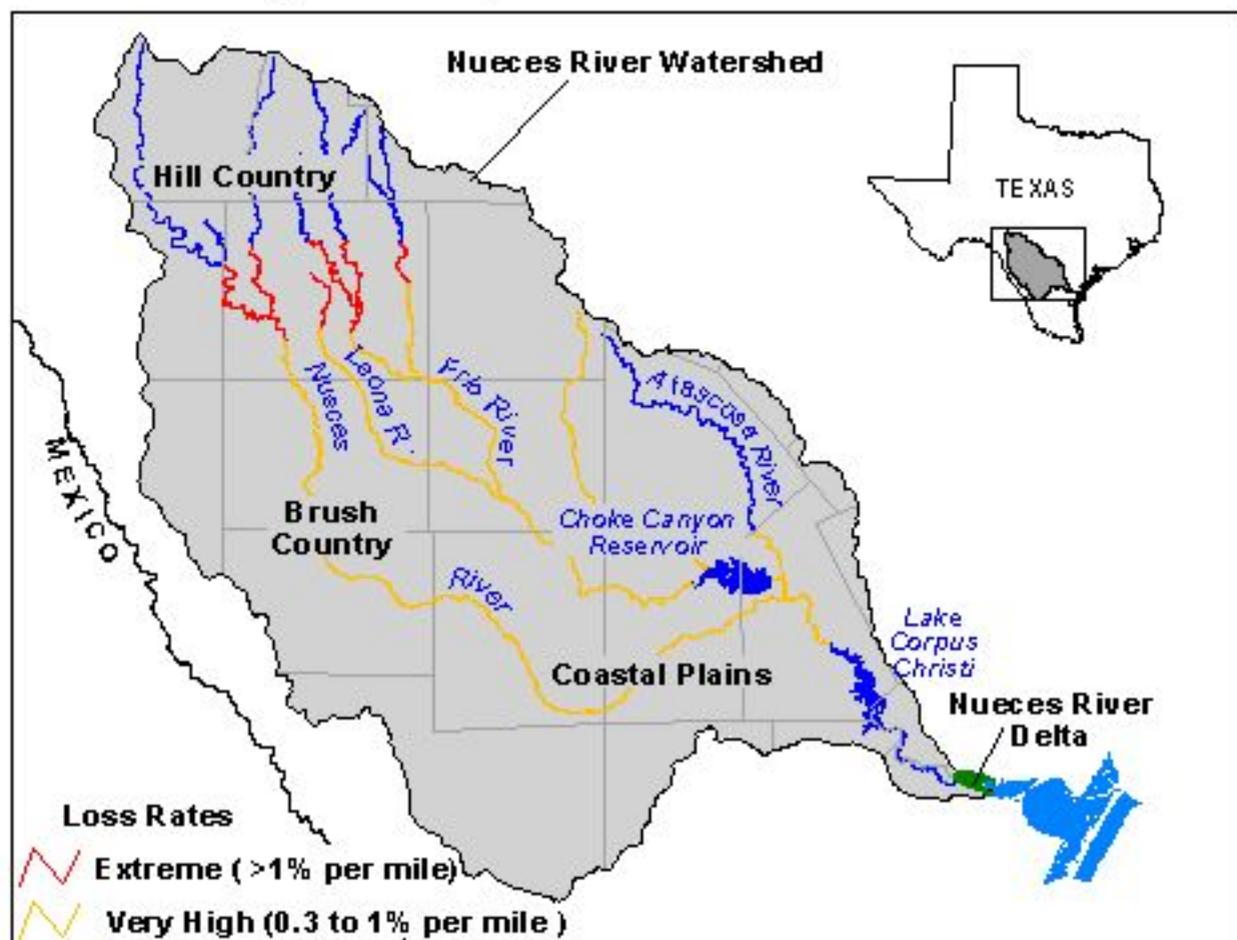


Figure C - Stream Segments & Channel Loss Rates



Figure D - Significant Springs and Braided Reach in the Basin

Figure 5-1. Physical and Hydrologic Data for the Nueces River Basin

Table 5-1.
Endangered and Threatened Species of the Nueces River Basin Region

Scientific Name	Common Name	Classification
<i>Ambrosia cheiranthifolia</i>	South Texas Ambrosia	Endangered
<i>Caretta caretta</i>	Loggerhead Sea Turtle	Threatened
<i>Chaadrius melodus</i>	Piping Plover	Threatened
<i>Echinocereus reichenbachii</i> var. <i>albertii</i>	Black Lace Cactus	Endangered
<i>Falco femoralis septentrionalis</i>	Northern Aplomado Falcon	Endangered
<i>Felis pardalis</i>	Ocelot	Endangered
<i>Felis yagouaroundi cocomitli</i>	Gulf Coast Jaguarundi	Endangered
<i>Grus americana</i>	Whooping Crane	Endangered
<i>Hoffmannseggia tenella</i>	Slender Rush Pea	Endangered
<i>Lepidochelys kempii</i>	Kemp's Sea Turtle	Endangered
<i>Numenius borealis</i>	Eskimo Curlew	Endangered
<i>Pelecanus occidentalis</i>	Brown Pelican	Endangered
<i>Sterna antillarum</i>	Least Tern	Threatened
<i>Tympanuchus cupido attwateri</i>	Attwater's Greater Prairie-Chicken	Endangered
<i>Ursus americanus luteolus</i>	Louisiana Black Bear	Threatened

Source: <http://endangered.fws.gov>

River delta and estuary systems depend on freshwater inflows for maintaining habitats and productivity. Freshwater inflows provide a mixing gradient that establishes a range of salinity as well as nutrients that are important for productivity of estuarine systems. Also, freshwater inflows deposit sediments, which help maintain the deltas and barrier islands that protect the bays and marshes. Without freshwater inflows many plant and animal species could not survive.

Within the Nueces River Basin, there are ecosystems that merit efforts towards ecosystem restoration. One is the ecosystem associated with the Nueces Delta area and the Nueces Estuary. Another ecosystem of concern includes the perennial streams located in the Texas Hill Country. Even though most of these streams lose their entire base flow to aquifer recharge as they exit out of the Hill Country, these streams start out as perennial, spring fed, pristine waterways that are a valuable environmental resource of the region. Also, major springs associated with the Edwards Aquifer support ecosystems in the Guadalupe and San Antonio