Protecting the National Parks in Texas Through Enforcement of Water Quality Standards: an Exploratory Analysis

Ronald A. Kaiser[1]

Steven E. Alexander[2]

and

J. Porter Hammitt[3]

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[1]Associate Professor, [2]Research Associate, and [3]Research Associate
Institute of Renewable Natural Resources
Department of Recreation, Park & Tourism Sciences
Texas Agricultural Experiment Station
Texas A&M University
College Station, Texas 77843-2261

United States Department of the Interior
National Park Service
Washington, D.C.

TABLE OF CONTENTS

1.0 INTRODUCTION

Many national parks are blessed with an abundance of biological, historical and cultural resources but are hampered by a scarcity of clean water. While an important recreation resource in it's own right, water is also important for sustaining and protecting water-dependent environments within national parks. For example, water draws people for boating, camping, fishing, sailing, skiing, and swimming; and it is also an important natural resource to maintain fish and wildlife species, riparian vegetation, and historic and cultural features. Water has two dimensions that are important for parks—a quantity and quality dimension. A diminution in either may present a threat to the integrity of the park.

An inadequate supply of water threatens many national parks, particularly in the West. Given the competing demands for water from agriculture, resource extraction industries, and municipal uses, some western parks find themselves fighting for water to support wildlife, fish, and vegetation, in order to serve the needs of visitors, and to maintain recreational activities such as swimming and boating. In some western parks, rivers and streams are depleted in the summer by legal diversions of water upstream from the park.[1]

While an inadequate supply of water presents serious problems, water quantity shortcomings have discernable legal and technical solutions[2] and may not be as serious as the invisible, but real threat of water pollution. Although concerns about water quality ranked low among those reported in the *1980 State of the Parks* survey[3], the essential role that water quality plays in maintaining ecosystems imparts a special urgency to the problem of water quality. If water quality falls below certain threshold levels, recreational activities and water-dependent resources could be impaired. Thus, water quality is important because of the National Park Service's (NPS) dual mandate of providing for recreation use, and preserving and protecting park resources.[4] Inasmuch as this report deals with the legal and institutional strictures to maintain and enhance water quality for

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[1]*See* The Conservation Foundation. 1985. *National Parks for a New Generation: Visions, Realities and Prospects.* Washington, D.C.: Conservation Foundation. p. 127., citing National Park Service. 1980. *State of the Parks: A 1980 Report to the Congress.* Washington, D.C.: U.S. Department of the Interior.

[2]*See* The prior appropriation system has contributed to the water quantity problem but it also offers technical and legal solutions through water marketing, statutory provisions for changes in water use, and minimum streamflow requirements.

[3]*See* National Park Service. 1980. *State of the Parks: A 1980 Report to the Congress.* Washington, D.C.: U.S. Department of the Interior.

[4]The basic mandate and statutory authority for the Service is derived from The National Park Service Act of 1916 (the Organic Act). Among other things, this Act mandates the Service's dual missions to be:

> [To]. . . promote and regulate the use of federal areas known as national parks, monuments and reservations hereinafter specified. . ., by such means and measures as conform to their fundamental purpose . . . to conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations (16 U.S.C. § 1).

the national parks in Texas, it is important to briefly discuss the dual mandates of the NPS in the context of water quality and water pollution.

1.01 The Multiple Missions of the National Park Service

The conflicts and issues facing the NPS have been chronicled by commentators[5] and documented in a number of studies.[6] Many of these conflicts arise from multiple mission directives given to, or assumed by the Service.[7] While much of the attention has focused on external threats it is not the only cause of concern. Internal problems also plague the NPS.[8] Many of the internal problems can be attributed to the Organic Act which commands the Service to both *serve* and *preserve.* This directive has forced the Service to serve an environmental constituency and a recreation industry.[9] The environmental constituency naturally advocates the primacy of preservation over recreation, while the recreation constituency seeks to reverse this order of priority.[10] At various times both philosophies have held sway in the Service.

Although the Service has equivocated between these two conceptually contradictory dictates, emphasizing sometimes use, sometimes preservation, it has found common ground

[5]For a standard history *see* Ise, J. 1961. *Our National Park Policy: A Critical History.* Baltimore: John Hopkins University Press; Runte, A. 1979. *National Parks: The American Experience.* Lincoln: University of Nebraska Press; Foresta, R. 1984. *America's National Parks and Their Keepers.* Washington D.C.: Resources for the Future. *For a critical commentary on some of the conflicts see* Sax, J. 1980. *Mountains without Handrails.* Ann Arbor: University of Michigan Press; Chase, A. 1986. *Playing God in Yellowstone.* San Diego: Harcourt Brace Jovanovich; Sax, J. 1976. America's National Parks: Their Principles, Purposes and Prospects. *American History,* 85(8), 57.

[6]For major reviews of NPS resource management programs *see* Leopold, A.S., S.A. Cain, C.M. Cottam, I.N. Gabrielson, and T.L. Kimball. 1963. Wildlife management in the national parks. *Trans. N. Amer. Wildl. and Natur. Resour. Conf.* 28:28-45 [known as the Leopold Report]; National Research Council. 1963. *A Report: Advisory Committee to the National Park Service.* Washington, D.C.: National Academy Press [known as the Robbins Report]; National Parks and Conservation Foundation. 1979. *NPCA Adjacent Lands Survey: No Park is an Island.* Washington D.C.: National Parks and Conservation Association; National Park Service. 1980. *State of the Parks: A Report to the Congress on a Service Strategy for Prevention and Mitigation of Natural and Cultural Resource Management Problems.* Washington, D.C.: U.S. Department of the Interior; General Accounting Office. 1987. *Limited Progress Made in Documenting and Mitigating Threats to the Parks.* Washington, D.C.: General Accounting Office; National Research Council. 1992. *Science and the National Parks.* Washington, D.C.: National Academy Press.

[7]For a discussion of some of the complimentary and conflicting missions *see* Runte, *National Parks*; and Foresta, *America's National Parks.*

[8]*See* Connally, E. (Ed.). 1982. *National Parks In Crises.* Washington, D.C.: National Parks and Conservation Foundation.

[9]*See* Runte, *National Parks.*

[10]*See* Runte, *National Parks*; Foresta, *America's National Parks*; and Sax, *Mountains Without Handrails.*

in the management philosophy of protection.[11] The Service focuses on the concept of protecting the visitor, the quality of the recreation experience, and the resource. Yet in spite of agreement on the concept of protection, the Service has not allocated financial resources based on that model. The resource management and science programs that provide the basis for management decisions are understaffed and underfunded.[12]

Park planning documents and management plans for the most part, have focused on the use and development of recreation resources and not on a systematic understanding of the natural dynamics and processes of ecosystems and other park resources.[13] This emphasis was particularly evident in this study as most of the documents furnished to the researchers focused on recreation uses of the resource.[14] The dearth of documentation characterizing the water-dependent environmental resources[15] of the parks makes a determination of the adequacy of state water quality standards to protect park resources difficult. However, existing documentation is adequate to show existing recreation uses in national parks that can then be compared with state water quality standard use designations to make determinations on the adequacy of the standards to protect park recreation uses.

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[11]*See* Chase, A., *Playing God in Yellowstone*. pp. 377-382.

[12]For a discussion of the shortcomings of the science program *see* National Research Council. 1992. *Science and the National Parks*. Washington, D.C.: National Academy Press.

[13]*Id.* p. 92.

[14]Many of the NPS furnished documents, such as the Water Resources Division. 1992. *Big Bend National Park Water Resources Scoping Report* (Technical Report NPS/NRWRD/NRTR-92/08), Washington, D.C., United States Department of Interior, do an adequate job of portraying perceived threats but they are not reinforced by extensive scientific analysis. While this statement is not intended to impugn the documents, it is intended to indicate the need for the type of scientific study advocated in National Resource Council's *Science in the National Parks* report on pp. 94-95. Concern over the paucity of data to document and corroborate external threats to national parks was also raised by park superintendents in the NPS document, *State of the Parks: A 1980 Report*.

[15]National Research Council, *Science and the National Parks*, p. 93 "Research to characterize park resources is frequently long term and basic. It includes inventories, monitoring, and long term analysis that involve a range of disciplines such as geology, hydrology, atmospheric sciences, archeology, biochemistry, botany, zoology and ecology. Comprehensive research examines the structure and function of organisms, populations, communities, ecosystems and landscapes as well as soil, ground water, air and other elements of the physical and social environment . . . As an absolute minimum, the NPS science program must include an inventory and monitoring of resources to provide a basis for detecting change. An inventory involves enumerating or mapping resources and assessing their status; monitoring involves repeated measurements to detect variations over time."

1.02 Water Quality in National Parks—The Regulatory Schema

1.021 The Concept of Clean Water

No naturally occurring water is completely pure. Unless purified, water contains many substances that may limit its utility. The substances found in water which determine water quality may be the result of natural causes, human activities, or both. Thus, the measure of whether water quality is "good" or "bad" is not its purity in any absolute sense, but rather its usefulness for a specific purpose.[16] Water that may be of a good quality for one purpose may be of bad quality for another purpose. For example, distilled water, which is free from impurities, has many practical uses (i.e., an automobile battery) but because of its flat taste is not desirable for use as drinking water. The mineral additives that make drinking water tasty will eventually ruin an automobile battery. Correspondingly, the alkalized water in New Mexico that contributed to the formation of the "white sands" is important for maintaining that geologic formation but its quality for use in agricultural irrigation or for a municipal water supply is not good.

Whether the addition of a substance to water will affect water quality depends on factors beyond merely the intended human use for the water.[17] Water quality is important for maintaining the integrity of plants, animals, organisms, and ecosystems that may not offer patent economic benefits but have latent utility. For purposes of this study, whether the addition of a water pollutant will affect the water quality will depend in great part, not only on the recreation uses being made of the water, but also on the other natural resources dependent on that water.

1.022 A Brief Overview of the Clean Water Act

Programs for protecting water quality take at least four types of approaches: (1) control of pollutants added to water; (2) reduction of the amount of waste that is

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[16]*See* Swenson and Baldwin. 1965. *A Primer on Water Quality*. Washington, D.C.: U.S. Department of the Interior, Geological Survey. p. 1. In general, "water quality" refers to physical, chemical, biological, radiological, and other properties affecting the usefulness of a specific quality of water for a specific purpose.

[17]The EPA recognizes the latent utility of water quality in that pollution is linked to impairment. *See* Environmental Protection Agency. 1982. *Manual of Individual Water Supply Systems*. Washington, D.C.: Environmental Protection Agency. p. 5, n. 1:

> "Pollution as used in this manual means the presence in water of any foreign substances (organic, inorganic, radiological or biological) which tend to lower its quality to a point that it constitutes a health hazard or impairs the usefulness of the water."

The Clean Water Act (33 U.S.C. § 1362 [19]) takes a slightly different tack. "Water pollution" is defined as

> "the man-made or man-induced alteration of the chemical, physical, biological and radiological integrity of water."

produced; (3) control of land-use activities that pollute; and (4) control of water use.[18] Federal water quality protection efforts for the most part, have centered on options 1 and 3. The Federal Water Pollution Control Act enacted in 1972, and now called the Clean Water Act, made the protection of water quality a national objective by controlling and eliminating discharges of pollutants into the nation's water. The regulatory regime and basic authority of the Clean Water Act is the result of a legislative evolution originating in the concept of navigability under the Commerce Clause.[19] Based on an expansive view of the activities included in interstate commerce, Congress extended the regulations to include the control over water quality and pollution.[20] While comprehensive and complex, a principal feature of the Act is the establishment of a federal—state regulatory partnership granting to the states the prime responsibility to control pollution. In a nutshell, the federal government, operating through the Environmental Protection Agency (EPA), develops the program criteria and monitors state programs but delegates to the states the authority to develop water quality standards and regulate the discharges of effluent into the waters of the nation. Part of that regulatory partnership requires that all federal agencies, including the NPS, comply with the requirements of state law for water quality management, regardless of jurisdictional status or land ownership.[21]

1.023 Establishing Water Quality Standards

Setting the standards for water purity is an essential element in controlling water pollution. This is accomplished, in part, through the establishment of (a) effluent limitations on discharges into the navigable waters,[22] (b) standards of performance for new sources of pollution discharges,[23] (c) water quality standards (including their periodic revision)[24],

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[18]*See* Getches, D., MacDonnell, L., and Rice, T. 1991. *Controlling Water Use: the Unfinished Business of Water Quality Protection.* Boulder: Natural Resources Law Center. pp. 3-9.

[19]U.S. CONST., art. I, § 8, cl. 3.

[20]Significant regulation began in 1948 with the passage of the Federal Water Pollution Control Act (Act of June 30, 1948, ch 758, 62 Stat. 1155, 33 U.S.C. 466-466g). In 1972, Congress enhanced federal efforts in water quality maintenance and pollution control with the passage of the Federal Water Pollution Control Act (Pub. L. No. 92-500, 86 Stat. 816). The major amendments to the Federal Water Pollution Control Act came with the Clean Water Act of 1977 (Pub. L. 95-217, 91 Stat. 15660) and the Water Quality Act of 1987 (Pub. L. 100-4, 101 Stat. 7), enacted over a Ronald Reagan veto.

[21]U.S.C. § 1323.

[22]*Id.* § 1311.

[23]*Id.* § 1316.

[24]*Id.* § 1313.

and (d) a national pollution discharge elimination system (NPDES).[25] States are required to review water quality standards every three years and to submit any revised or new standards to the EPA.[26] These triennial state water quality standards submissions must contain: (a) use designations, (b) numerical water quality standards designed to protect the designated uses,[27] (c) an antidegradation policy, and (d) the methods and analysis used by the state to support the standards.[28]

Antidegradation Policy: Of particular importance to the NPS in protecting water quality is the antidegradation policy that each state is required to adopt.[29] As outlined in the Code of Federal Regulations (CFR), a state's antidegradation policy should follow a three-tiered approach to protecting water quality. First, all existing instream water uses are to be maintained and protected and no degradation that interferes with those uses is permitted.[30] Second, existing high quality water has to be maintained and protected unless lower water quality standards are necessary to accommodate important economic or social development in the area where the waters are located[31], and thirdly, where water degradation is associated with thermal discharges, the policy must be consistent with § 316 of the Act.[32] Embedded in the second condition is the provision that where *high* quality waters constitute an outstanding national resource, any designated "Outstanding National Resource Waters" (ONRW's) must not be degraded.[33] ONRW's are high quality water constituting outstanding national resources, such as water of national and state parks and

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[25]*Id.* § 1342.

[26]*Id.* § 1313 (c).

[27]Conceptually, state water quality standards allow for some water quality deterioration or impairment as long as the designated use for the water is maintained. This approach is conceptually contrary to the approach suggested in the NPS Organic Act which mandates a zero-impairment standard—i.e., resources in the parks must be preserved in perpetuity in an unimpaired state.

[28]*See* 40 C.F.R. § 131.6.

[29]The antidegradation policy is not a statutory directive of the Clean Water Act; rather it is a policy borrowed by the EPA from the Department of the Interior. The basic policy was established in 1968 by the Secretary of the U.S. Department of the Interior and was included in the EPA's first water quality standards regulation in 1975.

[30]40 C.F.R. § 131.12 (a) (1).

[31]*Id.* § 131.12 (a) (2).

[32]*Id.* § 131.12 (a) (4).

[33]*Id.* § 131.12(a) (3) ("such as water of national and state parks and wildlife refuges and waters of exceptional recreational and ecological significance").

wildlife refuges and waters of exceptional recreational and ecological significance. Ordinarily, ONRW is thought to be the highest quality waters (i.e., the cleanest) however, the category also offers a means to protect water of "ecological significance." When states designate waters as ONRW's, then water quality must be maintained and protected. This represents a zero-tolerance standard– that is, no long-term degradation of water quality is permitted.

While all states have adopted antidegradation policies not all states have adopted ONRW designation processes or criteria.[34] The public participation processes associated with the triennial review of water quality standards offers the opportunity for the NPS manager to propose ONRW status for water in the NPS units.

1.03 Purpose and Scope of this Study

Park boundaries that define parks do not insulate them from the external influences or threats. The regulatory jurisdiction of the NPS is generally restricted to the geographical boundaries within the park and therefore, does not provide a framework, nor the authority to successfully deal with external threats to park resources. Since most pollutants that impair water quality originate outside the boundaries of national parks, managers must rely on other statutory tools to protect park resources. One such tool is the Clean Water Act.[35] The Water Resources Division of the NPS, in conjunction with the EPA, initiated this study as a prototype to develop a methodology for determining whether existing state water quality standards adequately protect the water and water-related resources of the units of the National Park System. The general purposes sought to be served by this prototype study were:

(1) to develop a method for evaluating state water quality standards and designated uses in light of NPS purposes and resource protection mandates;

(2) to provide a process by which NPS may petition the states for greater protection for NPS water resources under the framework of state water quality programs;

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[34]A very small percentage of waters in national parks have been designed as "ONRW's". None of the nine units of the National Park Service in Texas are designed as "ONRW's". For a state-by-state listing of the process and criteria for designating "ONRW's", *see* West, B. 1989. *Outstanding National Resource Waters: a Resource Management Tool.* Denver: U.S. Department of the Interior, National Park Service, Water Resources Division.

[35]33 U.S.C. §§ 1251-1376.

(3) to initiate a program to alert the states to the unique needs and requirement of managing and protecting the water resources of NPS units;

(4) to provide a relatively low-cost, and long-term method for protecting park water resources under the framework of the state regulatory program; and

(5) to seek to develop a set of criteria for determining the national significance of water resources for the purposes of the NPS water resources management program.

The NPS selected Texas for this prototype because of the variety of marine and freshwater resources that are present in the state. The Texas study will develop and test methodology and criteria for determining whether state water quality standards adequately protect the water and water-related resources of the nine units of the National Park System in the state. The parks included in the study were: (1) Amistad National Recreation Area; (2) Big Bend National Park; (3) Big Thicket National Preserve; (4) Guadalupe Mountains National Park; (5) Lake Meredith National Recreation Area; (6) Lyndon B. Johnson National Historic Park; (7) Padre Island National Seashore; (8) Rio Grande Wild and Scenic River; and (9) San Antonio Missions National Historic Park.

This project is intended to be an intensive examination of water resources in the nine Texas NPS units and their relationship to the Texas water quality regulatory system. The study seeks to provide information and data to enable the NPS to determine if any waters in their Texas units can be designated as Outstanding National Resource Waters (ONRW) as provided for in § 307.5(b) (3) of Title 31 of the Texas Administrative Code. The development of criteria for determining "national significance" will be conducted by the NPS. Specific research objectives for the study include the following:

(1) An identification of stream segments or lakes of concern to the NPS by using segmentation methods of the Texas Water Commission;

(2) A determination of existing state water quality standards for stream segments within Texas units of the NPS;

(3) In consultation with staff in each park unit and through a review of relevant park documents and other literature, a determination of water quality needs, by stream segment, for each Texas park unit;

(4) In consultation with the NPS,

a. segmented stream assessment of whether current state water quality standards protect existing park uses and resource needs consistent with NPS management goals and objectives, and

b. identification of whether a given stream segment meets criteria for "national significance" and is designated as an ONRW, or if it is not so designated to provide information that could be used to upgrade a stream segment to that standard.

1.04 Research Methodology

Park water quality needs were determined by reviewing park master plans and other planning documents to determine the water-dependent activities and resource needs. Recreation activity analysis and proposed developments were used to identify current and future water uses and needs.

Once park water quality needs were determined, the water resource segments (stream segments) used by the Texas Water Commission (TWC), now the Texas Natural Resources Conservation Commission (TNRCC), were reviewed for applicability to each park. Stream segments above park boundaries were included in the analysis, since permits for discharges into these waters may affect park uses and resources. A description and map of the relevant stream segments for each park are included in the "Findings" chapter.

State water quality standards for each stream segment were taken from the rules of the TWC and presented to each park manager. Managers were asked to comment on whether the stream segments and the water quality standards for each relevant segment were adequate to protect existing park uses and resource needs.

Based on the review of the park planning documents, the water quality standards of the TWC, comments from park managers, site visits to selected parks, a review of relevant literature, and consultation with state water officials, a series of recommendations were developed. These recommendations are outlined in Chapter 4.

2.0 TEXAS WATER FACTS

The diversity of Texas is manifested in its land and water resources. The state's physical features range from the mountain peaks and deserts of West Texas to the piney woods of East Texas—from the High Plains (*Llano Estacado)* to the flat coastal regions along the Gulf of Mexico. In elevation, the surface of the state varies from sea level to 8,749 feet above sea level at the summit of Guadalupe Mountain, located in Guadalupe National Park, in Culberson County.

Rainfall patterns are as varied as the landscape. Texas has experienced the worst of both worlds—devastating droughts that lasted for years followed by life-threatening floods. Generally, the wettest areas of the state are along the Texas-Louisiana border in southeast Texas, and the driest are in the Trans-Pecos region of West Texas (Figure 2-1). For example, rainfall in El Paso averages a mere 6-8 inches per year, while the Beaumont-Port Arthur area averages more than 60 inches per year.

2.01 Texas River Basins[36]

The Texas river system includes the ordinary flow, underflow, and tides of every flowing river, natural streams and lakes, storm waters or floodwaters in these watersheds, and the waters of every bay or river on the Gulf of Mexico.[37] Texas has 15 major river basins and eight coastal basins (Figure 2-2). These 23 basins include approximately 3,700 streams and tributaries and 80,000 linear miles of streambeds. The longest river in Texas is the Rio Grande, which begins its 1,800 mile course in Colorado and empties into the Gulf of Mexico at Brownsville. The Comal, arising from springs in New Braunfels and emptying into the Guadalupe River, is the shortest river being only 2 miles long.

On average, the annual runoff totals 49 million acre-feet per year (one acre-foot equals 325,851 gallons) ranging from about 1,100 acre-feet per square mile in East Texas, to practically zero in the Trans-Pecos region of West Texas. Between 1940 and 1970, statewide runoff varied from an average of 57 million acre-feet per year during the wettest period (1940-1950) to as little as 23 million acre-feet per year during the most severe recorded statewide drought of the mid-1950s.

In total, there are about 5,700 reservoirs on the Texas river system, including 188 major impoundments that contain more than 5,000 acre-feet of water. These major reservoirs have a total conservation storage capacity of about 36 million acre-feet, a flood storage capacity of 17 million acre-feet, and a dependable firm surface water supply of about 12 million acre-

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[36]Data for sections 2.03 and 2.03 was derived from state water planning documents, *see* Texas Water Development Board. 1990. *Water For Texas: Today and Tomorrow*. Austin: Texas Water Development Board. pp. 1-1 to 1-12.

[37]Tex. Water Code Ann. § 11.021.

Figure 2-1. Annual distribution of precipitation in Texas.

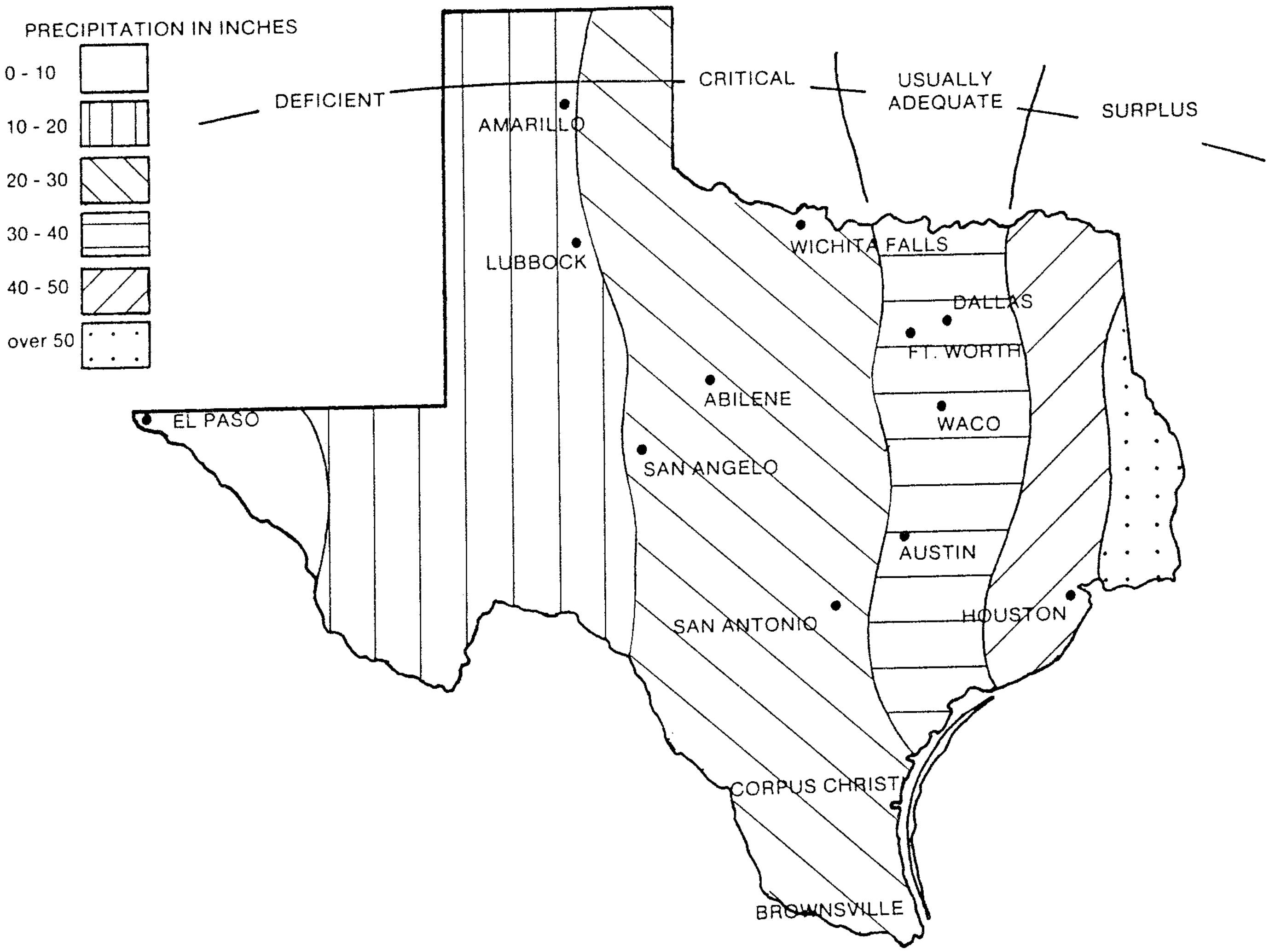

Figure 2-2. Major rivers and river basins.

feet. Of these major impoundments, 98 percent of the 12 million acre-feet of firm surface water supply is held in just 74 reservoirs. Texans use about 7 million acre feet (64%) of this dependable supply on an annual basis.

2.02 Texas Water Use

In 1990, Texas used about 15 million acre-feet of water. Among the six major water uses, agriculture is the largest consumer of water in Texas. Agricultural irrigation accounts for about 65 percent of all the water used annually. Municipalities use about 20 percent, while manufacturing uses slightly more than 10 percent. Electrical energy production through steam generation, surface mining, and livestock watering account for the remaining 5 percent of annual usage.

Of the 15 million acre feet of water used each year in Texas, about 8 million acre-feet comes from ground water and 7 million acre-feet from surface water supplies. Groundwater usage has been declining steadily since 1974, when it made up about three-fourths of all water usage.

Water use is not distributed evenly across the state. Interstate Highway 35 (I-35) traverses the state running from Dallas through Austin, San Antonio, and ending in Laredo. Nearly 80 percent of the Texas population lives along or east of I-35 and they use about 55 percent of the state's water. The more arid lands west of I-35 contain about 20 percent of the state's population which uses about 45 percent of the state's water.

2.03 Texas Water Agencies

In contrast to some states, planning and management responsibilities for Texas water resources are dispersed among a number of agencies and entities. Responsibility for planning, design, funding, construction, and operation of water supply and water quality facilities rests with more than 4,500 federal, state, local, and non-profit entities. This diverse array of jurisdictions presents a major problem in the management of water resources that the state is seeking to resolve through better agency coordination.

The lead regulatory agency is the Texas Natural Resources Conservation Commission (TNRRC), which is charged with protecting surface and groundwater quality by implementing state water laws and enforcing rules, orders and permits. It also oversees water quality monitoring, dam safety management, hazardous and industrial solid waste management, and administers the water rights permits for state surface waters.

Another state agency, the Texas Water Development Board (TWDB), is the planning and financing arm for water management in the state. The TWDB provides low-interest loans to political subdivisions and non-profit water supply corporations for the construction of water supply, wastewater treatment, and flood control facilities. Additionally, the TWDB is responsible for preparing and updating the Texas Water Plan.

Other state agencies share involvement in overseeing standards for water quality and quantity. The Texas Railroad Commission (TRC) is responsible for regulating water quality related to oil, gas and surface mining activities.[38] The Commission issues permits for the discharge of brine from oil and gas production and regulates its disposal. The Department of Parks and Wildlife investigates pollution that may cause loss of fish and wildlife and reviews all permits proposed by the TNRCC and the TRC for wastewater discharge and hazardous waste disposal.[39] Both of these agencies must enforce the water quality standards issued by the TNRCC.[40]

2.04 A New State Water Agency (TNRCC)

The configuration of state oversight for environment and water has been changed. As approved by the Legislature, the Texas Water Commission (TWC) went out of business in September 1993, and reemerged as the Texas Natural Resource Conservation Commission (TNRCC). This agency has the primary responsibility for administering laws relating to conservation, water and the environment. The TNRCC will assume the powers and duties of the TWC, the Texas Air Control Board, Water Well Drillers Board, Board of Irrigators and the solid waste, water hygiene, on-site sewage and wastewater treatment, and radioactive waste disposal programs of the Texas Department of Health.

2.05 Texas Water Quality Program

Water quality problems, both natural and man-made, affect a significant part of the state's surface water resources. Problems of naturally occurring salinity are particularly severe in the upper reaches of the Red, Colorado, Brazos, and Pecos River basins. In these areas, natural pollution, primarily sodium chloride, is contributed by salt springs and salt flats located within the drainage areas of the rivers.

Many of the man-made water quality problems that occur in Texas streams originate in urbanized areas which include Austin, Dallas-Ft. Worth, El Paso, Houston, and San Antonio. The Trinity and San Antonio rivers below Dallas and San Antonio respectively, are dominated by treated sewage effluent during the summer months. In other areas, the problem of excessive sewage discharges is aggravated to some extent by oil and gas production and exploration activities.

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[38] Tex. Water Code Ann. § 26.131.

[39] *Id.* § 26.129.

[40] *Id.* § 26.124.

2.051 *Texas Natural Resources Conservation Commission*

The Texas Natural Resources Conservation Commission (TNRCC), is responsible for water quality management and regulation in Texas. Established by the Legislature as an agency of the state, the Commission is composed of three members who are appointed by the governor. The three full-time commissioners perform the legislative and judicial functions of the TRRCC. Each commissioner is appointed for a six-year term and must represent a different region of the state.[41] Rules and general agency policies to carry out the statutory responsibilities of the TNRCC are adopted by the Commission. In addition to adopting rules and regulations, the Commission hires the executive director and appoints a general counsel, a chief hearings examiner, a chief clerk, and the public interest counsel, each of whom serves at the will of the Commission (Figure 2-3).

Executive Director: The executive director is in charge of the day-to-day administration of the agency and is authorized to establish the basic organization structure of the agency, and to appoint staff to those divisions, units, or sections.[42] Staff in these positions report to the executive director. Under the current structure, five offices report to the director. While each office may have some importance for this study, the Office of Water Resources Management is the primary contact for the NPS.

Office of Water Resource Management: The deputy director of this office oversees three divisions: Standards and Assessments, Water Utilities, and Watershed Management. These divisions are responsible for efforts to assess prevention, control, and abatement of water pollution in Texas. Their activities are vital components in developing and maintaining the State of Texas Surface Water Quality Standards which establish stream, river, reservoir and estuary uses, and specify general and numerical criteria to protect those uses.

Jurisdiction of TNRCC: The Legislature has given the TNRCC basic responsibility for all matters relating to water quality. Under Chapter 26 of the Water Code, TNRCC has the exclusive authority to establish water quality standards for surface and ground water.[43] The TNRCC also has the duty to enforce its water quality standards, and to do so, it has some investigatory powers. As necessary, the Commission may enter property, conduct hearings, monitor water quality, examine records, and issues orders to carry out the mandates of Chapter 26.[44] To assure attainment of water quality standards the TNRCC may issue wastewater discharge permits designed to achieve compliance with those standards.[45]

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[41] *Id.* § 5.052 (b).

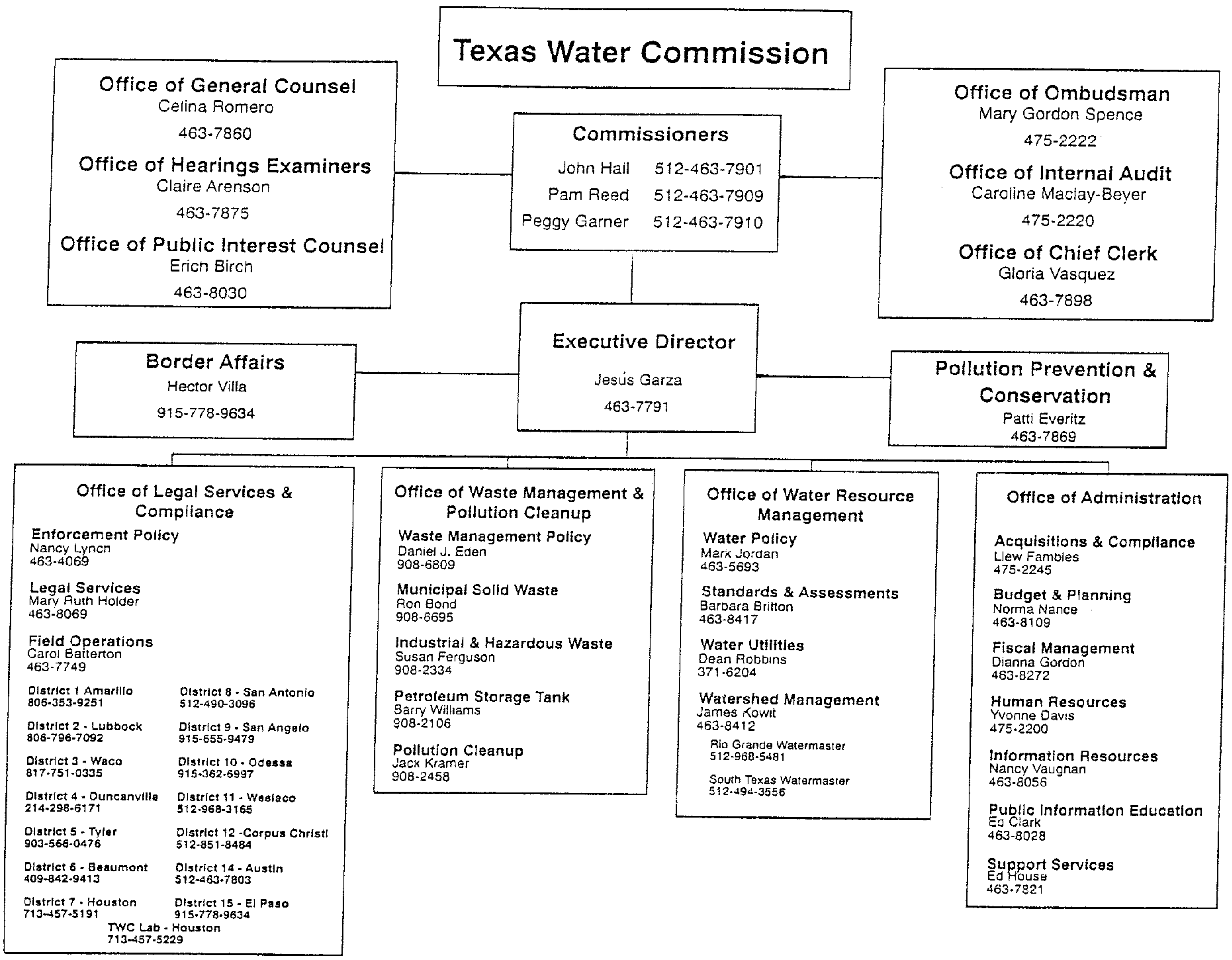
[42] *Id.* § 5.223. The Commission must approve the organizational structure.

[43] *Id.* § 26.023.

[44] *Id.* §§ 26.014; 26.020; 26.042; 26.015; 26.019(a).

[45] *Id.* § 26.027.

Figure 2-3. Texas Water Commission organizational chart.



2.06 Texas Surface Water Assessment[46]

Texas is required by the EPA to periodically assess the quality of its waters to determine the success of its pollution control efforts. Several functions are included in protecting and restoring surface water quality. Establishment of surface water quality standards which designate desirable uses and numerical criteria for Texas' waters is the core of the TNRCC's surface water quality management program. Field studies and waste-load allocation modeling establish wastewater treatment levels that are needed to meet designated water quality standards. Permits which specify wastewater quality for discharges are developed and issued based on findings of these studies, waste-load allocations, and by state regulation.

Wastewater quality is monitored both by permittees responsible for the discharges (self-reporting data), and by TNRCC inspectors during compliance inspections. When self-reporting data or compliance inspection results indicate that permit requirements are being violated, the TNRCC pursues enforcement action to eliminate future permit violations.

Finally, routine fixed-station monitoring and intensive field surveys of ambient surface waters describe the impact of wastewater discharges and control measures on the quality of surface waters. The monitoring data also enable the TNRCC to evaluate surface water standards on a regular basis ensuring that designated criteria and uses are appropriate.

Surface water standards have been established for most rivers and their major tributaries, major reservoirs, and marine waters. At present, the state has designated segment boundaries and segment specific uses and criteria for 14,255 miles of streams; 1,485,889 surface-acres of reservoirs; and 1,990 square miles of bays.

During the 1988-90 reporting cycle, 619 water-bodies were assessed using current ambient monitoring data and professional evaluations. These waters included 16,184 stream miles; 1,543,897 surface-acres of reservoirs; 1,990 square miles of bays; and 3,879 square miles of gulf waters. Evaluated waters are waters assessed based on information other than current site-specific routine monitoring data.

2.061 Assessment Methodology

Use attainability analysis of the state's waters was determined by following criteria established by EPA in the 305(b) guidelines (February 17, 1989). Waters are classified as fully, partially, or not supporting their designated water uses. Waters were assessed using four years of routine surface water monitoring data (October 1, 1985—September 30, 1989), and were reviewed station-by-station, and then compared to the Texas Surface Water Quality Standards (1988).

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[46]Information for this section is taken from the Texas water assessment, *see* Texas Water Commission. 1990. *Texas Water Quality Assessment* 10th ed. (LP90-06). Austin: Texas Water Commission. pp. 1-35.

Waters fully supporting uses are those which do not exceed the criteria in more than 10 percent of the measurements, or that do not have any pollution sources present which could interfere with the use. Waters partially supporting uses are those in which any one pollutant exceeds its criterion in 11 to 25 percent of the measurements and has a mean within the criterion. Waters that are partially supporting uses may have pollution sources present. Waters classified as not supporting uses exceed the criteria in more than 25 percent of the measurements, or have pollution sources likely to impair the use.

Raw domestic water supply as a water use was determined by using the recommended limits required by the Texas Department of Health Drinking Water Standards. The segments for which drinking water supply is a designated use were reviewed and determined to not meet that use, if either chloride or sulfate means were greater than 300 milligrams per liter (mg/L) and/or the total dissolved solids mean was greater than 1000 mg/L.

The degree of use-attainability was determined on the basis of evaluated or monitored assessments. Evaluated waters for use-attainment are water bodies assessed using the professional judgment of knowledgeable biologists or local citizens, and telephone questionnaires rather than current ambient monitoring data. Although this type of assessment is subjective, it is considered valid and a valuable tool for use-assessment.

In order to determine if a water-body meets a fishable and swimmable goal, four years of routine surface water monitoring data were reviewed station-by-station, with respect to the following criteria: if more than 10 percent of the dissolved oxygen measurements were less than 3.0 mg/L, the station was determined to be not fishable. If the geometric mean of each station's fecal coliform bacteria level was greater than 200 organisms/100 mL and/or 10 percent of the measurements were greater than
400 organisms per 100 mL, the station was determined to be not swimmable.

2.062 Water Quality Summary

Based on the TNRCC's recent assessment in the *State of Texas Water Quality Inventory*[47] of classified segments covered by the state's water quality standards,
84 percent of classified stream miles, and 88 percent of the classified reservoirs in the state exhibit suitable water quality to support the major uses designated by TNRCC (i.e., public water supply, contact and non-contact recreation, aquifer protection, and aquatic habitat).[48] Smaller water-bodies that are not classified segments and which are perennial or support perennial aquatic life uses are designated for contact recreation, and at least limited quality aquatic life.

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[47]Texas Water Commission. 1990. *The State of Texas Water Quality Inventory*. 10th ed. (LP 90-06). Austin: Texas Water Commission.

[48]*Id.* p. 2.

About 89 percent of the classified streams, and 99 percent of the classified reservoirs meet the "swimmable" goal of the Clean Water Act. The "fishable" goal of the Act is achieved in more than 99 percent of the classified streams and reservoirs assessed. The causes of major reductions in water quality, ranked by number of river miles affected for rivers not fully supporting uses, include: indicator bacteria suggesting the presence of pathogenic bacteria; salinity, total dissolved solids, and chlorides; and organic enrichment. Sources contributing to major reductions in river water quality, in order of magnitude, include: municipal point-sources, natural sources, and urban runoff and storm sewers.

The most important causes of major degradation in reservoir water quality, ranked by acres affected for lakes not fully supporting uses, include: salinity, total dissolved solids, and chlorides; indicator bacteria suggesting the presence of pathogenic bacteria; and sediment. Sources contributing to major reductions in reservoir quality, in order of magnitude, include: natural sources, municipal point sources, and agricultural activities.

2.07 Texas Water Quality Standards

Under the Clean Water Act, states are required to review water quality standards every three years and to submit any revised or new standards to the EPA for approval.[49] Federal regulations require, as a minimum, that state water quality standards contain:

(1) water-use designations;

(2) the methods and analyses used by the state to support the revisions;

(3) water quality criteria sufficient to support the designated uses;

(4) an antidegradation policy; and

(5) a certification that the standards were adopted under state law.[50]

Under these regulations, uses for water must be designated and numerical criteria developed to protect the designated uses. The basic-use designations recognized by EPA are: public water supply, protection and propagation of fish and wildlife, recreation, agriculture, industry and navigation.[51] A state is free to add new use-classifications to a body of water not covered by these categories, however, before a state can adopt a use-designation not on the EPA list, the state must do an assessment of the factors affecting the attainment of the

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[49] U.S.C. § 1313 (c).

[50] 40 C.F.R. § 131.6.

[51] *Id.* § 131.10(a).

use.[52] The apparent purpose of this exercise is to insure that the new designation requires more stringent numerical standards than existing use-designations with the net result being an upgrading rather than a downgrading of water quality. **Texas is currently operating under standards approved in 1991, but is in the process of reviewing and revising its standards for submission to EPA in 1994. Public input in this process is being sought by the TNRCC.**

2.071 Procedural Requirements for Adopting Texas Water Quality Standards

The TNRCC must hold public hearings before issuing water quality standards.[53] As part of this hearings process, the TNRCC is required to give notice of hearings on water quality standards to affected parties and offer them the opportunity to appear and give relevant evidence and testimony. This listing of possible affected parties may include the NPS which has areas and facilities on regulated waters in Texas. The Commission must consider this testimonial information in the promulgation of revised standards. Prior to submitting the revised standards to EPA for approval, the TWC must publish its standards or amendments and make them available to the public or to interested parties.[54]

The 1991 Texas water quality standards are applicable to all surface waters unless specifically exempted.[55] Texas follows a two-tiered approach in their program. The first tier of protection is based on narrative criteria applicable to unclassified waters and the second tier on site-specific numerical criteria for classified waters.

2.072 General Standards

These standards apply to unclassified waters[56] and specifically, to man-made substances. General parameters do not apply to those instances where the pollution is the result of natural phenomena. About 60,000 miles of small streams in Texas are unclassified, representing about three-fourths of the total surface water streams of the state. For these waters, the general parameters provide the primary standards for water quality protection. The general

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[52]*Id.* § 131.10(g).

[53]Tex. Water Code Ann. § 26.014.

[54]*Id.* § 26.026.

[55]31 Tex. Admin. Code § 307.4 (a).

[56]These are waters for which no site specific numerical criteria have been developed. They apply generally to intermittent streams or to small creeks.

parameters are: (1) aesthetics, (2) radiological materials, (3) toxic substances, (4) nutrients, (5) temperature, (6) salinity, (7) dissolved oxygen, and (8) bacteria.[57]

The water quality standards under the general criteria are not stated as standards in the sense of numerical limitations or requirements, rather, they are stated as *ad hoc* limitations. For example, the aesthetic parameters guidance are based on factors such as color, odor, taste, turbidity, floating and suspended solids, and oil and grease residue.[58] The toxic parameters provide that "surface waters will not be toxic to man or to terrestrial or aquatic life."[59]

2.073 Designated Uses and Numerical Criteria

Following EPA guidelines, the TNRCC has classified various segments of surface waters according to uses. Based on these uses, the Commission has promulgated specific numerical standards for each category. The designated uses are:

[1] Recreation: "Recreational use consists of two subcategories—contact recreation waters and non-contact recreation waters. Classified segments will be designated for contact recreation unless elevated fecal coliform bacteria concentrations frequently occur due to sources of pollution which cannot be reasonably controlled by the existing regulations or contact recreation is considered unsafe for other reasons such as ship or barge traffic. A designation of contact recreation is not a guarantee that the water so designated is completely free of disease causing organisms. In a classified segment where contact recreation is considered unsafe for reasons unrelated to water quality, a designated use of non-contact recreation may be assigned the fecal coliform criteria normally associated with contact recreation."

(A) Contact recreation waters.
- (i) Fecal coliform content shall not exceed 200 colonies per 100 ml as a geometric mean based on a representative sampling of not less than five samples collected over not more than 30 days.
- (ii) Fecal coliform content shall not equal or exceed 400 colonies per 100 ml in more than 10 percent of all samples, but based on at least five samples, taken during any 30 day period. If ten or fewer samples are analyzed, no more than one sample shall exceed 400 colonies per 100 ml.

(B) Non-contact recreation waters.
- (i) Fecal coliform content shall not exceed 2,000 colonies per 100 ml as a geometric mean based on a representative sampling of not less than five samples collected over not more than 30 days.

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[57] 31 Tex. Admin. Code § 307.4 (b) to (i).

[58] *Id.* § 307.4 (b).

[59] *Id.* § 307.4 (d). "Toxic Parameters. Surface waters will not be toxic to man from ingestion of water, consumption of aquatic organisms, or contact with the skin, or to terrestrial or aquatic life. Additional standards requirements for toxic materials are specified in § 307.6 of this title (relating to Toxic Materials)."

(ii) Fecal coliform content shall not equal or exceed 4,000 colonies per 100 ml in more than 10 percent of all samples, but based on at least five samples, taken during any 30 day period. If ten or fewer samples are analyzed, no more than one sample shall exceed 4,000 colonies per 100 ml.[60]

[2] Domestic Water Supply: This use "consists of two use subcategories—public water supply and aquifer protection." Public water supply segments "are those known to be used as the supply source for public water systems, as defined by the Texas Department of Health in 25 TAC § 337 (relating to Drinking Water Standards)". Aquifer protection segments are those "capable of recharging the Edwards Aquifer. The principal purpose of this use designation is to protect the quality of water infiltrating into and recharging the aquifer."[61]

[3] Aquatic Life: "The establishment of numerical criteria for aquatic life is highly dependent on desired use, sensitivities of usual aquatic communities, and local physical and chemical characteristics. Five subcategories of aquatic life are established. They include limited quality, intermediate quality, high quality, and exceptional quality aquatic habitat and oyster waters"[62] (Figure 2-4).

[4] Additional Uses: "Other basic uses, such as navigation, agricultural water supply, and industrial water will be maintained and protected for all water in the state in which these uses can be achieved."[63]

Recreation use standards are based on numerical values for fecal coliform content.[64] The public water supply criteria are based on federal regulations under the Safe Drinking Water Act. Aquatic life standards are based on numerical criteria for dissolved oxygen. The rules also allow for the establishment of numerical and narrative standards for chemical, pH, temperature, or toxic parameters on any designated use.[65]

2.074 Exemptions

The Texas water quality standards allow for significant exceptions to their application. Among the more notable standards are the (1) low-flow conditions, known as the "7Q2" conditions. This is expressed as the 2-year, 7-day minimum flow. It is statistically determined and thus represents the lowest average 7-day flow with a recurrence interval of

[60] *Id.* § 307.7 (b).

[61] *Id.* § 307.7 (2) (A).

[62] *Id.* § 307.7 (3).

[63] *Id.* § 307.7 (5).

[64] The fecal coliform summaries presented in this report are geometric means as opposed to arithmetic means.

[65] *Id.* § 307.7 (4).

Figure 2-4. Aquatic life designated use subcategories and dissolved oxygen criteria.

Aquatic Life Subcategories

Aquatic Life Use Subcategory	Dissolved Oxygen Criteria, mg/L			Aquatic Life Attributes					
	Freshwater mean/minimum	Freshwater in Spring mean/minimum	Saltwater mean/minimum	Habitat Characteristics	Species Assemblage	Sensitive Species	Diversity	Species Richness	Trophic Structure
Exceptional	6.0/4.0	6.0/5.0	5.0/4.0	Outstanding natural variability	Exceptional or unusual	Abundant	Exceptionally high	Exceptionally high	Balanced
High	5.0/3.0	5.5/4.5	4.0/3.0	Highly diverse	Usual association of regionally expected species	Present	High	High	Balanced to slightly imbalanced
Intermediate	4.0/3.0	5.0/4.0	3.0/2.0	Moderately diverse	Some expected species	Very low in abundance	Moderate	Moderate	Moderately imbalanced
Limited	3.0/2.0	4.0/3.0		Uniform	Most regionally expected species absent	Absent	Low	Low	Severely imbalanced

Dissolved oxygen means are applied as an average over a 24-hour period.

Daily minima are not to extend beyond 8 hours per 24-hour day. Lower dissolved oxygen minima may apply on a site-specific basis, when natural daily fluctuations below the mean are greater than the difference between the mean and minima of the appropriate criteria.

Spring criteria to protect fish spawning periods are applied during that portion of the first half of the year when water temperatures are 63.0°F to 73.0°F.

Quantitative criteria to support aquatic life attributes are described in the standards implementation procedures document.

Dissolved oxygen analyses and computer models to establish effluent limits for permitted discharges will normally be applied to mean criteria at steady-state, critical conditions.

Determination of standards attainment for dissolved oxygen criteria is specified in §307.9(d)(6) (relating to Determination of Standards Attainment).

two years;[66] the non-applicability of general criteria to naturally resulting pollutants;[67] and the reasonable mixing-zone—the point where permitted discharges reach surface waters.[68]

2.075 Antidegradation

The antidegradation policy contained in the Water Code[69] and Commission regulations[70] assures protection of water quality at the level for existing uses, and prohibits degradation of existing fishable/swimmable waters below that classification. This policy affords three tiers of protection to the waters in the state. The first level stipulates that the existing uses of the water body will be maintained and protected.[71] The second level affords protection of actual water quality where the quality of waters exceed the typical fishable/swimmable criteria. The quality of these waters in the area impacted by the discharge outside the mixing zone can only be lowered, if necessary, for important social and economic development.[72] The third level provides special protection to those high quality waters for which ordinary use classifications do not suffice, denoted as "Outstanding National Resource Waters (ONRW)". These waters are defined as "high quality waters within *or adjacent to* national parks and wildlife refuges, state parks, wild and scenic rivers designated by law, and other designated areas of *exceptional recreational and ecological significance*" [emphasis added].[73]

The TNRCC's rules provide a procedure by which the staff will review discharge permit applications to assure that the antidegradation policy is followed. If water quality is degraded, the staff must determine if the "economic or social development" balancing test is satisfied. If a discharge application invokes the antidegradation policy, interested persons must be notified and provided an opportunity to present comments and information to the Commission about the permit and potential degradation.

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[66]*Id.* § 307.8. During "7Q2" conditions, the site specific standards of § 307.7, the total chronic toxicity limits of § 307.6, the maximum temperature differentials, the dissolved oxygen levels, and fecal coliform for unclassified water *do not* apply.

[67]*Id.* § 307.4(a).

[68]*Id.* § 307.8(b).

[69]Tex. Water Code Ann. § 26.003.

[70]31 Tex. Admin. Code § 307.5.

[71]*Id.* § 307.5 (b)(1).

[72]*Id.* § 307.5 (b)(2).

[73]*Id.* § 307.5 (b)(3).

3.0 FINDINGS

This study provides a substantial amount of water use and quality information associated with water quality in the nine units of the national parks in Texas. The findings are organized to generally correspond to the major objectives of the study. Information is presented on a park-by-park basis for (1) river basin characteristics[74]; (2) water-based recreational uses and water-dependent resource needs;[75] (3) stream segmentation, designated uses and state water quality standards by stream segments;[76] (4) water quality assessments;[77] and (5) water quality concerns as expressed by park staff.[78]

3.01 National Parks on the Rio Grande

3.011 River Basin Data[79]

Three units of the National Park System in Texas: Amistad National Recreation Area, Big Bend National Park and Rio Grande Wild and Scenic River, are located along the banks of the Rio Grande. This general discussion of the Rio Grande basin applies to all three units, although each park unit will be discussed separately in this section.

The Rio Grande originates in southern Colorado, flows southerly across New Mexico, and enters Texas about 20 miles northwest of El Paso (Figure 3-1). It forms the international boundary between the United States and Mexico from El Paso to the Gulf of Mexico. The total basin drainage area is 182,215 square miles of which 88,960 square miles is in the United States and 48,260 square miles in Texas.

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[74]River basin information is from Texas Water Development Board. 1990. *Water for Texas: Today and Tomorrow*. Austin: Texas Water Development Board. For greater discussion on each basin see Appendix A .

[75]Water needs for each park were determined from an analysis of park master plans, environmental assessments, resource management plans and/or scoping reports.

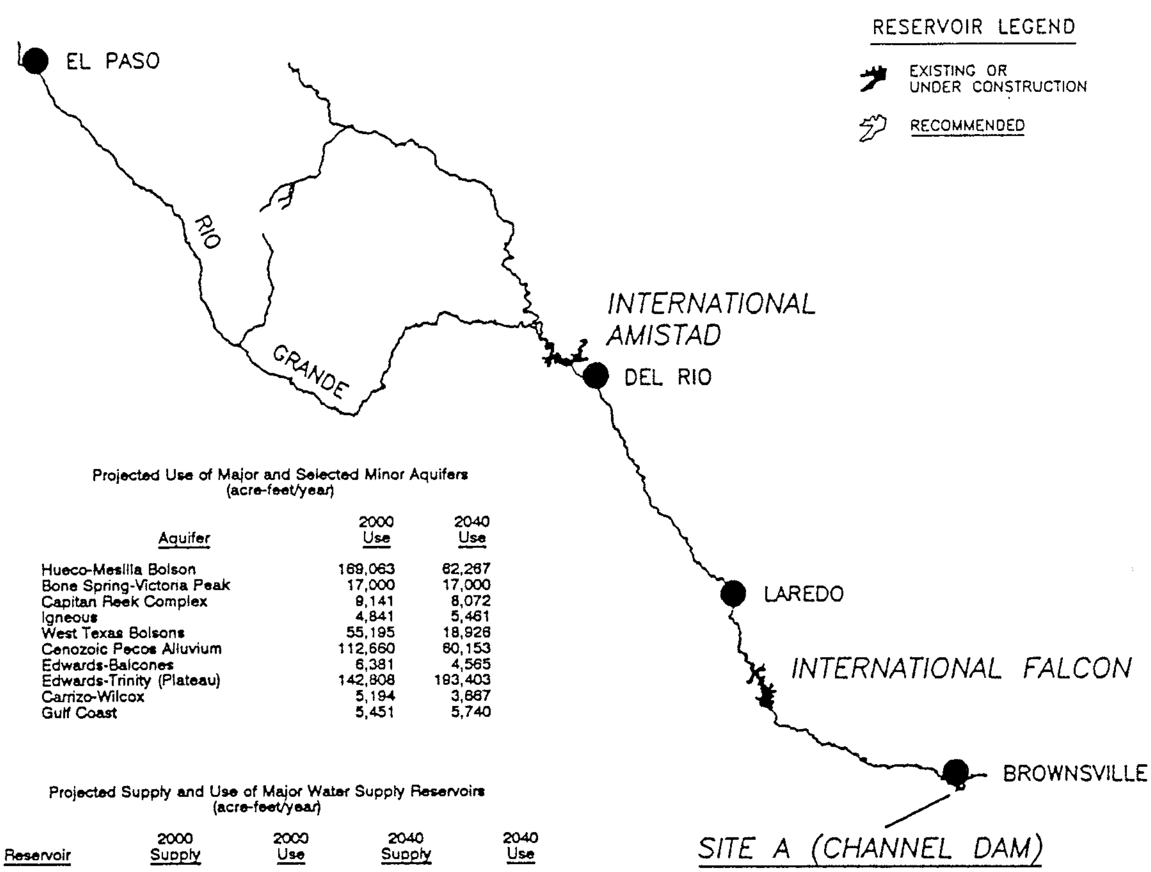
[76]Stream segments, designated uses, and water quality standards are from the text of the Texas Surface Water Quality Standards found in 31 Tex. Admin. Code § 307.1 to 307.10.

[77]Information on water quality assessments on stream segments are from Texas Water Commission. 1990. *The State of Texas Water Quality Inventory*. 10th ed. (LP 90-06). Austin: Texas Water Commission.

[78]The synopsis of park concerns is based on personal interviews, site visits, and communication with park staff. Each park superintendent was sent a copy of the 1991 Texas Water Quality Standards for their park and was asked to comment.

[79]For a more detailed discussion on the river basin *see* Appendix A.

Figure 3-1. Rio Grande basin.



Projected Use of Major and Selected Minor Aquifers
(acre-feet/year)

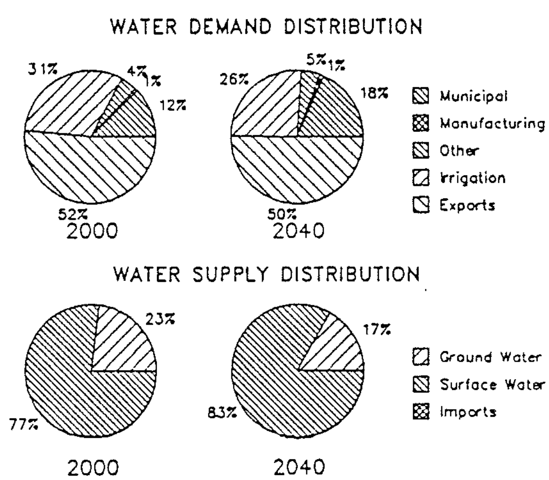
Aquifer	2000 Use	2040 Use
Hueco-Mesilla Bolson	169,063	82,267
Bone Spring-Victoria Peak	17,000	17,000
Capitan Reek Complex	9,141	8,072
Igneous	4,841	5,461
West Texas Bolsons	55,195	18,928
Cenozoic Pecos Alluvium	112,660	60,153
Edwards-Balcones	6,381	4,565
Edwards-Trinity (Plateau)	142,808	193,403
Carrizo-Wilcox	5,194	3,687
Gulf Coast	5,451	5,740

Projected Supply and Use of Major Water Supply Reservoirs
(acre-feet/year)

Reservoir	2000 Supply	2000 Use	2040 Supply	2040 Use
Falcon-Amistad	1,500,000	1,418,060	1,500,000	1,500,000
Rio Grande Project	128,700	128,700	128,700	128,700
Site A Channel Dam	0	0	85,000	84,081

PROJECTED WATER DEMANDS AND SUPPLIES
(acre-feet/year)

ITEM	2000	2040
IN-BASIN DEMAND		
Municipal	277,516	474,030
Manufacturing	15,800	25,607
Steam Electric	16,000	21,000
Mining	54,346	75,343
Irrigation	710,815	673,060
Livestock	21,804	21,804
Total In-Basin Demands	1,096,281	1,290,844
IN-BASIN SUPPLIES		
Ground Water	532,700	388,910
Surface Water	1,725,352	1,750,557
Total In-Basin Supplies	2,258,052	2,139,467
TRANSFERS		
Import Supplies	0	0
Export Demands	1,168,488	1,298,767
ADDITIONAL NEW SUPPLIES	61,100	175,000
AGRICULTURAL SHORTAGE	(27,557)	(171,447)
NET AVAILABILITY	81,940	(103,697)



Tributaries in the upper reach of the Rio Grande from below El Paso to Amistad Dam include the Devils River, Alamito Creek, and the Pecos River on the American side, and the Rio Conchos on the Mexican side. The waters of the Rio Grande Basin vary greatly in quality because of the basin's size and the wide range of geologic conditions which exist in the basin. Most of the flow of the Rio Grande in the area around El Paso is diverted for irrigation and municipal uses. Below El Paso, most of the flow consists of treated municipal wastewater and irrigation return flows. While these flows are relatively high in dissolved solids, they are periodically diluted by local storm runoff. As a result, water quality improves as inflows of good quality water enter downstream.

The Devils River and Alamito Creek are of excellent quality with total dissolved solids normally under 500 to 600 mg/L. By contrast, the Pecos River is a major source of salt in the Rio Grande Basin and the Rio Conchos has been identified as a source of pesticides to the Rio Grande.

3.02 Amistad National Recreation Area

Amistad National Recreation Area[80] is located on the Texas-Mexico border near the town of Del Rio in Val Verde County, Texas (Figure 3-2). Its main feature is Lake Amistad, an immense reservoir fed by the Rio Grande, Pecos, and Devils rivers. The recreation area contains 57,292 acres, including 43,250 acres of water. Recreational opportunities include boating, camping, fishing, hunting, picnicking, scuba diving, and swimming. Natural amenities include rock formations in upstream canyons and semidesert plants and animals. Recreational activities and park resources have been managed by the NPS under a 1965 agreement with the International Boundary and Water Commission.

One National Register site and four National Register districts are within or adjacent to Lake Amistad. These contain rock art paintings and archeological sites as well as midden deposits which may contain a prehistoric record of as long ago as 10,000 years.

3.021 Water Uses

Water-dependent recreational activities in the Amistad Recreation Area include body- contact requirements for swimming, rafting, boating, and non-body contact for fishing. In additional to these water-based recreation uses, water quality needs exist for protection of aquatic life and riparian vegetation.

3.022 River Segments and Water Quality Standards

The stream segments that are important to the Amistad Recreation Area are segments 2306 and 2305 of the Rio Grande, segment 2309 of the Devils River and segment 2310 of the

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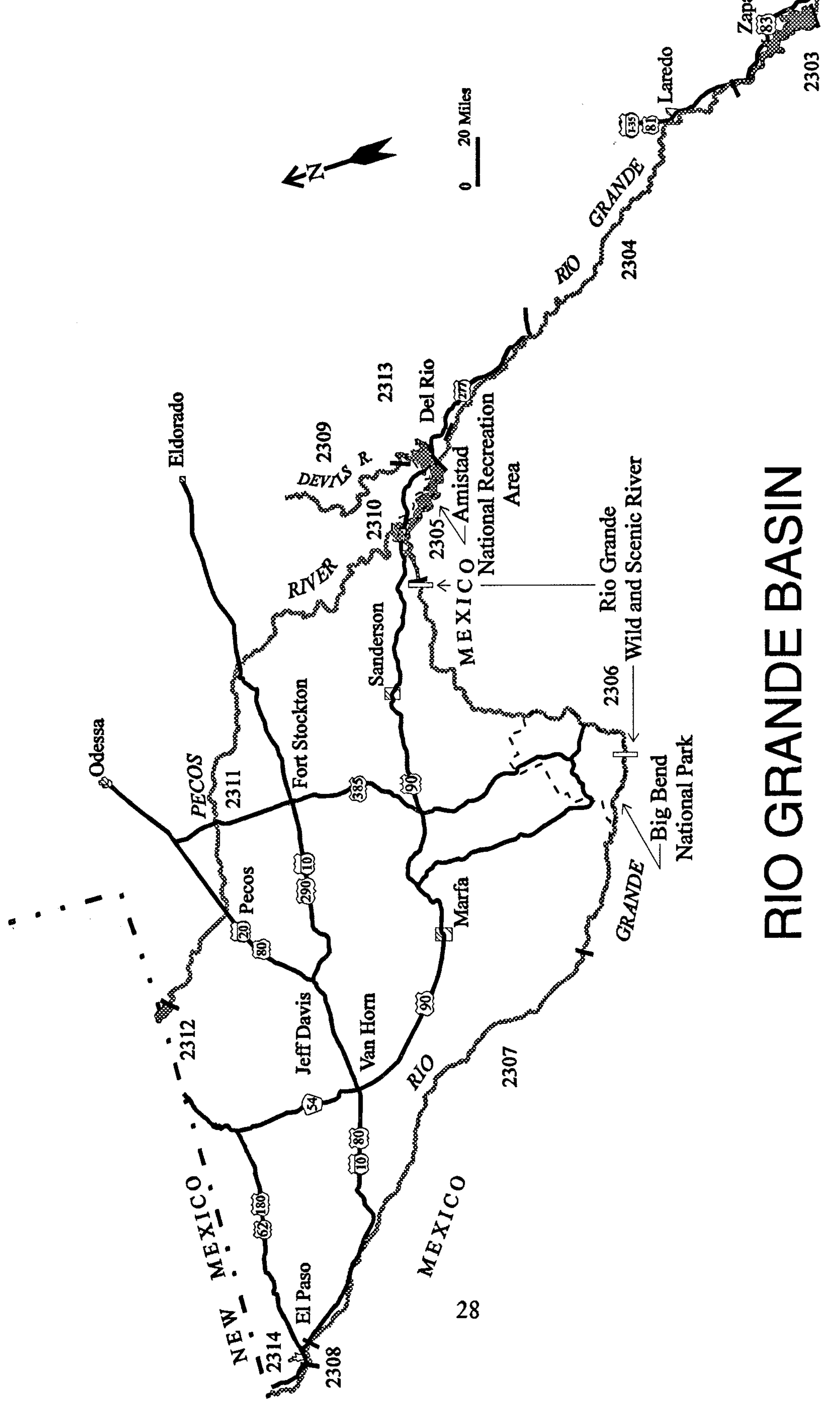
[80]Information taken from the Park Master Plan.

Figure 3-2. River segments and park locations, Rio Grande basin.



Pecos River. These segments include stretches of river within and above the Amistad recreation area and reservoir. Designated uses for these two segments include contact recreation, protection of aquatic life and public water supply. The existing water quality standards appear to adequately protect the recreational uses of the Amistad National Recreation Area.

3.023 Synopsis of Park Concerns

Staff commented that they had limited expertise in evaluating water quality needs and were unable to offer substantive comments about the water quality standards or the stream segments.

3.03 Big Bend National Park

Big Bend National Park, established in 1944, is located in the southern part of the Trans-Pecos area of Texas at the "big bend" of the Rio Grande.[81] Located in a sparsely populated region of the state, the park preserves a representative portion of the montane, deserts, and riverine environments found in the northern Chichuahuan Desert (Figure 3-2).

Big Bend displays some of the finest mountain scenery in the United States and is a land of contrasts. There are vast, unbounded vistas, huge erosional forms, upthrust mountain masses, spectacular canyons, wooded peaks, river-swept floodplains, and a large tract of the upper and lower Chihuahuan Desert. Diverse species of plants and wildlife abound with more than 1,000 known species of plants, more than 65 known mammals, more than 385 known birds, more than 55 known reptiles, more than 35 known fish, and at least 10 amphibian species are known to reside within park boundaries.

Water plays an important role in this diverse environment, strongly influencing the surface geology and the distribution of ecological communities. Approximately 107 miles of the Rio Grande are contained within the boundaries of Big Bend, and the Rio Grande Wild and Scenic River includes another 138 miles. Other surface water features include intermittent streams, more than 200 springs and many seeps, tinajas, stock tanks and other man-made water structures.[82]

3.031 Park Water Uses

Water-dependent recreational activities include body contact requirements for swimming, rafting, boating, and non-body contact for fishing. In addition to these water based recreation uses, water quality needs exist for protection of aquatic and riparian flora and fauna. The provision of an adequate and safe drinking-water supply for park facilities, visitor centers and maintenance operations is a specific water need.[83]

3.032 River Segments and Water Quality Standards

Two river segments (2306 and 2307) are relevant to Big Bend. These segments are among the longest of all the river segments in the state. Segment 2306 is 313 miles long and Segment 2307 is 222 miles long. The river's water quality has been monitored by the Texas Natural Resources Conservation Commission (and it predecessor agencies) in cooperation

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[81]Information derived from Park Master Plan.

[82]*See* Water Resources Division. 1992. *Big Bend National Park Water Resources Scoping Report.* (NPS/NRWRD/NRTR-92/08). Denver: National Park Service, Technical Information Center. p. v.

[83]*Id.* pp. 4-8.

with the International Boundary Commission, for about 25 years. The park uses this data as water quality references.

Designated water uses on both segments include contact recreation, high quality aquatic habitat and public water supply. These uses appear adequate to protect park recreation uses, however, the adequacy of the standards to protect the biological resources of the park are subject to speculation. The few preliminary water quality and biological studies conducted in the two river segments from below El Paso to the southeastern boundary of the park,[84] taken together, indicate that water quality degradation has probably occurred. However, the park has no systematic program to monitor changes occurring within the riparian zone or to water-dependent resources and the values associated with those resources.[85] The river's water quality has been monitored by the Texas Water Commission for about 25 years, of which the park uses as a reference guide.

Known water quality problems on the 2306 segment includes elevated fecal coliform bacteria levels so that a portion of the segment does not meet swimmable criteria. The 2307 segment has experienced elevated levels of chloride, sulfate, and dissolved solids from natural causes. Chloride levels along this segment exceed the Texas Department of Health drinking water criteria.

3.033 Synopsis of Park Concerns

A number of water quality problems do exist on both river segments. Among the concerns expressed by staff are:

(1) The biocide load carried by the Rio Conchos tributary which adds to the problems on the Rio Grande;

(2) the criteria for dissolved oxygen is set too low—consideration should be given to raising the numerical standards;

(3) water quality monitoring requires a long-term comprehensive program commitment; and

(4) serious consideration should be given to reevaluating the present water quality standards to protect park resources.

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[84]*Id.* pp. 15-18.

[85]*Id.* p. 23.

3.04 Rio Grande Wild and Scenic River

One of the primary reasons for including the Rio Grande in the National Wild and Scenic Rivers System is to preserve it in a free-flowing condition, free from impoundments. The 195-mile Rio Grande segment, designated in 1978, begins at a point just above Mariscal Canyon within the park and runs downstream to the Terrell-Val Verde County line. The boundary of the Rio Grande Wild and Scenic River includes only the river area from the United States/Mexico international boundary in the center of the river to the mean high-water line on the Texas side of the river. Of the land ownership along the Texas side of the river, 35% is within the Big Bend National Park; 22% is within the state Black Gap Wildlife Management Area; and 43% is in private ownership.[86] The river bed of the section of the Wild and Scenic River downstream from the Big Bend National Park is the property of the state of Texas.

The NPS has no authority to manage the non-federal land or resources adjacent to the river, nor to control the river in contravention of treaties between the United States and Mexico. That portion of the river within the Big Bend National Park is managed according the Big Bend General Management Plan and NPS policy. For the stretches of the river outside the park, the NPS must rely on cooperative relationships with the Government of Mexico, the State of Texas, local governments, and private landowners to manage the river. In implementing this cooperative management framework, the NPS seeks to preserve the scenic and wilderness values and to permit recreational uses compatible with those values.[87]

3.041 Water Uses

Water-dependent recreational activities include body-contact requirements for swimming, rafting, boating, and non-body contact for fishing and camping. In addition to these water-based recreation uses, water quality needs exist for protection of aquatic life and riparian vegetation.

3.042 River Segments and Water Quality Standards

The Wild and Scenic River is located in river segment 2306 and is administered by the Big Bend National Park (Figure 3-2). Designated uses include contact recreation, high quality aquatic habitat, and public water supply. While the designated uses adopted by the TWC appear adequate to protect the Wild and Scenic River's recreation uses, they may not be adequate to protect the biological and cultural resources from impairment. The few preliminary water quality and biological studies conducted in the two river segments from

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[86] National Park Service. 1981. *Final General Management Plan/Development Concept Plan—Rio Grande Wild and Scenic River*. Denver: U.S. Department of the Interior. p.6.

[87] *Id.* p. 20. The NPS manages the river according to the dictates of the Wild and Scenic Rivers Act [16 U.S.C. § 1271 *et seq* (1976)], and consistent with the provisions of the NPS Organic Act [16 U.S.C. § 1 *et seq* (1916)].

below El Paso to the south boundary of the river,[88] taken together, indicate that water quality degradation has probably occurred (Figures 3-3, 3-4, and 3-5). However, the river has no systematic program to monitor changes occurring within the riparian zone, nor to water-dependent resources and the values associated with those resources.[89]

A total of 12 discharge permits have been issued for this 313 mile stretch of river. Known water quality problems originate from the Rio Conchos river. These include periodic elevations of fecal coliform bacteria, chloride, sulfate, and total dissolved solids downstream of the Rio Conchos and Rio Grande confluence.

3.043 Synopsis of Park Concerns

The comments associated with Big Bend National Park are applicable to this segment of the river. Among the concerns expressed by staff are:

(1) The biocide load carried by the Rio Conchos tributary which adds to the problems on the Rio Grande;

(2) the criteria for dissolved oxygen is set too low—consideration should be give to raising the numerical standards;

(3) water quality monitoring needs to be improved; and

(4) serious consideration should be given to reevaluating the present water quality standards to protect park resources.

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[88] *Id.* pp. 15-18.

[89] *Id.* p. 23.

Figure 3-3. River segments for the basin.

23 RIO GRANDE RIVER BASIN

2301 Rio Grande Tidal - from the confluence with the Gulf of Mexico in Cameron County to a point 10.8 kilometers (6.7 miles) downstream of the International Bridge in Cameron County

2302 Rio Grande Below Falcon Reservoir - from a point 10.8 kilometers (6.7 miles) downstream of the International Bridge in Cameron County to Falcon Dam in Starr County

2303 International Falcon Reservoir - from Falcon Dam in Starr County to the confluence of the Arroyo Salado (Mexico) in Zapata County, up to the normal pool elevation of 301.1 feet (impounds Rio Grande)

2304 Rio Grande Below Amistad Reservoir - from the confluence of the Arroyo Salado (Mexico) in Zapata County to Amistad Dam in Val Verde County

2305 International Amistad Reservoir - from Amistad Dam in Val Verde County to a point 1.8 kilometers (1.1 miles) downstream of the confluence of Ramsey Canyon on the Rio Grande Arm in Val Verde County and to a point 0.7 kilometer (0.4 mile) downstream of the confluence of Painted Canyon on the Pecos River Arm in Val Verde County and to a point 0.6 kilometer (0.4 mile) downstream of the confluence of Little Satan Creek on the Devils River Arm in Val Verde County, up to the normal pool elevation of 1117 feet (impounds Rio Grande)

2306 Rio Grande Above Amistad Reservoir - from a point 1.8 kilometers (1.1 miles) downstream of the confluence of Ramsey Canyon in Val Verde County to the confluence of the Rio Conchos (Mexico) in Presidio County

2307 Rio Grande Below Riverside Diversion Dam - from the confluence of the Rio Conchos (Mexico) in Presidio County to Riverside Diverson Dam in El Paso County

2308 Rio Grande Below International Dam - from the Riverside Diversion Dam in El Paso County to International Dam in El Paso County

2309 Devils River - from a point 0.6 kilometer (0.4 mile) downstream of the confluence of Little Satan Creek in Val Verde County to the confluence of Dry Devils River in Sutton County

2310 Lower Pecos River - from a point 0.7 kilometer (0.4 mile) downstream of the confluence of Painted Canyon in Val Verde County to the low water crossing 0.3 kilometer (0.2 mile) downstream of the confluence of Big Fielder Draw in Val Verde County

2311 Upper Pecos River - from the low water crossing 0.3 kilometer (0.2 mile) downstream of the confluence of Big Fielder Draw in Val Verde County to Red Bluff Dam in Loving/Reeves County

2312 Red Bluff Reservoir - from Red Bluff Dam in Loving/Reeves County to the New Mexico State Line in Loving/Reeves County, up to the normal pool elevation of 2842 feet (impounds Pecos River)

2313 San Felipe Creek - from the confluence with the Rio Grande in Val Verde County to a point 4.0 kilometers (2.5 miles) upstream of US 90 in Val Verde County

2314 Rio Grande Above International Dam - from International Dam in El Paso County to the New Mexico State Line in El Paso County

Figure 3-4. Texas surface water quality standards by river segment.

RIO GRANDE BASIN		USES				CRITERIA						
SEGMENT NUMBER	SEGMENT NAME	RECREATION	AQUATIC LIFE	DOMESTIC WATER SUPPLY	OTHER	CHLORIDE (mg/L) Annual average not to exceed	SULFATE (mg/L) Annual average not to exceed	TOTAL DISSOLVED SOLIDS (mg/L) Annual average not to exceed	DISSOLVED OXYGEN (mg/L)	pH RANGE	FECAL COLIFORM (#/100 mL) Thirty-day geometric mean not to exceed	TEMPERATURE (°F) Not to exceed
2301	Rio Grande Tidal	CR	E						5.0	6.5-9.0	200	95
2302	Rio Grande Below Falcon Reservoir	CR	H	PS		270	350	880	5.0	6.5-9.0	200	90
2303	International Falcon Reservoir	CR	H	PS		140	300	700	5.0	6.5-9.0	200	93
2304	Rio Grande Below Amistad Reservoir	CR	H	PS		200	300	1,000	5.0	6.5-9.0	200	95
2305	International Amistad Reservoir	CR	H	PS		150	270	800	5.0	6.5-9.0	200	88
2306	Rio Grande Above Amistad Reservoir	CR	H	PS		300	570	1,550	5.0	6.5-9.0	200	93
2307	Rio Grande Below Riverside Diversion Dam	CR	H	PS		300	550	1,500	5.0*	6.5-9.0	200	93
2308	Rio Grande Below International Dam	NCR	L			250	450	1,400	3.0	6.5-9.0	2,000	95
2309	Devils River	CR	E	PS		30	20	300	6.0	6.5-9.0	200	90
2310	Lower Pecos River	CR	H	PS		1,000	500	3,000	5.0	6.5-9.0	200	92
2311	Upper Pecos River	CR	H			7,000	3,500	15,000	5.0	6.5-9.0	200	92
2312	Red Bluff Reservoir	CR	H			6,000	3,500	15,000	5.0	6.5-9.0	200	90
2313	San Felipe Creek	CR	H	PS		25	30	500	5.0	6.5-9.0	200	90
2314	Rio Grande Above International Dam	CR	H	PS		340	600	1,800	5.0	6.5-9.0	200	92

* The dissolved oxygen criterion in the upper reach of Segment 2307 (Riverside Diversion Dam to the end of the rectified channel below Fort Quitman) shall be 3.0 mg/L when headwater flow over the Riverside Diversion Dam is less than 35 ft^3/s.

Figure 3-5. Surface water quality data by river segment.

Segment 2305 of the Rio Grande Basin

NAME: International Amistad Reservoir

DESCRIPTION: from Amistad Dam in Val Verde County to a point 1.8 kilometers (1.1 miles) downstream of the confluence of Ramsey Canyon on the Rio Grande Arm in Val Verde County and to a point 0.7 kilometer (0.4 mile) downstream of the confluence of Painted Canyon on the Pecos River Arm in Val Verde County and to a point 0.6 kilometer (0.4 mile) downstream of the confluence of Little Satan Creek on the Devils River Arm in Val Verde County, up to the normal pool elevation of 1117 feet (impounds Rio Grande)

SEGMENT CLASSIFICATION: Water Quality Limited

LENGTH: 75 miles (120 kilometers)

SURFACE AREA: 64,890 acres

DESIGNATED WATER USES: Contact Recreation
High Quality Aquatic Habitat
Public Water Supply

MONITORING STATIONS: 2305.0200, 2305.0300, 2305.0350, 2305.0400, 2305.0500

INTENSIVE SURVEYS: 20 Feb 1974 Q,F,C,S,P,A,B IMS-21 (Kirkpatrick)

PERMITTED FACILITIES (FINAL):

There are no permitted facilities discharging to this segment.

KNOWN WATER QUALITY PROBLEMS/WATER QUALITY STANDARD COMPARISON:

Chloride levels in the Pecos River arm of the reservoirs exceed the Texas Department of Health drinking water criteria.

POTENTIAL WATER QUALITY PROBLEMS:

Elevated chloride and sulfate levels occur persistently in Pecos River area of the lake. Elevated levels of chloride, sulfate and total dissolved solids occur periodically in the main body of the Reservoir.

WATER QUALITY STATUS:

THE FOLLOWING TABLE ILLUSTRATES THE LAST FOUR YEARS (OCT. 1, 1985 THRU SEPT. 30, 1989) OF WATER QUALITY INFORMATION FOR SEGMENT 2305.

PARAMETER	CRITERIA	NUMBER SAMPLES	MINIMUM	MAXIMUM	MEAN	NUMBER OF VALUES OUTSIDE CRITERIA	MEAN VALUES OUTSIDE CRITERIA
DISSOLVED OXYGEN (MG/L)	5.0	84	4.1	14.2	9.2	1	4.1
TEMPERATURE (F)	88.0	88	47.2	87.8	64.0	0	0
PH	6.5-9.0	75	7.1	9.2	8.2	1	9.2
CHLORIDE (MG/L)	150	77	48	1238	246	51	308
SULFATE (MG/L)	270	77	73	734	300	40	351
TOTAL DISSOLVED SOLIDS (MG/L)	800	85	313	2480	905	21	1719
FECAL COLIFORMS (#/100 ML)	200	46	1	10	1	0	0

TOTAL DISSOLVED SOLIDS WERE ESTIMATED BY MULTIPLYING SPECIFIC CONDUCTANCE BY .50

Figure 3-5 (cont.).

Segment 2306 of the Rio Grande Basin

NAME: Rio Grande Above Amistad Reservoir

DESCRIPTION: from a point 1.8 kilometers (1.1 miles) downstream of the confluence of Ramsey Canyon in Val Verde County to the confluence of the Rio Conchos (Mexico) in Presidio County

SEGMENT CLASSIFICATION: Water Quality Limited

LENGTH: 313 miles (503 kilometers)

DESIGNATED WATER USES: Contact Recreation
High Quality Aquatic Habitat
Public Water Supply

MONITORING STATIONS: 2306.0250, 2306.0300

INTENSIVE SURVEYS: None

PERMITTED FACILITIES (FINAL):

Domestic	8 outfalls	0.57 MGD
Industrial	4 outfalls	0.28 MGD
Total	12 outfalls	0.84 MGD

KNOWN WATER QUALITY PROBLEMS/WATER QUALITY STANDARD COMPARISON:

Elevated fecal coliform bacteria levels occur periodically downstream of the Rio Conchos confluence. A portion of this segment does not meet swimmable criteria due to elevated levels of fecal coliform bacteria.

POTENTIAL WATER QUALITY PROBLEMS:

Chloride, sulfate and total dissolved solids are periodically elevated downstream from the Rio Conchos. Elevated nutrients and slightly elevated chlorophyll a levels exist in this segment.

WATER QUALITY STATUS:

THE FOLLOWING TABLE ILLUSTRATES THE LAST FOUR YEARS (OCT. 1, 1985 THRU SEPT. 30, 1989) OF WATER QUALITY INFORMATION FOR SEGMENT 2306.

PARAMETER	CRITERIA	NUMBER SAMPLES	MINIMUM	MAXIMUM	MEAN	NUMBER OF VALUES OUTSIDE CRITERIA	MEAN VALUES OUTSIDE CRITERIA
DISSOLVED OXYGEN (MG/L)	5.0	52	5.4	12.5	7.8	0	0
TEMPERATURE (F)	93.0	55	44.6	86.0	66.6	0	0
PH	6.5-9.0	53	6.5	8.7	7.8	0	0
CHLORIDE (MG/L)	300	54	7	429	223	13	349
SULFATE (MG/L)	570	54	69	662	402	6	612
TOTAL DISSOLVED SOLIDS (MG/L)	1550	52	420	1500	911	0	0
FECAL COLIFORMS (#/100 ML)	200	37	1	3700	32	11	680

TOTAL DISSOLVED SOLIDS WERE ESTIMATED BY MULTIPLYING SPECIFIC CONDUCTANCE BY .50

Figure 3-5 (cont.).

Segment 2307 of the Rio Grande Basin

NAME: Rio Grande Below Riverside Diversion Dam

DESCRIPTION: from the confluence of the Rio Conchos (Mexico) in Presidio County to Riverside Diverson Dam in El Paso County

SEGMENT CLASSIFICATION: Effluent Limited

LENGTH: 222 miles (357 kilometers)

DESIGNATED WATER USES: Contact Recreation
High Quality Aquatic Habitat
Public Water Supply

MONITORING STATIONS: 2307.0050, 2307.0160

INTENSIVE SURVEYS: None

PERMITTED FACILITIES (FINAL):

Domestic	21 outfalls	109.47 MGD
Industrial	17 outfalls	0.19 MGD
Total	38 outfalls	109.66 MGD

KNOWN WATER QUALITY PROBLEMS/WATER QUALITY STANDARD COMPARISON:

Depressed dissolved oxygen levels and pH levels less than the stream criteria have been recorded. Elevated levels of chloride, sulfate, and total dissolved solids regularly occur due to springs and seeps along the river. This segment exceeds the Texas Department of Health drinking water criteria due to elevated chloride levels.

POTENTIAL WATER QUALITY PROBLEMS:

Fecal coliform levels are periodically elevated. Phosphorus levels are elevated; chlorophyll a levels are slightly elevated.

WATER QUALITY STATUS:

THE FOLLOWING TABLE ILLUSTRATES THE LAST FOUR YEARS (OCT. 1, 1985 THRU SEPT. 30, 1989) OF WATER QUALITY INFORMATION FOR SEGMENT 2307.

PARAMETER	CRITERIA	NUMBER SAMPLES	MINIMUM	MAXIMUM	MEAN	NUMBER OF VALUES OUTSIDE CRITERIA	MEAN VALUES OUTSIDE CRITERIA
DISSOLVED OXYGEN (MG/L)	5.0	47	4.5	12.2	7.5	5	4.6
TEMPERATURE (F)	93.0	50	41.9	89.6	65.9	0	0
PH	6.5-9.0	48	6.0	8.9	7.9	1	6.0
CHLORIDE (MG/L)	300	49	160	1194	423	31	543
SULFATE (MG/L)	550	49	229	897	439	13	673
TOTAL DISSOLVED SOLIDS (MG/L)	1500	41	548	1900	1175	11	1711
FECAL COLIFORMS (#/100 ML)	200	40	1	1400	19	9	397

TOTAL DISSOLVED SOLIDS WERE ESTIMATED BY MULTIPLYING SPECIFIC CONDUCTANCE BY .50

Segment 2308 of the Rio Grande Basin

NAME: Rio Grande Below International Dam

DESCRIPTION: from the Riverside Diversion Dam in El Paso County to International Dam in El Paso County

SEGMENT CLASSIFICATION: Effluent Limited

LENGTH: 15 miles (24 kilometers)

DESIGNATED WATER USES: Noncontact Recreation
Limited Quality Aquatic Habitat

MONITORING STATIONS: 2308.0050

INTENSIVE SURVEYS: 12 Oct 1977 Q,F,C,S,P,I,B IMS-82 (Ottmers: 1979)

PERMITTED FACILITIES (FINAL):

Domestic	2 outfalls	27.72 MGD
Industrial	6 outfalls	0.21 MGD
Total	8 outfalls	27.93 MGD

KNOWN WATER QUALITY PROBLEMS/WATER QUALITY STANDARD COMPARISON:

No stream violations have been recorded during this reporting period.

POTENTIAL WATER QUALITY PROBLEMS:

Phosphorus is frequently elevated. Chlorophyll a levels are slightly elevated.

RELATIVE SIGNIFICANCE OF POINT AND NONPOINT SOURCE POLLUTANTS:

A major contributor of pollutants is the El Paso Public Service Board Haskell Street WWTP, which discharges greater than 20 MGD of municipal effluent. The relative significance of nonpoint sources of pollutants is unknown.

CONTROL PROGRAMS:

A waste load evaluation was published in February 1986. It recommended a wastewater treatment level of secondary for dischargers to the segment.

FACTORS NEEDING CLARIFICATION WITH RESPECT TO CAUSE/EFFECT RELATIONSHIPS:

None.

KNOWN RELATIONSHIPS TO OTHER ENVIRONMENTAL PROBLEMS:

None.

WATER QUALITY STATUS:

THE FOLLOWING TABLE ILLUSTRATES THE LAST FOUR YEARS (OCT. 1, 1985 THRU SEPT. 30, 1989) OF WATER QUALITY INFORMATION FOR SEGMENT 2308.

PARAMETER	CRITERIA	NUMBER SAMPLES	MINIMUM	MAXIMUM	MEAN	NUMBER OF VALUES OUTSIDE CRITERIA	MEAN VALUES OUTSIDE CRITERIA
DISSOLVED OXYGEN (MG/L)	3.0	22	4.5	12.5	7.9	0	0
TEMPERATURE (F)	95.0	23	43.7	78.8	60.5	0	0
PH	6.5-9.0	18	6.9	8.4	7.9	0	0
CHLORIDE (MG/L)	250	23	50	220	107	0	0
SULFATE (MG/L)	450	22	132	394	211	0	0
TOTAL DISSOLVED SOLIDS (MG/L)	1400	3	345	714	566	0	0
FECAL COLIFORMS (#/100 ML)	2000	19	1	440	21	0	0

TOTAL DISSOLVED SOLIDS WERE ESTIMATED BY MULTIPLYING SPECIFIC CONDUCTANCE BY .50

Figure 3-5 (cont.).

Segment 2309 of the Rio Grande Basin

NAME: Devils River

DESCRIPTION: from a point 0.6 kilometer (0.4 mile) downstream of the confluence of Little Satan Creek in Val Verde County to the confluence of Dry Devils River in Sutton County

SEGMENT CLASSIFICATION: Effluent Limited

LENGTH: 67 miles (108 kilometers)

DESIGNATED WATER USES: Contact Recreation
Exceptional Quality Aquatic Habitat
Public Water Supply

MONITORING STATIONS: 2309.0100

INTENSIVE SURVEYS: None

PERMITTED FACILITIES (FINAL):

Domestic	6 outfalls	1.44 MGD
Industrial	0 outfalls	0.00 MGD
Total	6 outfalls	1.44 MGD

KNOWN WATER QUALITY PROBLEMS/WATER QUALITY STANDARD COMPARISON:

None.

POTENTIAL WATER QUALITY PROBLEMS:

Levels of nitrate nitrogen are persistently elevated, probable cause is spring flow to the river.

WATER QUALITY STATUS:

THE FOLLOWING TABLE ILLUSTRATES THE LAST FOUR YEARS (OCT. 1, 1985 THRU SEPT. 30, 1989) OF WATER QUALITY INFORMATION FOR SEGMENT 2309.

PARAMETER	CRITERIA	NUMBER SAMPLES	MINIMUM	MAXIMUM	MEAN	NUMBER OF VALUES OUTSIDE CRITERIA	MEAN VALUES OUTSIDE CRITERIA
DISSOLVED OXYGEN (MG/L)	6.0	8	7.2	10.2	9.0	0	0
TEMPERATURE (F)	90.0	8	53.4	83.3	69.9	0	0
PH	6.5-9.0	7	7.7	8.3	8.0	0	0
CHLORIDE (MG/L)	30	8	4	1145	152	1	1145
SULFATE (MG/L)	20	8	1	2145	272	1	2145
TOTAL DISSOLVED SOLIDS (MG/L)	300	7	175	3450	659	1	3450
FECAL COLIFORMS (#/100 ML)	200	5	2	27	8	0	0

TOTAL DISSOLVED SOLIDS WERE ESTIMATED BY MULTIPLYING SPECIFIC CONDUCTANCE BY .50

Figure 3-5 (cont.).

Segment 2310 of the Rio Grande Basin

NAME: Lower Pecos River

DESCRIPTION: from a point 0.7 kilometer (0.4 mile) downstream of the confluence of Painted Canyon in Val Verde County to the low water crossing 0.3 kilometer (0.2 mile) downstream of the confluence of Big Fielder Draw in Val Verde County

SEGMENT CLASSIFICATION: Effluent Limited

LENGTH: 49 miles (79 kilometers)

DESIGNATED WATER USES: Contact Recreation
High Quality Aquatic Habitat
Public Water Supply

MONITORING STATIONS: 2310.0100

INTENSIVE SURVEYS: 1989 Q,F,C,P,B,D,X (Buzan: in preparation).

PERMITTED FACILITIES (FINAL):

There are no permitted facilities discharging to this segment.

KNOWN WATER QUALITY PROBLEMS/WATER QUALITY STANDARD COMPARISON:

In the past, fish kills have occurred due to the toxic alga Prymnesium. Due to elevated chloride levels this segment does not meet the Texas Department of Health drinking water criteria.

POTENTIAL WATER QUALITY PROBLEMS:

Chloride, sulfate and total dissolved solids are periodically elevated. Elevated dissolved oxygen and pH levels have been observed due to algal metabolism.

WATER QUALITY STATUS:

THE FOLLOWING TABLE ILLUSTRATES THE LAST FOUR YEARS (OCT. 1, 1985 THRU SEPT. 30, 1989) OF WATER QUALITY INFORMATION FOR SEGMENT 2310.

PARAMETER	CRITERIA	NUMBER SAMPLES	MINIMUM	MAXIMUM	MEAN	NUMBER OF VALUES OUTSIDE CRITERIA	MEAN VALUES OUTSIDE CRITERIA
DISSOLVED OXYGEN (MG/L)	5.0	35	6.6	15.5	9.7	0	0
TEMPERATURE (F)	92.0	36	49.8	85.1	61.8	0	0
PH	6.5-9.0	34	7.3	9.1	8.0	2	9.1
CHLORIDE (MG/L)	1000	28	140	2003	1075	16	1368
SULFATE (MG/L)	500	28	112	1316	687	19	845
TOTAL DISSOLVED SOLIDS (MG/L)	3000	36	1250	4000	2353	8	3311
FECAL COLIFORMS (#/100 ML)	200	8	2	180	8	0	0

TOTAL DISSOLVED SOLIDS WERE ESTIMATED BY MULTIPLYING SPECIFIC CONDUCTANCE BY .50

3.05 Big Thicket National Preserve

Big Thicket National Preserve is located in southeast Texas, just north of Beaumont (Figure 3-6). It was established in 1974 "to assure preservation, conservation, and protection of the natural, scenic, and recreational values of a significant portion of the Big Thicket area."[90] The preserve is made up of 12 scattered units which together cover approximately 4 percent of a 3,500 square mile area. The Big Thicket is a "biological crossroads," in that it is a transition zone for the moist eastern hardwood forest, the arid southwestern desert, the tropical costal marsh, and the central prairies. Species from all of these different vegetation types come together in the thicket, exhibiting a variety of vegetation and wildlife that has received national interest.

The Big Thicket National Preserve has the most detailed and comprehensive inventory and baseline information on biological resources of all of the NPS Texas units.[91] A water quality monitoring program to document resource conditions and to identify possible changes induced by external and internal land activities has been ongoing since 1984.

3.051 River Basin Data[92]

The preserve is located in the Neches River basin. The comparatively wide floodplains in the basin have small main channels with generally flat slopes. High rainfall rates produce frequent flooding of low-lying areas and floods of large magnitude occur on an average five-year frequency. Because of the shallow topographic gradients in the area, the floods result in standing pools of water rather than rushing torrents often encountered in more mountainous regions. The low stream velocities associated with flood events do not result in significant erosion or sedimentation. Surface water quality in the basin is generally good, although localized areas of high salinity from oil field run-off are present.

3.052 Water Uses

Water dependent recreation activities in the preserve include body-contact requirements for swimming, boating, and non-body contact for fishing and hunting. In addition to these water-based recreation uses, water quality needs exist for the preservation of aquatic life and riparian vegetation. Harcombe and Marks define the four vegetation types in the preserve as

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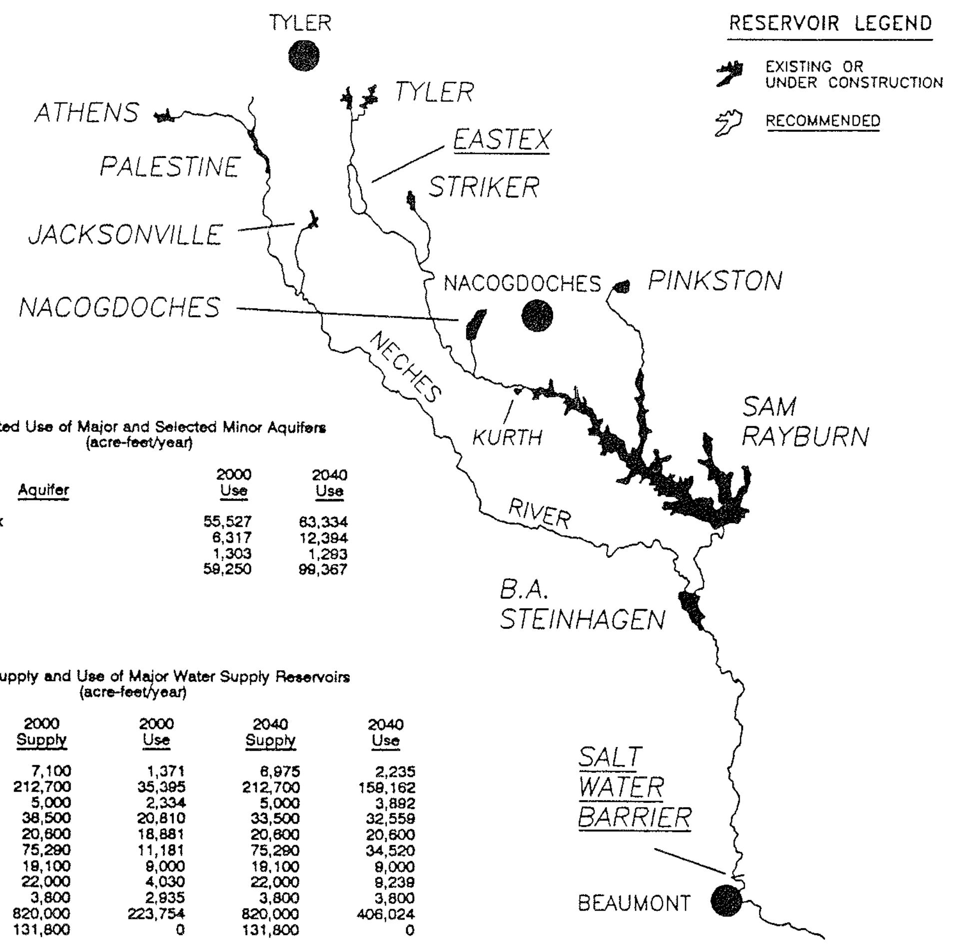
[90] Information taken from the Park Master Plan.

[91] Based on a review of the Resource Management Plans for each of the NPS units in Texas. The preserve has the only functioning Geographical Information System (GIS) that maps significant natural resource features and resource threats.

[92] *See* Appendix A for greater detail on the basin.

Figure 3-6. Neches River basin.



Projected Use of Major and Selected Minor Aquifers (acre-feet/year)

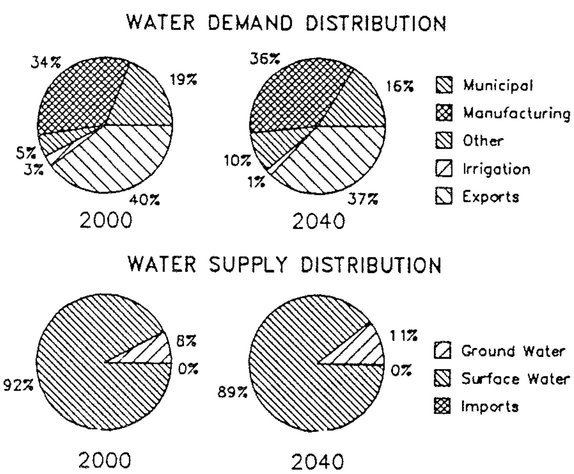
Aquifer	2000 Use	2040 Use
Carrizo-Wilcox	55,527	63,334
Queen City	6,317	12,394
Sparta	1,303	1,293
Gulf Coast	59,250	99,367

Projected Supply and Use of Major Water Supply Reservoirs (acre-feet/year)

Reservoir	2000 Supply	2000 Use	2040 Supply	2040 Use
Athens	7,100	1,371	6,975	2,235
Palestine	212,700	35,395	212,700	158,162
Jacksonville	5,000	2,334	5,000	3,892
Lake Tyler	38,500	20,810	33,500	32,559
Striker	20,600	18,881	20,600	20,600
Eastex	75,290	11,181	75,290	34,520
Kurth	19,100	9,000	19,100	9,000
Nacogdoches	22,000	4,030	22,000	9,239
Pinkston	3,800	2,935	3,800	3,800
Sam Rayburn	820,000	223,754	820,000	406,024
Steinhagen	131,800	0	131,800	0

PROJECTED WATER DEMANDS AND SUPPLIES (acre-feet)

ITEM	2000	2040
IN-BASIN DEMAND		
Municipal	111,900	161,441
Manufacturing	198,441	358,441
Steam Electric	17,000	78,000
Mining	3,772	8,308
Irrigation	15,064	15,064
Livestock	11,397	11,397
Total In-Basin Demands	357,574	632,651
IN-BASIN SUPPLIES		
Ground Water	127,048	181,753
Surface Water	1,445,849	1,442,895
Total In-Basin Supplies	1,572,897	1,624,648
TRANSFERS		
Import Supplies	1,413	4,888
Export Demands	234,538	373,341
ADDITIONAL NEW SUPPLIES	75,290	75,290
AGRICULTURAL SHORTAGE	(71)	(336)
NET AVAILABILITY	1,057,559	699,170



upland, slope, floodplain, and flatland vegetation types.[93] Several categories of floodplain vegetation are found in the preserve with sweetgum and water oak dominating in the small stream floodplains, bald cypress and water tupelo in the deep slough floodplains, and black tupelo and sweetbay in the seepage water areas.

The preserve has developed a significant amount of baseline physicochemical, bacteriological, and benthic macroinvertebrate data for most of its major water courses. The investigations leading to this data base established baseline water quality conditions for major stream segments within the preserve management units.

A number of endangered and threatened wildlife and plants exist within the preserve. The federal list of "Endangered and Threatened Wildlife and Plants" includes seven wildlife species,[94] five plant species,[95] and one reptile species.[96] Some of these are highly water-dependent species and water quality is important for their preservation.

3.053 River Segments and Water Quality Standards

Since the land area of the preserve is divided into many individual, discrete management units, the potential for water quality impacts from external sources is great. The management units are often narrow corridors, with small buffer areas between the stream and adjacent land use. No headwaters for major streams flowing through the units are located in any of these units. These conditions often lead to water quality problems from oil and gas production, timber harvesting, runoff of biocides from agricultural operations and septic tank usage from rural homesites.[97]

The TWC has divided the Neches River basin into 14 river segments (Figure 3-7). The segments of primary concern to the preserve are segments 0602, 0603, 0607, 0608, and 0609. These segments include waters within or just above the preserve.

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[93]*See* Harcombe, P., and P. Marks. 1979. *Forest Vegetation of the Big Thicket National Preserve*. Contract no. PX7029-8-0437. Santa Fe: National Park Service. Southwest Regional Office.

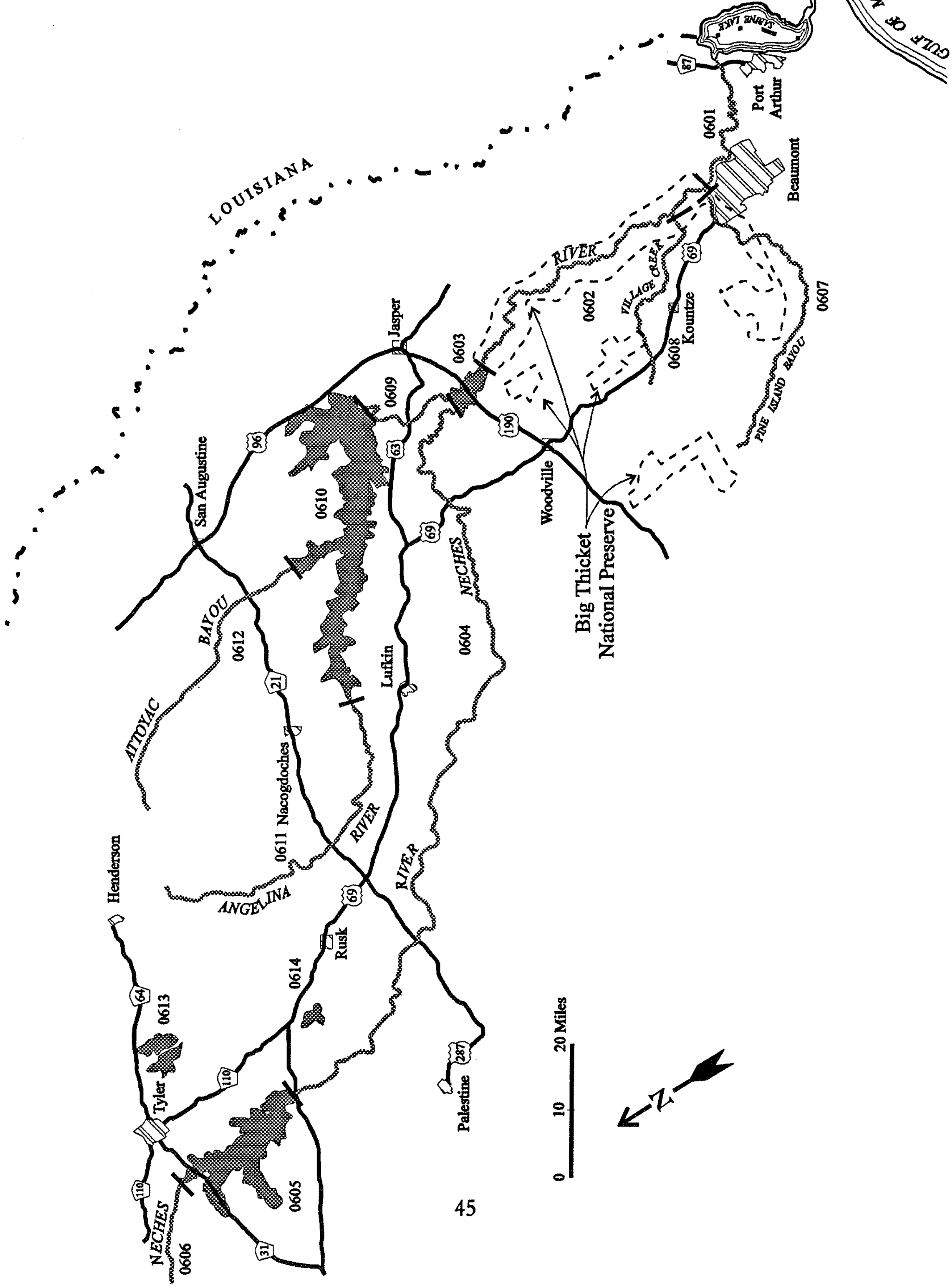
[94]Wildlife species include the bald eagle (*Haliaeetus leucocephalus*), peregrine falcon (*Falco peregrinus*), red-cockaded woodpecker (*Piocoides borealis*), American alligator (*Alligator mississippiensis*), the Houston toad (*Bufo houstonensis*), the ivory billed woodpecker (*Campephilus principalis*) and the red wolf (*Canis rufus*). Woods and Dunatchik. *Resource Management Plan*. p. 42.

[95]*Id.* p. 43. Plant species consist of *Phlox nivalis texensis*, *Amsonia glaberrima*, *Carex fissa*, *Eriocaulon kornickianum*, and *Cyerus grayioides*.

[96]*Id.* p. 42. The one reptile is the alligator snapping turtle (*Macroclemys temmincki*).

[97]*See* Woods, J., and D. Dunatchik. 1987. *Resource Management Plan for Big Thicket National Preserve*. Santa Fe: National Park Service. Southwest Regional Office. p. 24.

Figure 3-7. River segments and park locations, Neches River basin.



The designated uses for the relevant stream segments of the preserve include public water supply, contact recreation, and high quality aquatic life. Except for some depressed dissolved oxygen and elevated fecal coliform parameters, the water quality is improving.[98] The existing use designations and numerical standards appear to adequately protect preserve recreation uses however, the oil and gas operations in and adjacent to the preserve threaten aquatic habitat and riparian vegetation[99] (Figures 3-8, 3-9, and 3-10).

3.054 Synopsis of Park Concerns

The following problems were identified by preserve staff:

(1) Segment 0602, Neches River below Steinhagen Reservoir—frequently excessive fecal coliform (FC) levels, some excessive salinity/total dissolved solids (TDS), some depressed dissolved oxygen (DO) levels;

(2) Segment 0607, Pine Island Bayou—frequently excessive FC, frequently excessive (and sometimes lethal) salinity/TDS, frequently depressed DO, frequently depressed pH levels; and

(3) Segment 0608, Village Creek—frequently excessive FC, some depressed DO, some depressed pH levels.[100]

Specific recommendations from the preserve staff include:

(1) Add presently unrecognized preserve streams to the existing TWC system. This should be done only if it provides enhanced legal means for ensuring against further degradation.

(2) If new stream segments are added, consider devising the segments to reflect actual drainage segments (i.e., source to the first major

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[98]A water quality study conducted by the NPS also found improving water quality. *See* Hughes, J., M. Flora, and J. Woods. 1987. *Big Thicket National Preserve: Water Quality Report 1984-1986.* WRC Report 87-2. Ft. Collins: Water Resources Division. National Park Service. p. 76.

[99]*See Big Thicket Resource Management Plan.* p. 25.

[100]Those streams of the preserve which are not recognized in the TWC system were compared to the designated standards for Pine Island Bayou and Village Creek. Similar patterns of deviation in FC, DO, pH, and salinity/TDC exist in their data. The fact that DO and pH levels are often lower than designated standards at some sites may be due to the somewhat arbitrary selection of acceptable levels for those parameters. Others, such as FC and salinity levels are anthropogenic. Additional water quality problems identified in Preserve planning documents include dioxin discharges into the Neches River, oil and brine contamination of Little Pine Island Bayou (particularly stormwater drainage from an abandoned brine disposal lake near the Saratoga Oil Field), and biocide application to crops in Preserve watersheds. [These concerns were raised by park staff in response to water quality data furnished by the researchers].

Figure 3-8. A description of stream segments for the basin.

06 NECHES RIVER BASIN

0601 Neches River Tidal - from the confluence with Sabine Lake in Orange County to a point 11.3 kilometers (7.0 miles) upstream of IH 10 in Orange County

0602 Neches River Below B. A. Steinhagen Lake - from a point 11.3 kilometers (7.0 miles) upstream of IH 10 in Orange County to Town Bluff Dam in Jasper/Tyler County

0603 B. A. Steinhagen Lake - from Town Bluff Dam in Jasper/Tyler County to a point immediately upstream of the confluence of Hopson Mill Creek on the Neches River Arm in Jasper/Tyler County and to a point immediately upstream of the confluence of Indian Creek on the Angelina River Arm in Jasper County, up to the normal pool elevation of 83 feet (impounds Neches River)

0604 Neches River Below Lake Palestine - from a point immediately upstream of the confluence of Hopson Mill Creek in Jasper/Tyler County to Blackburn Crossing Dam in Anderson/Cherokee County

0605 Lake Palestine - from Blackburn Crossing Dam in Anderson/Cherokee County to a point 6.7 kilometers (4.2 miles) downstream of FM 279 in Henderson/Smith County, up to the normal pool elevation of 345 feet (impounds Neches River)

0606 Neches River Above Lake Palestine - from a point 6.7 kilometers (4.2 miles) downstream of FM 279 in Henderson/Smith County to Rhines Lake Dam in Van Zandt County

0607 Pine Island Bayou - from the confluence with the Neches River in Hardin/Jefferson County to FM 787 in Hardin County

0608 Village Creek - from the confluence with the Neches River in Hardin County to Lake Kimble Dam in Hardin County

0609 Angelina River Below Sam Rayburn Reservoir - from a point immediately upstream of the confluence of Indian Creek in Jasper County to Sam Rayburn Dam in Jasper County

0610 Sam Rayburn Reservoir - from Sam Rayburn Dam in Jasper County to the aqueduct crossing 1.0 kilometer (0.6 mile) upstream of the confluence of Paper Mill Creek on the Angelina River Arm in Angelina/Nacogdoches County and to a point 3.9 kilometers (2.4 miles) downstream of Curry Creek on the Attoyac Bayou Arm in Nacogdoches/San Augustine County, up to the normal pool elevation of 164 feet (impounds Angelina River)

0611 Angelina River Above Sam Rayburn Reservoir - from the aqueduct crossing 1.0 kilometer (0.6 mile) upstream of the confluence of Paper Mill Creek in Angelina/Nacogdoches County to the confluence of Barnhardt Creek and Mill Creek at FM 225 in Rusk County

0612 Attoyac Bayou - from a point 3.9 kilometers (2.4 miles) downstream of Curry Creek in Nacogdoches/San Augustine County to FM 95 in Rusk County

0613 Lake Tyler/Lake Tyler East - from Whitehouse Dam and Mud Creek Dam in Smith County up to the normal pool elevation of 375.38 feet (impounds Prairie Creek and Mud Creek)

0614 Lake Jacksonville - from Buckner Dam in Cherokee County up to the normal pool elevation of 422 feet (impounds Gum Creek)

Figure 3-9. Texas surface water quality standards by river segment.

NECHES RIVER BASIN		USES				CRITERIA						
SEGMENT NUMBER	SEGMENT NAME	RECREATION	AQUATIC LIFE	DOMESTIC WATER SUPPLY	OTHER	CHLORIDE (mg/L) Annual average not to exceed	SULFATE (mg/L) Annual average not to exceed	TOTAL DISSOLVED SOLIDS (mg/L) Annual average not to exceed	DISSOLVED OXYGEN (mg/L)	pH RANGE	FECAL COLIFORM (#/100 mL) Thirty-day geometric mean not to exceed	TEMPERATURE (°F) Not to exceed
0601	Neches River Tidal	CR	I						3.0*	6.0-8.5	200	95
0602	Neches River Below B. A. Steinhagen Lake	CR	H	PS		50	30	150	5.0	6.0-8.5	200	91
0603	B. A. Steinhagen Lake	CR	H	PS		50	30	150	5.0	6.0-8.5	200	93
0604	Neches River Below Lake Palestine	CR	H	PS		50	30	150	5.0	6.0-8.5	200	91
0605	Lake Palestine	CR	H	PS		50	30	150	5.0	6.0-8.5	200	90
0606	Neches River Above Lake Palestine	CR	I	PS		50	30	150	4.0*	6.0-8.5	200	95
0607	Pine Island Bayou	CR	H	PS		150	50	300	5.0	6.0-8.5	200	95
0608	Village Creek	CR	H	PS		150	75	300	5.0	6.0-8.5	200	90
0609	Angelina River Below Sam Rayburn Reservoir	CR	H	PS		70	40	250	5.0	6.0-8.5	200	90
0610	Sam Rayburn Reservoir	CR	H	PS		70	40	250	5.0	6.0-8.5	200	93
0611	Angelina River Above Sam Rayburn Reservoir	CR	H	PS		125	40	250	5.0	6.0-8.5	200	90
0612	Attoyac Bayou	CR	H	PS		75	50	150	5.0	6.0-8.5	200	90
0613	Lake Tyler/Lake Tyler East	CR	H	PS		30	30	150	5.0	6.5-9.0	200	93
0614	Lake Jacksonville	CR	H	PS		50	75	750	5.0	6.5-9.0	200	93

* Dissolved oxygen criterion in Segment 0601 does not apply to flows of less than 1,000 ft^3/s.
Dissolved oxygen criterion in Segment 0606 does not apply to flows of less than 22.0 ft^3/s.

Figure 3-10. Surface water quality data by river segment.

Segment 0602 of the Neches River Basin

NAME: Neches River Below B. A. Steinhagen Lake

DESCRIPTION: from a point 11.3 kilometers (7.0 miles) upstream of IH 10 in Orange County to Town Bluff Dam in Jasper/Tyler County

SEGMENT CLASSIFICATION: Effluent Limited

LENGTH: 88 miles (141 kilometers)

DESIGNATED WATER USES: Contact Recreation
High Quality Aquatic Habitat
Public Water Supply

MONITORING STATIONS: 0602.0100, 0602.0200

INTENSIVE SURVEYS: None

PERMITTED FACILITIES (FINAL):

Domestic	2 outfalls	1.01 MGD
Industrial	4 outfalls	0.00 MGD
Total	6 outfalls	1.01 MGD

KNOWN WATER QUALITY PROBLEMS/WATER QUALITY STANDARD COMPARISON:

There are no significant water quality problems in this segment.

POTENTIAL WATER QUALITY PROBLEMS:

One dissolved oxygen measurement during the past years was below the criterion. Two pH measurements were marginally outside the range specified in the standards. Occasional elevated fecal coliform levels occur in the segment.

WATER QUALITY STATUS:

THE FOLLOWING TABLE ILLUSTRATES THE LAST FOUR YEARS (OCT. 1, 1985 THRU SEPT. 30, 1989) OF WATER QUALITY INFORMATION FOR SEGMENT 0602.

PARAMETER	CRITERIA	NUMBER SAMPLES	MINIMUM	MAXIMUM	MEAN	NUMBER OF VALUES OUTSIDE CRITERIA	MEAN VALUES OUTSIDE CRITERIA
DISSOLVED OXYGEN (MG/L)	5.0	38	4.3	12.2	7.9	1	4.3
TEMPERATURE (F)	91.0	38	43.2	87.6	70.4	0	0
PH	6.0-8.5	38	5.9	8.6	7.1	1/1	5.9/8.6
CHLORIDE (MG/L)	50	32	9	44	19	0	0
SULFATE (MG/L)	30	32	7	26	18	0	0
TOTAL DISSOLVED SOLIDS (MG/L)	150	38	36	136	75	0	0
FECAL COLIFORMS (#/100 ML)	200	27	8	840	85	7	396

TOTAL DISSOLVED SOLIDS WERE ESTIMATED BY MULTIPLYING SPECIFIC CONDUCTANCE BY .50

Figure 3-10 (cont.). Segment 0603 of the Neches River Basin

NAME: B. A. Steinhagen Lake

DESCRIPTION: from Town Bluff Dam in Jasper/Tyler County to a point immediately upstream of the confluence of Hopson Mill Creek on the Neches River Arm in Jasper/Tyler County and to a point immediately upstream of the confluence of Indian Creek on the Angelina River Arm in Jasper County, up to the normal pool elevation of 83 feet (impounds Neches River)

SEGMENT CLASSIFICATION: Water Quality Limited

LENGTH: 14 miles (22 kilometers)

SURFACE AREA: 13,690 acres

DESIGNATED WATER USES: Contact Recreation
High Quality Aquatic Habitat
Public Water Supply

MONITORING STATIONS: 0603.0050, 0603.0100

INTENSIVE SURVEYS: None

PERMITTED FACILITIES (FINAL):

Domestic	2 outfalls	1.83 MGD
Industrial	1 outfalls	1.44 MGD
Total	3 outfalls	3.27 MGD

KNOWN WATER QUALITY PROBLEMS/WATER QUALITY STANDARD COMPARISON:

No known significant water quality problems exist in this segment.

POTENTIAL WATER QUALITY PROBLEMS:

No potential water quality problems have been identified; however, an insufficient number of samples were collected to adequately determine standards compliance.

WATER QUALITY STATUS:

THE FOLLOWING TABLE ILLUSTRATES THE LAST FOUR YEARS (OCT. 1, 1985 THRU SEPT. 30, 1989) OF WATER QUALITY INFORMATION FOR SEGMENT 0603.

PARAMETER	CRITERIA	NUMBER SAMPLES	MINIMUM	MAXIMUM	MEAN	NUMBER OF VALUES OUTSIDE CRITERIA	MEAN VALUES OUTSIDE CRITERIA
DISSOLVED OXYGEN (MG/L)	5.0	5	4.6	6.2	5.6	1	4.6
TEMPERATURE (F)	93.0	5	81.1	89.8	84.3	0	0
PH	6.0-8.5	5	7.3	7.6	7.4	0	0
CHLORIDE (MG/L)	50	4	14	18	16	0	0
SULFATE (MG/L)	30	2	18	19	18	0	0
TOTAL DISSOLVED SOLIDS (MG/L)	150	5	51	80	71	0	0
FECAL COLIFORMS (#/100 ML)	200	4	3	25	6	0	0

TOTAL DISSOLVED SOLIDS WERE ESTIMATED BY MULTIPLYING SPECIFIC CONDUCTANCE BY .50

Figure 3-10 (cont.).

Segment 0604 of the Neches River Basin

NAME: Neches River Below Lake Palestine

DESCRIPTION: from a point immediately upstream of the confluence of Hopson Mill Creek in Jasper/Tyler County to Blackburn Crossing Dam in Anderson/Cherokee County

SEGMENT CLASSIFICATION: Effluent Limited

LENGTH: 231 miles (372 kilometers)

DESIGNATED WATER USES: Contact Recreation
High Quality Aquatic Habitat
Public Water Supply

MONITORING STATIONS: 0604.0200, 0604.0500, 0604.0550, 0604.0650

INTENSIVE SURVEYS: None

PERMITTED FACILITIES (FINAL):

Domestic	19 outfalls	14.52 MGD
Industrial	19 outfalls	1.25 MGD
Total	38 outfalls	15.77 MGD

KNOWN WATER QUALITY PROBLEMS/WATER QUALITY STANDARD COMPARISON:

Occasionally low dissolved oxygen levels result from hypolimnetic releases from Lake Palestine. No problems with aquatic life, due to the depressed dissolved oxygen levels, have been observed.

POTENTIAL WATER QUALITY PROBLEMS:

Fecal coliform levels are occasionally elevated. Elevated levels of phosphorus appear in less than 10% of collected samples.

WATER QUALITY STATUS:

THE FOLLOWING TABLE ILLUSTRATES THE LAST FOUR YEARS (OCT. 1, 1985 THRU SEPT. 30, 1989) OF WATER QUALITY INFORMATION FOR SEGMENT 0604.

PARAMETER	CRITERIA	NUMBER SAMPLES	MINIMUM	MAXIMUM	MEAN	NUMBER OF VALUES OUTSIDE CRITERIA	MEAN VALUES OUTSIDE CRITERIA
DISSOLVED OXYGEN (MG/L)	5.0	360	4.0	11.0	6.8	52	4.0
TEMPERATURE (F)	91.0	359	33.8	89.6	64.7	0	0
PH	6.0-8.5	9	6.3	7.4	6.9	0	0
CHLORIDE (MG/L)	50	537	12	37	21	0	0
SULFATE (MG/L)	30	5	19	44	26	1	44
TOTAL DISSOLVED SOLIDS (MG/L)	150	9	47	121	83	0	0
FECAL COLIFORMS (#/100 ML)	200	6	26	290	99	2	284

TOTAL DISSOLVED SOLIDS WERE ESTIMATED BY MULTIPLYING SPECIFIC CONDUCTANCE BY .50

Figure 3-10 (cont.).

Segment 0607 of the Neches River Basin

NAME: Pine Island Bayou

DESCRIPTION: from the confluence with the Neches River in Hardin/Jefferson County to FM 787 in Hardin County

SEGMENT CLASSIFICATION: Water Quality Limited

LENGTH: 81 miles (131 kilometers)

DESIGNATED WATER USES: Contact Recreation
High Quality Aquatic Habitat
Public Water Supply

MONITORING STATIONS: 0607.0100, 0607.0200, 0607.0300, 0607.0400

INTENSIVE SURVEYS:				
	07 Oct 1975	Q,X,F,C,B,I	IMS-75	(Adsit/Hagen: Apr 1978)
	04 Nov 1975	Q,X,D,F,C,S,B	IMS-75	(Adsit/Hagen: Apr 1978)
	19 Jul 1976	Q,X,D,F,C,S,B,I,W	IMS-75	(Adsit/Hagen: Apr 1978)
	25 Aug 1987	Q,F,C,B		(Petrick: In Preparation)

PERMITTED FACILITIES (FINAL):

Domestic	9 outfalls	3.13 MGD
Industrial	1 outfalls	0.00 MGD
Total	10 outfalls	3.13 MGD

KNOWN WATER QUALITY PROBLEMS/WATER QUALITY STANDARD COMPARISON:

Dissolved oxygen levels are frequently less than the segment criterion. The depressed levels of dissolved oxygen occur primarily during summer low flow conditions. A portion of this segment does not meet swimmable criteria due to elevated levels of fecal coliform bacteria.

POTENTIAL WATER QUALITY PROBLEMS:

Fecal coliform levels were elevated in about half of the samples collected. Nutrient levels, especially phosphorus, are elevated about 10% of the time.

RELATIVE SIGNIFICANCE OF POINT AND NONPOINT SOURCE POLLUTANTS:

The periodic low dissolved oxygen levels are most likely attributable to near stagnant velocities. The treated effluents from six small domestic plants also contribute to the problems. Runoff of septic tank effluent to the bayou may contribute periodically to the low dissolved oxygen levels and elevated fecal coliform levels.

CONTROL PROGRAMS:

A. Existing: An intensive survey and waste load evaluation for the segment have been conducted by the Commission. These evaluations indicate that the water quality problems observed in Pine Island Bayou are due primarily to natural causes. Construction of centralized collection systems and domestic treatment plants to alleviate septic tank problems at the Pinewood, Sour Lake, Daisetta, Bevil Oaks, Lumberton, Rose Hill Acres, and Nome communities has been completed. A study to address the relationship between nonpoint sources and water quality problems in Pine Island Bayou has been completed (December, 1983) by the Lower Neches Valley Authority. The results of the study indicate that dissolved oxygen levels in Pine Island Bayou are usually above the 5 mg/L criterion except during periods of low flow. The highest levels of fecal coliform bacteria were found near urban areas that were served by sewage treatment plants. The fecal coliform data indicate that the mainstem of Pine Island Bayou violates the criterion (200/100 mL) for contact recreation. The study also revealed that chloride levels are elevated near oil fields.

B. Programs still to be implemented: A use attainability analysis is scheduled for the segment by the Commission.

FACTORS NEEDING CLARIFICATION WITH RESPECT TO CAUSE/EFFECT RELATIONSHIPS:

The relationships among domestic waste loads, nonpoint source contributions, reaeration rates and benthal oxygen demand have not been determined during summertime low flow conditions.

KNOWN RELATIONSHIPS TO OTHER ENVIRONMENTAL PROBLEMS:

None anticipated.

Figure 3-10 (cont.).

WATER QUALITY STATUS:

THE FOLLOWING TABLE ILLUSTRATES THE LAST FOUR YEARS (OCT. 1, 1985 THRU SEPT. 30, 1989) OF WATER QUALITY INFORMATION FOR SEGMENT 0607.

PARAMETER	CRITERIA	NUMBER SAMPLES	MINIMUM	MAXIMUM	MEAN	NUMBER OF VALUES OUTSIDE CRITERIA	MEAN VALUES OUTSIDE CRITERIA
DISSOLVED OXYGEN (MG/L)	5.0	147	2.8	9.7	4.7	101	4.0
TEMPERATURE (F)	95.0	147	42.8	89.6	71.8	0	0
PH	6.0-8.5	147	5.8	8.2	7.0	1	5.8
CHLORIDE (MG/L)	150	24	3	70	30	0	0
SULFATE (MG/L)	50	23	2	20	9	0	0
TOTAL DISSOLVED SOLIDS (MG/L)	300	157	33	400	114	1	400
FECAL COLIFORMS (#/100 ML)	200	73	7	390000	403	38	1804

TOTAL DISSOLVED SOLIDS WERE ESTIMATED BY MULTIPLYING SPECIFIC CONDUCTANCE BY .50

Figure 3-10 (cont.).

Segment 0608 of the Neches River Basin

NAME: Village Creek

DESCRIPTION: from the confluence with the Neches River in Hardin County to Lake Kimble Dam in Hardin County

SEGMENT CLASSIFICATION: Effluent Limited

LENGTH: 53 miles (85 kilometers)

DESIGNATED WATER USES: Contact Recreation
High Quality Aquatic Habitat
Public Water Supply

MONITORING STATIONS: 0608.0100

INTENSIVE SURVEYS: None

PERMITTED FACILITIES (FINAL):

Domestic	10 outfalls	2.02 MGD
Industrial	7 outfalls	0.60 MGD
Total	17 outfalls	2.62 MGD

KNOWN WATER QUALITY PROBLEMS/WATER QUALITY STANDARD COMPARISON:

Two low dissolved oxygen measurements and one low pH measurement were recorded; however, these appear to result from natural conditions.

POTENTIAL WATER QUALITY PROBLEMS:

No potential water quality problems have been identified.

WATER QUALITY STATUS:

THE FOLLOWING TABLE ILLUSTRATES THE LAST FOUR YEARS (OCT. 1, 1985 THRU SEPT. 30, 1989) OF WATER QUALITY INFORMATION FOR SEGMENT 0608.

PARAMETER	CRITERIA	NUMBER SAMPLES	MINIMUM	MAXIMUM	MEAN	NUMBER OF VALUES OUTSIDE CRITERIA	MEAN VALUES OUTSIDE CRITERIA
DISSOLVED OXYGEN (MG/L)	5.0	8	3.9	10.2	7.5	2	4.0
TEMPERATURE (F)	90.0	8	44.8	79.7	65.6	0	0
PH	6.0-8.5	8	5.0	7.3	6.6	1	5.0
CHLORIDE (MG/L)	150	8	4	19	11	0	0
SULFATE (MG/L)	75	8	1	12	4	0	0
TOTAL DISSOLVED SOLIDS (MG/L)	300	7	24	59	40	0	0
FECAL COLIFORMS (#/100 ML)	200	5	20	840	56	1	839

TOTAL DISSOLVED SOLIDS WERE ESTIMATED BY MULTIPLYING SPECIFIC CONDUCTANCE BY .50

Figure 3-10 (cont.).

Segment 0609 of the Neches River Basin

NAME: Angelina River Below Sam Rayburn Reservoir

DESCRIPTION: from a point immediately upstream of the confluence of Indian Creek in Jasper County to Sam Rayburn Dam in Jasper County

SEGMENT CLASSIFICATION: Effluent Limited

LENGTH: 18 miles (29 kilometers)

DESIGNATED WATER USES: Contact Recreation
High Quality Aquatic Habitat
Public Water Supply

MONITORING STATIONS: 0609.0100

INTENSIVE SURVEYS: 24 May 1977 F,C,S,B IS-3 (Hagen/Adsit: 1979)

PERMITTED FACILITIES (FINAL):

Domestic	2 outfalls	0.31 MGD
Industrial	0 outfalls	0.00 MGD
Total	2 outfalls	0.31 MGD

KNOWN WATER QUALITY PROBLEMS/WATER QUALITY STANDARD COMPARISON:

No significant water quality problems exist.

POTENTIAL WATER QUALITY PROBLEMS:

None anticipated.

RELATIVE SIGNIFICANCE OF POINT AND NONPOINT SOURCE POLLUTANTS:

Depressed dissolved oxygen levels occur as a result from hypolimnetic releases from Sam Rayburn Reservoir upstream. No problems with aquatic life have been observed.

CONTROL PROGRAMS:

A. Existing: The Lower Neches Valley Authority in conjunction with the U.S. Army Corps of Engineers (Fort Worth District) and the Commission conducted a study to determine if turbine venting at Sam Rayburn Dam would remedy the low dissolved oxygen levels downstream. The study indicated that turbine venting was not a viable alternative.

B. Programs still to be implemented: An intensive survey and special project were conducted on the segment by the Commission. The results of these studies indicate that problems associated with low dissovled oxygen levels are directly related to the release of hypolimnetic water from Sam Rayburn Reservoir. A use attainability analysis of the segment will be conducted by the Commission to determine if the numerical water quality criteria are appropriate and water uses deemed desirable are attainable.

FACTORS NEEDING CLARIFICATION WITH RESPECT TO CAUSE/EFFECT RELATIONSHIPS:

None.

KNOWN RELATIONSHIPS TO OTHER ENVIRONMENTAL PROBLEMS:

None identified.

Figure 3-10 (cont.).

WATER QUALITY STATUS:

THE FOLLOWING TABLE ILLUSTRATES THE LAST FOUR YEARS (OCT. 1, 1985 THRU SEPT. 30, 1989) OF WATER QUALITY INFORMATION FOR SEGMENT 0609.

PARAMETER	CRITERIA	NUMBER SAMPLES	MINIMUM	MAXIMUM	MEAN	NUMBER OF VALUES OUTSIDE CRITERIA	MEAN VALUES OUTSIDE CRITERIA
DISSOLVED OXYGEN (MG/L)	5.0	7	4.1	11.4	8.2	2	4.5
TEMPERATURE (F)	90.0	7	48.7	80.2	63.5	0	0
PH	6.0-8.5	6	6.4	7.9	7.2	0	0
CHLORIDE (MG/L)	70	7	13	18	14	0	0
SULFATE (MG/L)	40	7	15	22	19	0	0
TOTAL DISSOLVED SOLIDS (MG/L)	250	7	50	81	71	0	0
FECAL COLIFORMS (#/100 ML)	200	5	2	11	5	0	0

TOTAL DISSOLVED SOLIDS WERE ESTIMATED BY MULTIPLYING SPECIFIC CONDUCTANCE BY .50

downstream confluence, thence to the next major downstream confluences).

(3) Base the stream standards on historical water quality data.

(4) Designate Preserve streams to reflects their status as national preserve waters.

(5) Consider the above recommendations for those segments already recognized by the TWC.

(6) Increase contact between NPS and state agencies in order to address the point and nonpoint pollution concerns previously identified.

3.06 Guadalupe Mountains National Park

Guadalupe Mountains National Park is located in sparsely populated west Texas, near the New Mexico border (Figure 3-11). Contrasting natural features in the park are the deserts, canyons, and highlands. Surrounding the park are areas of low-lying basins and range land, while the core of the park contains the impressive Guadalupe Mountains which run north into New Mexico. The park offers scenic wilderness experiences to visitors and is of scientific importance to researchers.

The park is noted for one of the most extensive and significant ancient reef structures in the world. It also contains the highest point in Texas, the 8,751-foot Guadalupe Peak; a conifer forest in the highland, known as the "bowl;" and the deeply incised McKittrick Canyon. Other features include archeological and historical remains from several periods. Wildlife is relatively abundant and some species are under park protection including black bear, mountain lion, and golden eagle. Eighteen rare plant species are protected here.[101]

Hiking, backpacking, and camping are the primary recreational activities here. Water is very scarce in the park, and no water-related recreational activities are permitted. In addition, only water brought in by hikers may be consumed in the backcountry. The entire area is a very fragile ecosystem and all backpackers venturing into the backcountry must have permits.

3.061 Water Uses

The major water-dependent need for the park is not for recreation activities but for the protection of aquatic life and riparian vegetation. In certain parts of the Park, such as aquatic habitats in McKittrick Canyon, unique biotic communities with a number of endangered or threatened species are found.[102] For these areas, water quality is hypercritical. Since these areas contrast sharply with the surrounding Chihuahuan Desert they provide important scenic and recreational values. The prime recreation activities are hiking and camping.

3.062 River Segments and Water Quality Standards

The intermittent streams flowing through the park are unclassified and are not segmented. Numerical water quality criteria do not exist for the water resources in the park. Water quality protection is only provided by the narrative standards of the TWC.[103]

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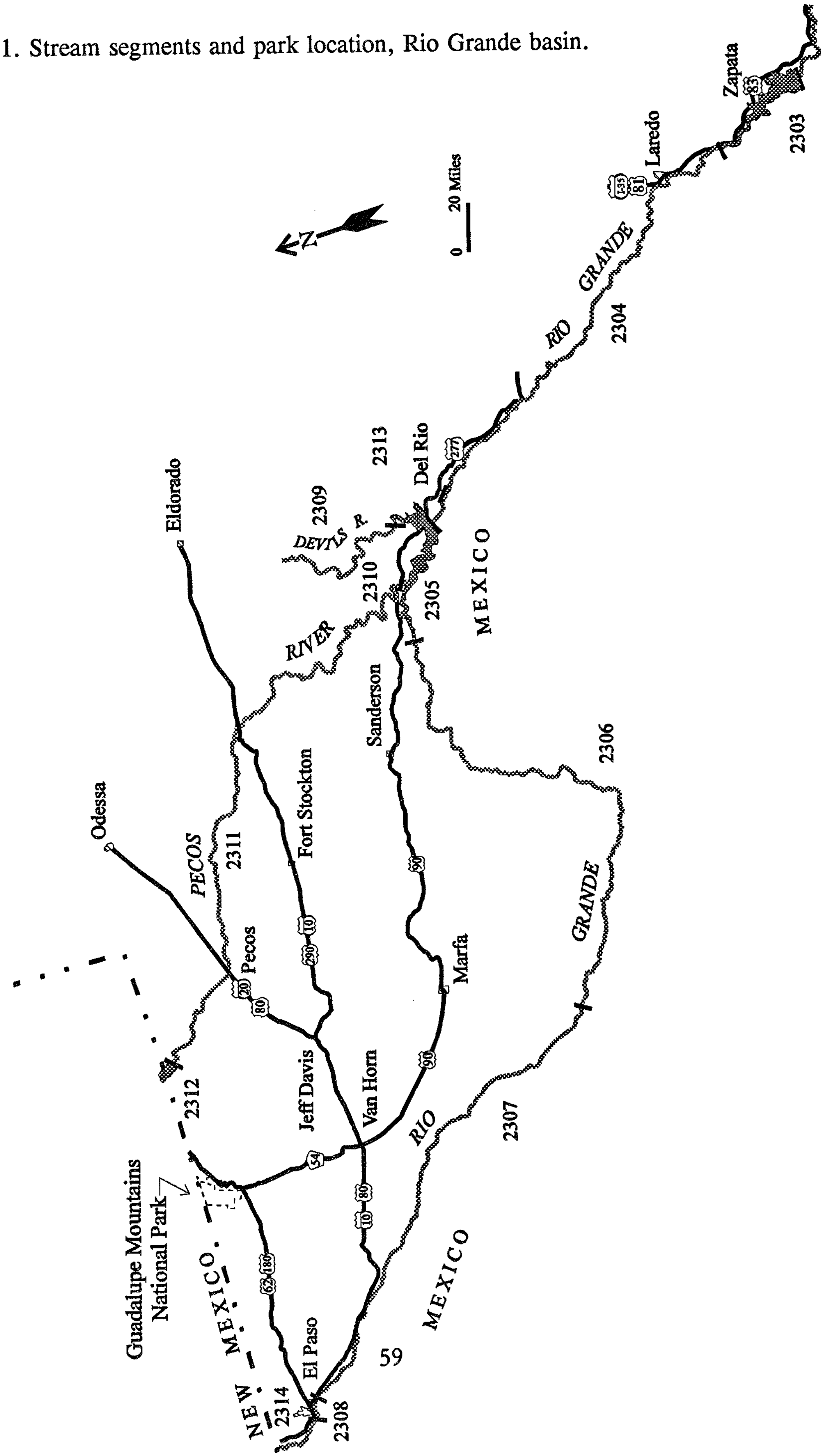
[101] National Park Service. 1988. *Statement for Management: Guadalupe Mountains National Park*. Santa Fe: National Park Service. Southwest Regional Office. Appendix B.

[102] *Id.* p.4.

[103] *See* 31 Tex. Admin. Code § 307.4.

Figure 3-11. Stream segments and park location, Rio Grande basin.



3.063 Synopsis of Park Concerns

Since 1984, park personnel have monitored water quality at a number of sites in the park. Based on this monitoring, park staff believe that they have very good quality water and have identified no deterioration of water quality from the base line.

A major concern for water quality problems could arise from activities in the adjacent Lincoln National Forest in New Mexico. The park's staff is concerned that timber harvesting and unregulated access to the backcountry may adversely affect the water quality in the park's watershed.

3.07 Lake Meredith National Recreation Area

Lake Meredith National Recreation Area is located in the Canadian River Basin in the panhandle region of Texas, 35 miles north of Amarillo (Figure 3-12). The lake is a man-made impoundment constructed in 1965 by the Bureau of Reclamation, with Sanford Dam operated by the Canadian River Municipal Water Authority. The recreation area includes 21,600 acres of water surface, and 23,300 acres of adjacent land to provide campsites and lake access.

There are no identified threatened or endangered species within the recreation area, but there are numerous species of plant, bird, and wildlife, which are typical of the arid high plains. Grazing permits are issued for approximately 7,000 acres of recreation area.

Supplying water to meet the needs of the surrounding communities was the primary motive for the construction of the reservoir; recreational opportunities provided by the lake were only secondary considerations in initial planning. Lake Meredith has become the primary resource for water-based recreational use in the panhandle region because no comparable body of water or land exists. Other purposes for water are to maintain the riparian ecosystem around the lake and for tributary creeks within park boundaries.

3.071 Basin Data[104]

The Canadian River arises in northeastern New Mexico, flows eastward across the Texas Panhandle into Oklahoma, and joins the Arkansas River in eastern Oklahoma. Major Texas tributaries are Punta de Agua Creek, Big Blue Creek near Borger, and Palo Duro Creek, 20 miles southwest of Perryton. Total basin drainage in Texas is about 12,700 square miles with average runoff of approximately 15 acre-feet per square mile.

Generally, surface-water quality degrades somewhat as the Canadian River traverses Texas. The principal water quality problem in the basin is the natural salinity of the Canadian River which adversely affects water in Lake Meredith. This problem is caused by the high chloride content contributed by the geologic formations traversed by the Canadian River and its tributaries. Localized water quality problems result from surface drainage from oil and gas production areas and municipal return flows.

3.072 Water Uses

Water-dependent recreation activities at Lake Meredith National Recreation Area include body-contact requirements for swimming, water-skiing, diving, boating, and non-body contact for fishing and camping. In addition to these water-based recreation uses, water quality needs exist for protection of aquatic life and riparian vegetation.

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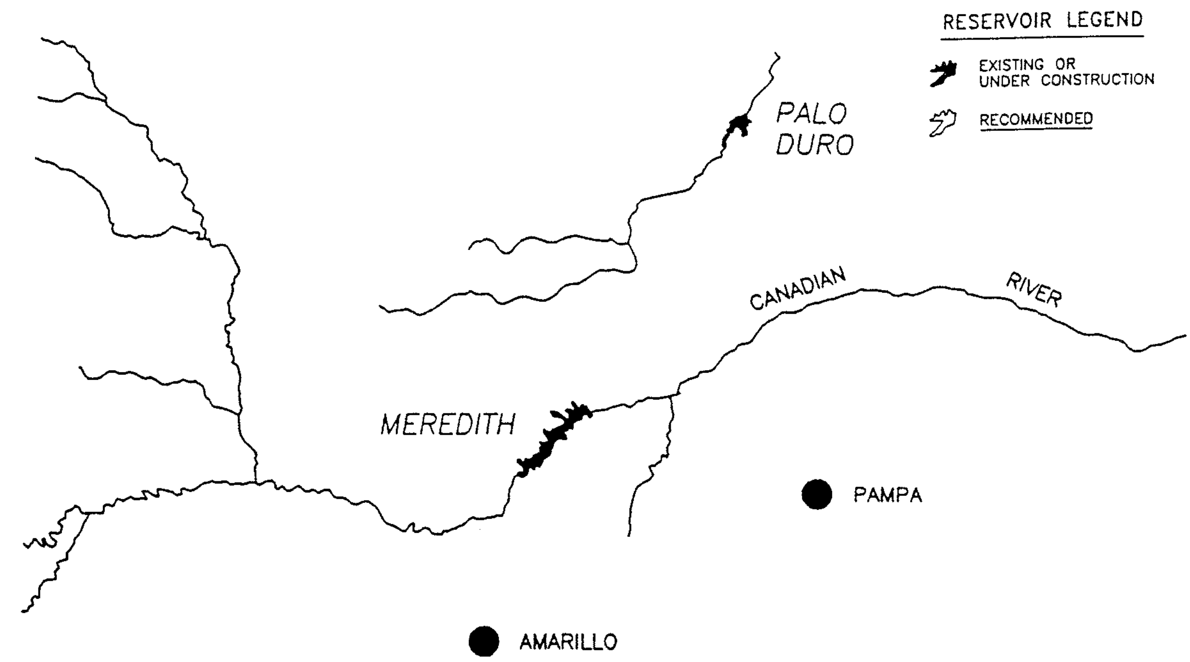
[104]*See* Appendix A for greater detail on the basin.

Figure 3-12. Canadian River basin.



Projected Supply and Use of Major Water Supply Reservoirs
(acre-feet/year)

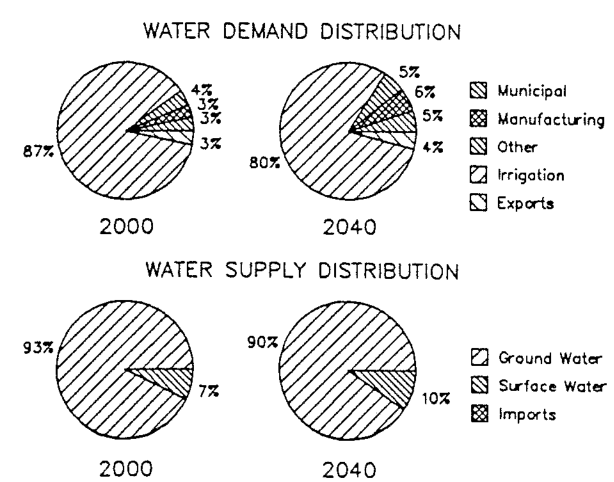
Reservoir	2000 Supply	2000 Use	2040 Supply	2040 Use
Meredith	74,350	51,894	62,550	61,470
Palo Duro	4,800	0	4,800	4,080

Projected Use of Major and Selected Minor Aquifers
(acre-feet/year)

Aquifer	2000 Use	2040 Use
Ogallala (High Plains)	744,570	602,050

PROJECTED WATER DEMANDS AND SUPPLIES
(acre-feet/year)

ITEM	2000	2040
IN-BASIN DEMAND		
Municipal	41,269	53,908
Manufacturing	37,735	60,004
Steam Electric	23,000	30,000
Mining	4,947	5,202
Irrigation	1,127,340	855,811
Livestock	21,676	21,676
Total In-Basin Demands	1,255,967	1,026,601
IN-BASIN SUPPLIES		
Ground Water	1,223,041	968,513
Surface Water	83,479	77,784
Total In-Basin Supplies	1,306,520	1,046,297
TRANSFERS		
Import Supplies	0	0
Export Demands	43,225	44,459
ADDITIONAL NEW SUPPLIES	12,657	24,810
AGRICULTURAL SHORTAGE	0	(1,753)
NET AVAILABILITY	19,985	1,800



3.073 River Segments and Water Quality Standards

Two river segments are of direct concern to the recreation area (Figures 3-13, and 3-14). Segment 0102 includes all of Lake Meredith and Segment 0103 covers the waters above Lake Meredith to the New Mexico border. The designated uses for Segment 0102 includes contact recreation, exceptional quality aquatic habitat, and public water supply. River Segment 0103 uses include contact recreation and high quality aquatic habitat. The designated uses for these segments appear to adequately protect the recreation uses of Lake Meredith National Recreation Area.

Except for the natural sources of brine discharged into the Canadian River near Logan, New Mexico which cause the chloride levels in the lake to exceed the Texas Department of Health criteria for drinking water, there are no significant violations of water quality standards in the river segments. Fecal coliform levels and dissolved solids levels are occasionally elevated in localized segments of the river basin (Figures 3-15 and 3-16).

3.074 Synopsis of Park Concerns

Stream Segment 0103, which includes all of the Canadian River Drainage basin above or tributary to Lake Meredith, should be further segmented. This would provide for a more detailed monitoring of water quality conditions in the drainage basin. Park staff recognize that many water quality problems on the river originate in New Mexico—this contamination occurs outside the segments designated by the State of Texas, and causes water quality monitoring problems for the program carried out by the State of Texas.

Park staff pointed out that the stream standards established by the state are often exceeded. For Segment 0102, the chloride concentrations of the lake are currently above the level of 400 mg/L and will continue to be until some substantial volume of fresh inflow is received, or the New Mexico sources are eliminated. In addition, chloride concentrations in Segment 0103 also are exceeded more frequently than indicated in the TWC summarized data. Samples taken along the main stem of the Canadian River are frequently above the chloride limit of 1050 mg/L, except during periods of high flow. The frequency and extent of such excesses will increase as the sampling point moves upstream.

Figure 3-13. River segments and park locations, Canadian River basin.

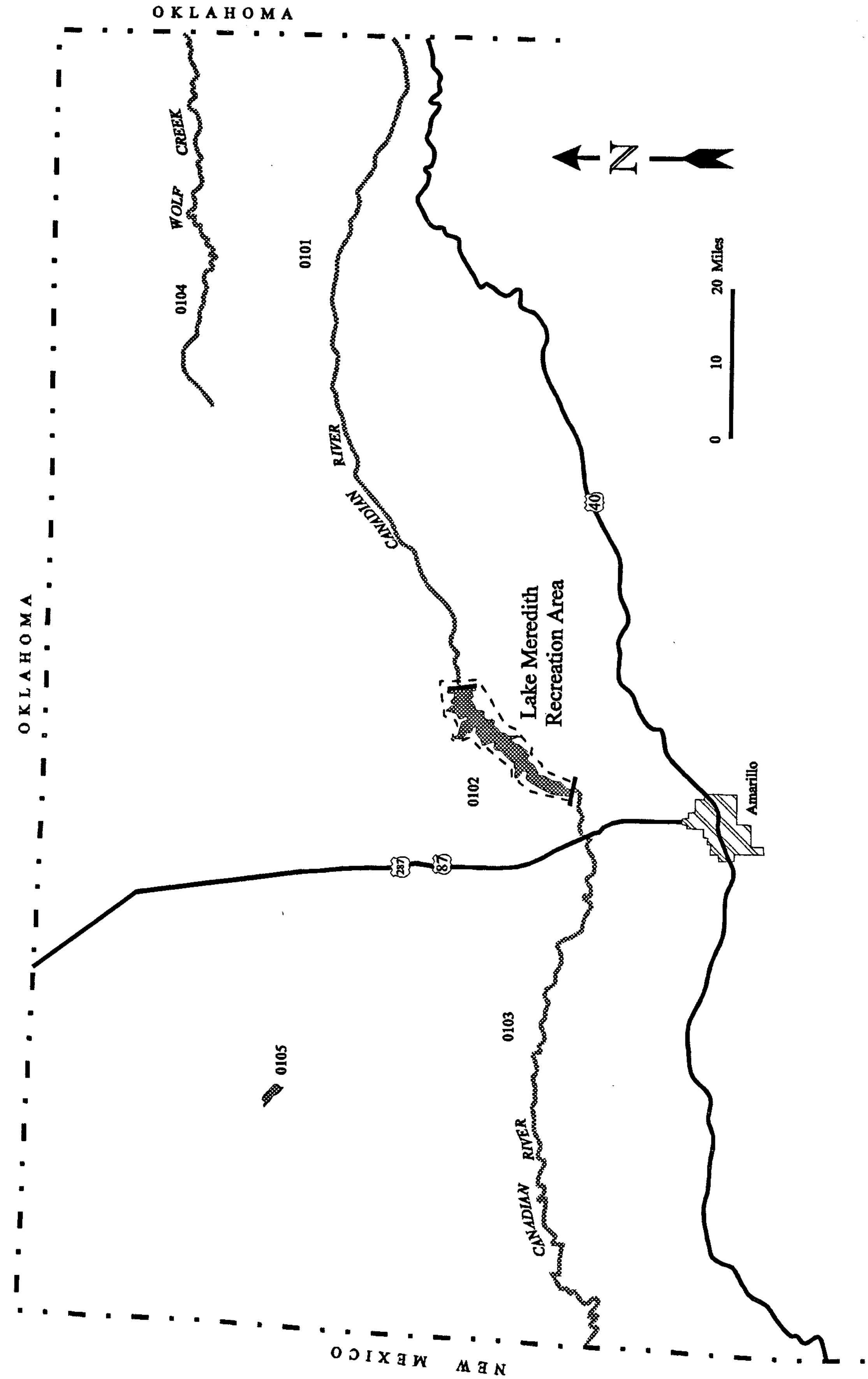


Figure 3-14. River segments for the basin.

01 CANADIAN RIVER BASIN

0101 Canadian River Below Lake Meredith - from the Oklahoma State Line in Hemphill County to Sanford Dam in Hutchinson County

★ 0102 Lake Meredith - from Sanford Dam in Hutchinson County to a point immediately upstream of the confluence of Camp Creek in Potter County, up to the normal pool elevation of 2936.5 feet (impounds Canadian River)

★ 0103 Canadian River Above Lake Meredith - from a point immediately upstream of the confluence of Camp Creek in Potter County to the New Mexico State Line in Oldham County

0104 Wolf Creek - from the Oklahoma State Line in Lipscomb County to a point 2.0 kilometers (1.2 miles) upstream of FM 3045 in Ochiltree County

0105 Rita Blanca Lake - from Rita Blanca Dam in Hartley County up to the normal pool elevation of 3860 feet (impounds Rita Blanca Creek)

Figure 3-15. Texas surface water quality standards by river segment.

CANADIAN RIVER BASIN		USES				CRITERIA						
SEGMENT NUMBER	SEGMENT NAME	RECREATION	AQUATIC LIFE	DOMESTIC WATER SUPPLY	OTHER	CHLORIDE (mg/L) Annual average not to exceed	SULFATE (mg/L) Annual average not to exceed	TOTAL DISSOLVED SOLIDS (mg/L) Annual average not to exceed	DISSOLVED OXYGEN (mg/L)	pH RANGE	FECAL COLIFORM (#/100 mL) Thirty-day geometric mean not to exceed	TEMPERATURE (°F) Not to exceed
0101	Canadian River Below Lake Meredith	CR	H			1,975	760	5,000	5.0	6.5-9.0	200	95
0102	Lake Meredith	CR	E	PS		400	350	1,300	6.0	6.5-9.0	200	85
0103	Canadian River Above Lake Meredith	CR	H			1,050	540	4,500	5.0	6.5-9.0	200	95
0104	Wolf Creek	CR	H			420	125	1,125	5.0	6.5-9.0	200	93
0105	Rita Blanca Lake	CR	H	PS		100	90	325	5.0	6.5-9.0	200	85

Figure 3-16. Surface water quality data by river segment.

Segment 0102 of the Canadian River Basin

NAME: Lake Meredith

DESCRIPTION: from Sanford Dam in Hutchinson County to a point immediately upstream of the confluence of Camp Creek in Potter County, up to the normal pool elevation of 2936.5 feet (impounds Canadian River)

SEGMENT CLASSIFICATION: Water Quality Limited

LENGTH: 30 miles (49 kilometers)

SURFACE AREA: 16,505 acres

DESIGNATED WATER USES: Contact Recreation
Exceptional Quality Aquatic Habitat
Public Water Supply

MONITORING STATIONS: 0102.0100, 0102.0150, 0102.0300, 0102.0350, 0102.0400, 0102.0500, 0102.0600, 0102.0650, 0102.0700, 0102.0800, 0102.0850, 0102.0900, 0102.1000, 0102.1100, 0102.1300

INTENSIVE SURVEYS: 08 Apr 1975 Q,F,C,S,A,B,P IMS-24 (Kirkpatrick: Apr 1976)

PERMITTED FACILITIES (FINAL):

Domestic	1 outfalls	0.00 MGD
Industrial	3 outfalls	0.00 MGD
Total	4 outfalls	0.00 MGD

KNOWN WATER QUALITY PROBLEMS/WATER QUALITY STANDARD COMPARISON:

Natural sources of brine discharge into the Canadian River near Logan, New Mexico and contribute to chloride levels in the lake which exceed the Texas Department of Health criteria for drinking water.

POTENTIAL WATER QUALITY PROBLEMS:

None

WATER QUALITY STATUS:

THE FOLLOWING TABLE ILLUSTRATES THE LAST FOUR YEARS (OCT. 1, 1985 THRU SEPT. 30, 1989) OF WATER QUALITY INFORMATION FOR SEGMENT 0102.

PARAMETER	CRITERIA	NUMBER SAMPLES	MINIMUM	MAXIMUM	MEAN	NUMBER OF VALUES OUTSIDE CRITERIA	MEAN VALUES OUTSIDE CRITERIA
DISSOLVED OXYGEN (MG/L)	6.0	37	6.4	13.0	9.8	0	0
TEMPERATURE (F)	85.0	38	35.9	80.7	58.2	0	0
PH	6.5-9.0	32	7.9	9.0	8.5	0	0
CHLORIDE (MG/L)	400	98	122	468	346	6	439
SULFATE (MG/L)	350	61	97	295	261	0	0
TOTAL DISSOLVED SOLIDS (MG/L)	1300	38	715	1115	966	0	0
FECAL COLIFORMS (#/100 ML)	200	677	1	980	2	6	373

TOTAL DISSOLVED SOLIDS WERE ESTIMATED BY MULTIPLYING SPECIFIC CONDUCTANCE BY .50

Figure 3-16 (cont).

Segment 0103 of the Canadian River Basin

NAME: Canadian River Above Lake Meredith

DESCRIPTION: from a point immediately upstream of the confluence of Camp Creek in Potter County to the New Mexi Line in Oldham County

SEGMENT CLASSIFICATION: Effluent Limited

LENGTH: 116 miles (187 kilometers)

DESIGNATED WATER USES: Contact Recreation
High Quality Aquatic Habitat

MONITORING STATIONS: 0103.0200

INTENSIVE SURVEYS:				
	11 Apr 1977	Q,F,C,S,I,B	IMS-76	(Dutton: Apr 1978)
	22 Apr 1985	Q,X,D,F,C,D	IS-86-09	(Ottmers: Nov 1986)
	27 Jun 1989	Q,X,D,F,C,B		(Ottmers: in preparation)

PERMITTED FACILITIES (FINAL):

Domestic	4 outfalls	16.21 MGD
Industrial	8 outfalls	0.35 MGD
Total	12 outfalls	16.56 MGD

KNOWN WATER QUALITY PROBLEMS/WATER QUALITY STANDARD COMPARISON:

There are no significant violations of water quality standards in this segment.

POTENTIAL WATER QUALITY PROBLEMS:

Naturally occurring high levels of chloride, sulfate, and total dissolved solids are found in the upper portion c segment. Phosphorus levels are occasionally elevated. Fecal coliform bacteria levels are occasionally elevated likely due to nonpoint source runoff.

RELATIVE SIGNIFICANCE OF POINT AND NONPOINT SOURCE POLLUTANTS:

The most significant source of pollutants is highly mineralized water emerging from an artesian aquifer and enteri river downstream from UTE Reservoir in New Mexico.

CONTROL PROGRAMS:

A. Existing: The lower portion of the segment has been somewhat degraded by East Amarillo Creek, which c treated sewage from the City of Amarillo. However, the City of Amarillo began a program in 1978 whereby s their treated sewage effluent is sold to local industry. Wastewater from this source only periodically Segment 0103.

   The Canadian River Municipal Water Authority in cooperation with the Bureau of Reclamation has a feasit study underway (Lake Meredith Salinity Control Study) to see if a concentrated brine source in the upper w shed in New Mexico can be eliminated.

B. Programs still to be implemented: Salinity control in the upper watershed, if appropriate.

FACTORS NEEDING CLARIFICATION WITH RESPECT TO CAUSE/EFFECT RELATIONSHIPS:

None at this time.

KNOWN RELATIONSHIPS TO OTHER ENVIRONMENTAL PROBLEMS:

None identified.

Figure 3-16 (cont).

WATER QUALITY STATUS:

THE FOLLOWING TABLE ILLUSTRATES THE LAST FOUR YEARS (OCT. 1, 1985 THRU SEPT. 30, 1989) OF WATER QUALITY INFORMATION FOR SEGMENT 0103.

PARAMETER	CRITERIA	NUMBER SAMPLES	MINIMUM	MAXIMUM	MEAN	NUMBER OF VALUES OUTSIDE CRITERIA	MEAN VALUES OUTSIDE CRITERIA
DISSOLVED OXYGEN (MG/L)	5.0	12	6.5	12.0	9.2	0	0
TEMPERATURE (F)	95.0	13	39.9	83.8	58.9	0	0
PH	6.5-9.0	13	7.8	8.8	8.3	0	0
CHLORIDE (MG/L)	1050	13	100	1020	607	0	0
SULFATE (MG/L)	540	13	91	494	320	0	0
TOTAL DISSOLVED SOLIDS (MG/L)	4500	13	270	2210	1494	0	0
FECAL COLIFORMS (#/100 ML)	200	10	2	855	50	2	562

TOTAL DISSOLVED SOLIDS WERE ESTIMATED BY MULTIPLYING SPECIFIC CONDUCTANCE BY .50

3.08 Lyndon B. Johnson National Historic Park

Lyndon B. Johnson National Historic Park site is located in the Texas hill country, in Johnson City, Texas. It is an historical park complex comprised of two units, which has the mission of preserving and displaying personal and family affects of the late-President, Lyndon B. Johnson (LBJ).

The Johnson City unit includes the Boyhood Home, the Johnson Settlement, and NPS management facilities. The LBJ unit consists of the LBJ ranch, the Birthplace House, the family cemetery, the Sam Ealy Johnson Farmhouse, and Johnson's first schoolhouse. While the primary significance of the two LBJ sites is historical and interpretive in nature—limited recreational or water-related activities are undertaken here—the Pedernales River flows through both units and its quality is important to maintaining the integrity of the resources associated with the LBJ ranch and park.

3.081 Basin Data[105]

The Pedernales River is a tributary of the Colorado River; the Colorado River basin encompasses a Texas drainage area of nearly 40,000 square miles (Figure 3-17). Other major tributaries of the Colorado River are the North and South Conchos, the San Saba, and the North and South Llano. Water quality in the Pedernales is very good with total dissolved solids concentrations below 300 mg/L for most of the year.

3.082 Water Uses

The Pedernales River is part of the LBJ National Historical Park, and although it is incidental to the recreation activities of the park, it is an important resource for visual and aesthetic activities that are found in the park. There are limited opportunities for body-contact recreation use and such uses are incidental to the park activities.

3.083 River Segments and Water Quality Standards

River Segment 1414 encompass more than 95 percent of the Pedernales River (Figures 3-18, 3-19). It begins near the headwaters of the river and ends at a point a short distance upstream from the confluence with the Colorado River. Contact recreation, high quality aquatic habitat and public water supply are the designated uses for the segment. While these designated uses appear to adequately protect the resources and activities of the park it should be noted that high quality water is integral to maintaining the cultural and historical significance of the LBJ National Historical Park (Figures 3-20 and 3-21).

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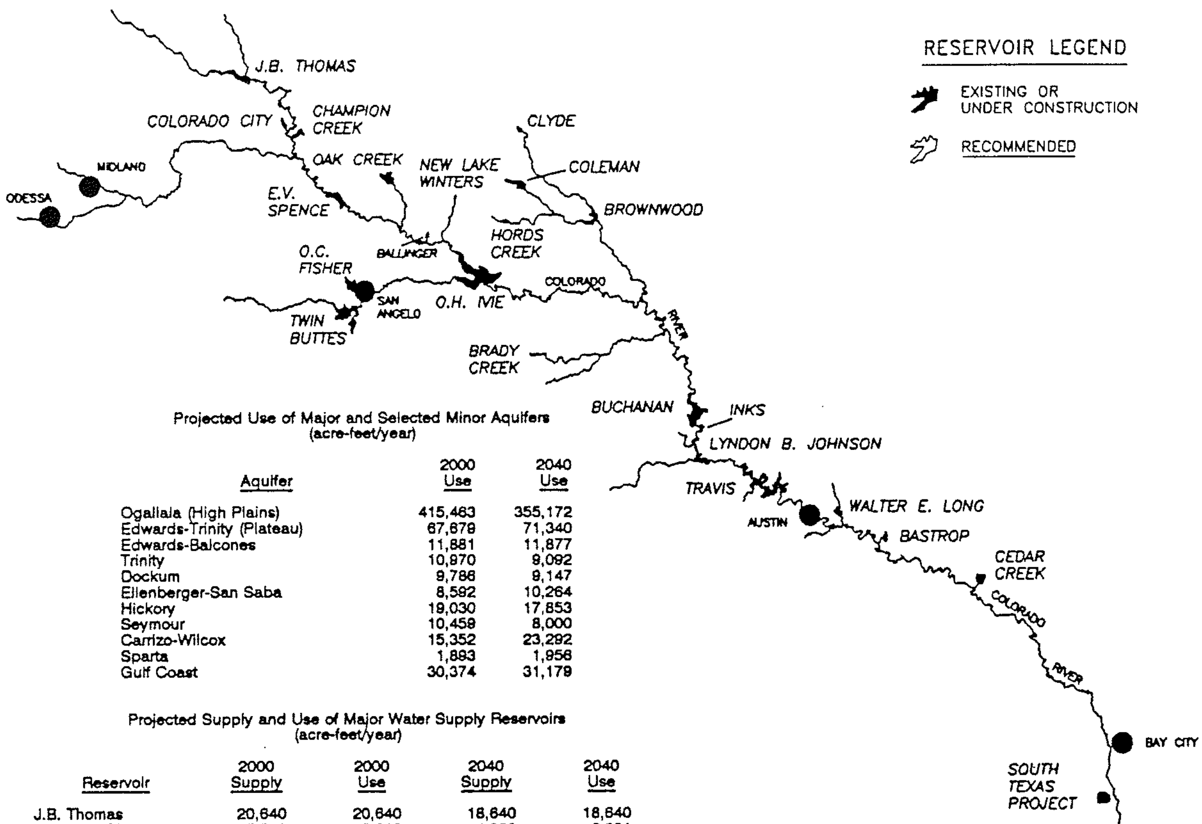
[105]See Appendix A for greater detail on the basin.

Figure 3-17. Colorado River basin.



Projected Use of Major and Selected Minor Aquifers
(acre-feet/year)

Aquifer	2000 Use	2040 Use
Ogallala (High Plains)	415,463	355,172
Edwards-Trinity (Plateau)	67,679	71,340
Edwards-Balcones	11,881	11,877
Trinity	10,970	9,092
Dockum	9,786	9,147
Ellenberger-San Saba	8,592	10,264
Hickory	19,030	17,853
Seymour	10,459	8,000
Carrizo-Wilcox	15,352	23,292
Sparta	1,883	1,956
Gulf Coast	30,374	31,179

Projected Supply and Use of Major Water Supply Reservoirs
(acre-feet/year)

Reservoir	2000 Supply	2000 Use	2040 Supply	2040 Use
J.B. Thomas	20,640	20,640	18,640	18,640
Colorado City	5,500	2,019	4,280	2,601
Champion Creek	5,000	5,000	5,000	5,000
E.V. Spence	48,100	34,611	43,430	43,930
Oak Creek	4,800	4,180	4,400	4,400
New Lake Winters	1,160	952	1,160	920
Ballinger	1,600	1,142	1,600	1,335
O.C. Fisher	13,200	13,200	9,300	9,300
Twin Buttes	31,400	28,971	29,000	28,881
O.H. Ivie	113,000	5,401	101,000	57,937
Hords Creek	1,200	107	1,200	122
Clyde	760	697	440	440
Coleman	7,090	1,539	6,400	2,257
Brownwood	31,400	12,870	30,466	21,574
Brady Creek	3,100	3,098	3,100	3,100
Highland Lakes	445,266	135,629	445,266	417,361

PROJECTED WATER DEMANDS AND SUPPLIES
(acre-feet/year)

ITEM	2000	2040
IN-BASIN DEMAND		
Municipal	353,859	546,757
Manufacturing	45,016	112,090
Steam Electric	74,000	104,100
Mining	36,428	26,447
Irrigation	649,578	602,285
Livestock	37,228	37,228
Total In-Basin Demands	1,196,109	1,428,907
IN-BASIN SUPPLIES		
Ground Water	638,482	582,647
Surface Water	1,274,386	1,258,149
Total In-Basin Supplies	1,912,868	1,840,796
TRANSFERS		
Import Supplies	2,858	4,387
Export Demands	292,979	363,267
ADDITIONAL NEW SUPPLIES	0	14,205
AGRICULTURAL SHORTAGE	(30,731)	(53,975)
NET AVAILABILITY	457,369	121,189

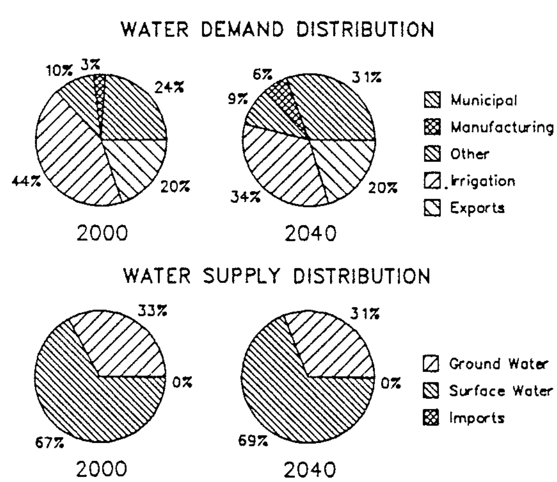


Figure 3-18. River segments and park locations, Colorado River basin.

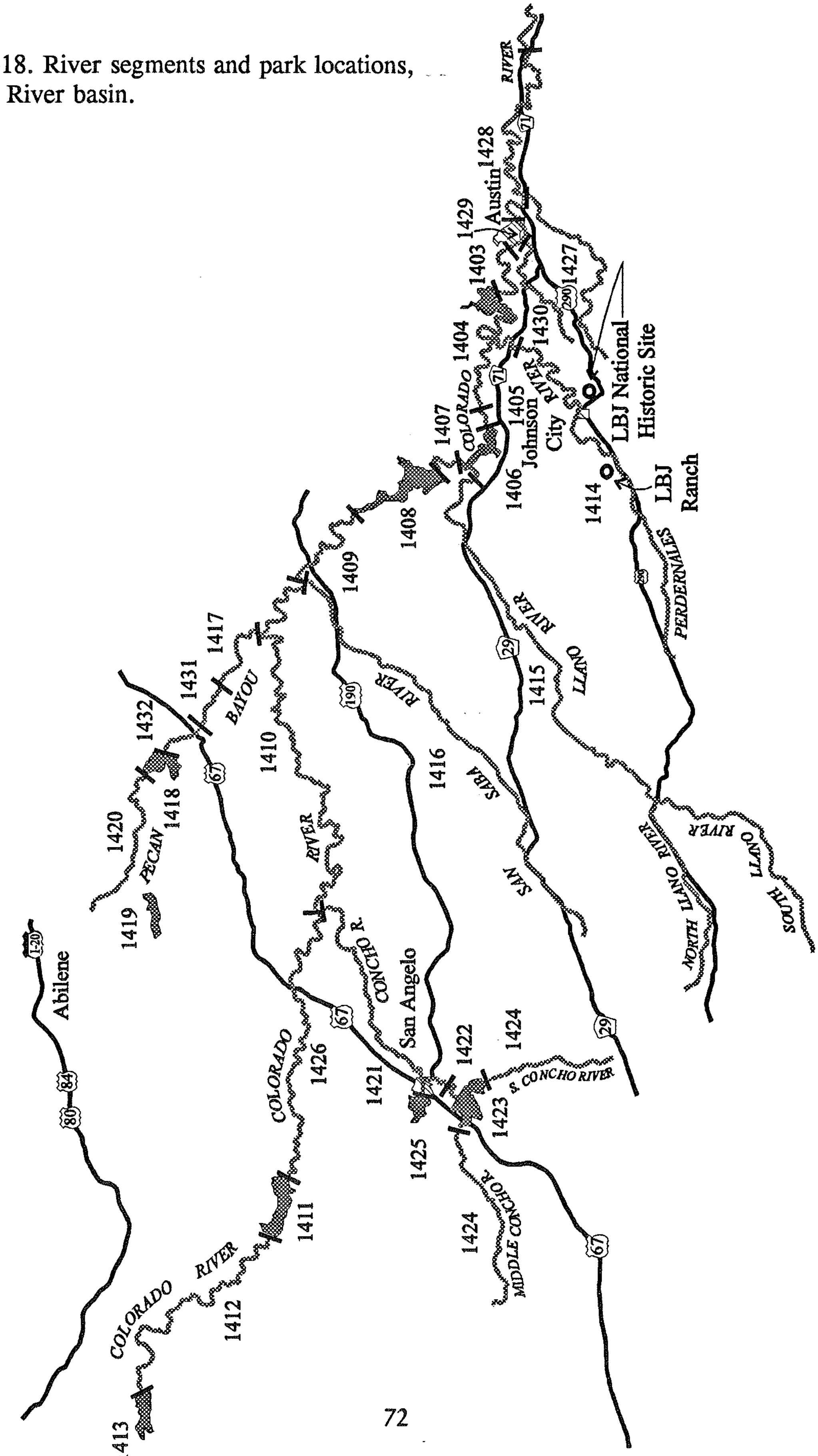


Figure 3-19. River segments for the basin.

14 COLORADO RIVER BASIN

1401 Colorado River Tidal - from the confluence with the Gulf of Mexico in Matagorda County to a point 2.1 kilometers (1.3 miles) downstream of the Missouri-Pacific Railroad in Matagorda County

1402 Colorado River Below Smithville - from a point 2.1 kilometers (1.3 miles) downstream of the Missouri-Pacific Railroad in Matagorda County to a point 100 meters (110 yards) downstream of SH 95/SH Loop 230 at Smithville in Bastrop County

1403 Lake Austin - from Tom Miller Dam in Travis County to Mansfield Dam in Travis County, up to the normal pool elevation of 492.8 feet (impounds Colorado River)

1404 Lake Travis - from Mansfield Dam in Travis County to Max Starcke Dam on the Colorado River Arm in Burnet County and to a point immediately upstream of the confluence of Fall Creek on the Pedernales River Arm in Travis County, up to the normal pool elevation of 681 feet (impounds Colorado River)

1405 Marble Falls Lake - from Max Starcke Dam in Burnet County to Alvin Wirtz Dam in Burnet County, up to the normal pool elevation of 738 feet (impounds Colorado River)

1406 Lake Lyndon B. Johnson - from Alvin Wirtz Dam in Burnet County to Roy Inks Dam on the Colorado River Arm in Burnet/Llano County and to a point immediately upstream of the confluence of Honey Creek on the Llano River Arm in Llano County, up to the normal pool elevation of 825 feet (impounds Colorado River)

1407 Inks Lake - from Roy Inks Dam in Burnet/Llano County to Buchanan Dam in Burnet/Llano County, up to the normal pool elevation of 888 feet (impounds Colorado River)

1408 Lake Buchanan - from Buchanan Dam in Burnet/Llano County to a point immediately upstream of the confluence of Yancey Creek, up to the normal pool elevation of 1020 feet (impounds Colorado River)

1409 Colorado River Above Lake Buchanan - from a point immediately upstream of the confluence of Yancey Creek in Burnet/San Saba/Lampasas County to the confluence of the San Saba River in San Saba County

1410 Colorado River Below Concho River - from the confluence of the San Saba River in San Saba County to the confluence of the Concho River in Concho County

1411 E. V. Spence Reservoir - from Robert Lee Dam in Coke County to a point immediately upstream of the confluence of Little Silver Creek in Coke County, up to the normal pool elevation of 1898 feet (impounds Colorado River)

1412 Colorado River Below Lake J. B. Thomas - from a point immediately upstream of the confluence of Little Silver Creek in Coke County to Colorado River Dam in Scurry County

1413 Lake J. B. Thomas - from Colorado River Dam in Scurry County up to the normal pool elevation of 2258 feet (impounds Colorado River)

1414 Pedernales River - from a point immediately upstream of the confluence of Fall Creek in Travis County to FM 385 in Kimble County

1415 Llano River - from a point immediately upstream of the confluence of Honey Creek in Llano County to FM 864 on the North Llano River in Sutton County and to SH 55 on the South Llano River in Edwards County

1416 San Saba River - from the confluence with the Colorado River in San Saba County to the confluence of the North Valley Prong and the Middle Valley Prong in Schleicher County

Figure 3-20. Texas surface water quality standards by river segment.

COLORADO RIVER BASIN		USES				CRITERIA						
SEGMENT NUMBER	SEGMENT NAME	RECREATION	AQUATIC LIFE	DOMESTIC WATER SUPPLY	OTHER	CHLORIDE (mg/L) Annual average not to exceed	SULFATE (mg/L) Annual average not to exceed	TOTAL DISSOLVED SOLIDS (mg/L) Annual average not to exceed	DISSOLVED OXYGEN (mg/L)	pH RANGE	FECAL COLIFORM (#/100 mL) Thirty-day geometric mean not to exceed	TEMPERATURE (°F) Not to exceed
1401	Colorado River Tidal	CR	H						4.0	6.5-9.0	200	95
1402 *	Colorado River Below Smithville	CR	H	PS		90	60	450	5.0	6.5-9.0	200	95
1403 *	Lake Austin	CR	H	PS		85	60	375	5.0	6.5-9.0	200	90
1404 *	Lake Travis	CR	E	PS		85	60	375	6.0	6.5-9.0	200	90
1405 *	Marble Falls Lake	CR	H	PS		115	70	450	5.0	6.5-9.0	200	94
1406 *	Lake Lyndon B. Johnson	CR	H	PS		115	70	450	5.0	6.5-9.0	200	94
1407 *	Inks Lake	CR	H	PS		135	95	525	5.0	6.5-9.0	200	90
1408 *	Lake Buchanan	CR	H	PS		145	95	525	5.0	6.5-9.0	200	90
1409 *	Colorado River Above Lake Buchanan	CR	H	PS		200	155	875	5.0	6.5-9.0	200	91
1410 *	Colorado River Below O. H. Ivie Reservoir	CR	H	PS		500	455	1,475	5.0	6.5-9.0	200	91
1411 *	E. V. Spence Reservoir	CR	H	PS		950	450	1,500	5.0	6.5-9.0	200	93
1412 *	Colorado River Below Lake J. B. Thomas	CR	H			11,000	2,500	20,000	5.0	6.5-9.0	200	93
1413	Lake J. B. Thomas	CR	H	PS		80	110	500	5.0	6.5-9.0	200	90
1414	Pedernales River	CR	H	PS		105	50	525	5.0	6.5-9.0	200	91
1415	Llano River	CR	H	PS		45	25	300	5.0	6.5-9.0	200	91
1416	San Saba River	CR	H	PS		40	30	425	5.0	6.5-9.0	200	90
1417	Lower Pecan Bayou	CR	H			310	120	1,025	5.0	6.5-9.0	200	90
1418	Lake Brownwood	CR	H	PS		150	100	500	5.0	6.5-9.0	200	90
1419	Lake Coleman	CR	H	PS		150	100	500	5.0	6.5-9.0	200	93
1420	Pecan Bayou Above Lake Brownwood	CR	H	PS		500	500	1,500	5.0	6.5-9.0	200	90

Figure 3-21. Surface water quality data by river segment.

Segment 1414 of the Colorado River Basin

NAME: Pedernales River

DESCRIPTION: from a point immediately upstream of the confluence of Fall Creek in Travis County to FM 385 in Kimble County

SEGMENT CLASSIFICATION: Effluent Limited

LENGTH: 125 miles (201 kilometers)

DESIGNATED WATER USES: Contact Recreation
High Quality Aquatic Habitat
Public Water Supply

MONITORING STATIONS: 1414.0075, 1414.0150, 1414.0200

INTENSIVE SURVEYS:				
	20 Feb 1973	Q,X,O,F,C,S,I,P,B	IMS-1	(Respess)
	12 Aug 1986		IS 89-05	(Ottmers: Jun 1989)
	17 July 1989	Q,K,F,C,B		(Ottmers: in preparation)

PERMITTED FACILITIES (FINAL):

Domestic	4 outfalls	2.09 MGD
Industrial	4 outfalls	0.00 MGD
Total	8 outfalls	2.09 MGD

KNOWN WATER QUALITY PROBLEMS/WATER QUALITY STANDARD COMPARISON:

Depressed dissolved oxygen levels occur.

POTENTIAL WATER QUALITY PROBLEMS:

Due to algal metabolism, elevated dissolved oxygen levels occasionally occur downstream of Barons Creek.

CONTROL PROGRAMS;

A waste load evaluation is in preparation for this segment.

WATER QUALITY STATUS:

THE FOLLOWING TABLE ILLUSTRATES THE LAST FOUR YEARS (OCT. 1, 1985 THRU SEPT. 30, 1989) OF WATER QUALITY INFORMATION FOR SEGMENT 1414.

PARAMETER	CRITERIA	NUMBER SAMPLES	MINIMUM	MAXIMUM	MEAN	NUMBER OF VALUES OUTSIDE CRITERIA	MEAN VALUES OUTSIDE CRITERIA
DISSOLVED OXYGEN (MG/L)	5.0	98	3.4	14.5	8.9	2	3.9
TEMPERATURE (F)	91.0	100	49.8	91.2	77.1	1	91.2
PH	6.5-9.0	94	7.3	8.8	8.4	0	0
CHLORIDE (MG/L)	105	25	24	98	60	0	0
SULFATE (MG/L)	50	25	10	44	33	0	0
TOTAL DISSOLVED SOLIDS (MG/L)	525	110	179	490	326	0	0
FECAL COLIFORMS (#/100 ML)	200	12	16	390	99	2	282

TOTAL DISSOLVED SOLIDS WERE ESTIMATED BY MULTIPLYING SPECIFIC CONDUCTANCE BY .50

3.084 Synopsis of Park Concerns

The park staff believe that water quality studies, waste-load evaluation, and monitoring of the Pedernales River and surrounding ranch waters, are needed to protect and preserve the park. They believe that existing monitoring activities are not adequately addressing any potential problems.

3.09 Padre Island National Seashore

Padre Island National Seashore is located in the Gulf of Mexico, south of Corpus Christi, Texas, to just north of the U.S./Mexico border. The park unit was established in 1962 "to save and preserve, for the purpose of public recreation, benefit, and inspiration, a portion of the diminishing seashores of the United States that remains undeveloped." The park preserves a barrier island ecosystem that offers outstanding opportunities for shoreline recreation and natural history study. The island remains relatively undisturbed, and as a consequence, visitors can find solitude for their recreational activities in the park's far reaches, or they can enjoy services offered at improved campgrounds (Figure 3-22).

Approximately two dozen archeological sites have been identified within the park, though the nature of shifting sands on the island may reveal more in time. The park also provides visitors with extensive panoramas and vistas. Padre Island has the longest stretch of undeveloped beach in the nation which provides for fishing, camping, swimming, beaches, scuba diving, boating and sailing. Historical and interpretive programs may also be a part of visitors experiences.

3.091 Estuary[106]

The Laguna Madre is one of three oceanic, hypersaline, lagoonal areas known in the world, which makes this estuary an important biological and economic asset[107] to the state. The most divergent estuarine system in Texas, the Laguna Madre, bounded by the Rio Grande River to the south, and Corpus Christi Bay to the north, receives freshwater inflow only from adjacent ungaged drainage areas. There are no major river basins which drain directly into this vast lagoon. Some excess floodwaters and municipal and agricultural wastewater is discharged through the Rio Grande Floodway and Arroyo Colorado into the lower Laguna Madre.

While maintaining freshwater inflows are essential to estuarine integrity,[108] the presence of pollutants in freshwater inflows can have a detrimental effect upon the biological integrity of the estuary. Waste loads which enter the estuary can be of several types, including municipal and industrial effluent and agricultural runoff. Samples of bottom sediments collected in the Laguna Madre estuary and the Arroyo Colorado indicated the presence of

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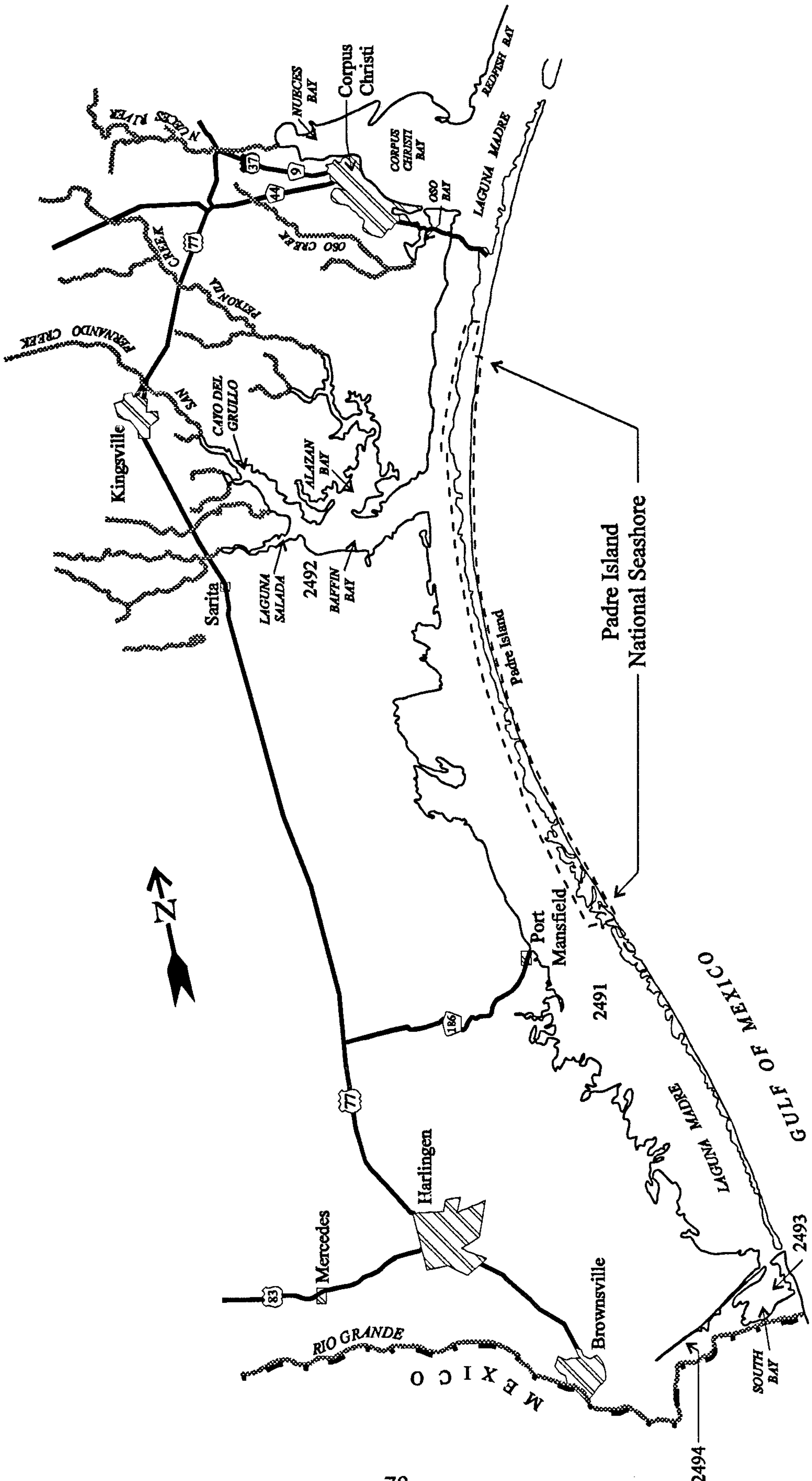
[106]This description of the estuary is taken from Texas Department of Water Resources. 1983. *Laguna Madre Estuary: A Study of the Influence of Freshwater Inflows*. (LP-182). Austin: Texas Department of Water Resources.

[107]*Id.* p. v. The total annual economic impact from commercial and sport fishing in the Laguna Madre is estimated to be nearly $40 million in 1976 dollars.

[108]*See* Kaiser, R., and S. Kelly. 1987. Water Rights for Texas Estuaries. *Texas Tech Law Review*. 18. pp. 1121-1156.

Figure 3-22. Bay segments and park location.



heavy metals and biocides, however, further statistical analysis were not possible due to the limited number of samples taken.[109]

3.092 Water Uses

Body-contact activities such as swimming, windsurfing, water-skiing, sailing, and wade-fishing are recognized recreational seashore uses. Non-body contact, but water- dependent recreation activities, include boating, fishing, and camping. In addition to the recreational uses, the Laguna Madre is a unique estuarine ecosystem that supports a variety of biological resources.[110] The seashore contains approximately 80,000 acres of freshwater marsh wetlands, and serves as one of the major wildlife refuges in North America. More than 320 bird species depend on these wetlands including ten protected species. Changes in water quality (i.e., salinity) would change some aspects of the food web in so many places in the biological framework, it would be difficult to predict the effects on the productivity of the total ecosystem.[111]

3.093 Estuarine Segments and Water Quality Standards

The Laguna Madre is divided into four segments—2491 to 2494. Contact recreation, exceptional quality aquatic habitat, and shellfish waters are designated uses for Segments 2491 and 2493. Segment 2492 varies slightly from these designated uses in that the aquatic habitat use is rated high, rather than exceptional. Segment 2494, the Brownsville Ship Channel, is designated for non-contact recreation and exceptional quality aquatic habitat.

Elevated levels of fecal coliform bacteria are sufficient to limit oyster harvesting in Segments 2491 and 2493. Except for these known water quality problems, the designated uses appear to protect the recreation activities of the Padre Island National Seashore, however, these designated uses may not protect the biological and ecological resources from impairment (Figures 3-23, and 3-24).

3.094 Synopsis of Park Concerns

The park staff believe that existing stream uses and standards adopted in 1991 need to be amended to lower the criteria for fecal coliform below the 200 colony forming units (cfu's)/100ml set for the Nueces-Rio Grande Coastal Basin.

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[109] *See* Texas Department of Water Resources. 1983. *Laguna Madre Estuary: A Study of the Influence of Freshwater Inflows*. pp. IV-24 and 25.

[110] *Id.* pp. VII-1 to VII-28, and VIII-1 to VIII-48.

[111] *Id.* p. I-4.

Figure 3-23. Texas surface water quality standards by bay segments.

BAYS AND ESTUARIES		USES				CRITERIA						
SEGMENT NUMBER	SEGMENT NAME	RECREATION	AQUATIC LIFE	DOMESTIC WATER SUPPLY	OTHER	CHLORIDE (mg/L) Annual average not to exceed	SULFATE (mg/L) Annual average not to exceed	TOTAL DISSOLVED SOLIDS (mg/L) Annual average not to exceed	DISSOLVED OXYGEN (mg/L)	pH RANGE	FECAL COLIFORM (#/100 mL) Thirty-day geometric mean not to exceed	TEMPERATURE (°F) Not to exceed
2491	Laguna Madre	CR	E/O						5.0	6.5-9.0	14	95
2492	Baffin Bay/Alazan Bay/Cayo del Grullo/Laguna Salada	CR	H/O						4.0	6.5-9.0	14	95
2493	South Bay	CR	E/O						5.0	6.5-9.0	14	95
2494	Brownsville Ship Channel	NCR	E						5.0	6.5-9.0	200	95

Figure 3-24. Surface water quality data by bay segments.

Segment 2491 of the Bays and Estuaries

NAME: Laguna Madre

DESCRIPTION:

SEGMENT CLASSIFICATION: Effluent Limited

SURFACE AREA: 347.4 square miles (899.8 square kilometers)

DESIGNATED WATER USES: Contact Recreation
Exceptional Quality Aquatic Habitat
Shellfish Waters

MONITORING STATIONS: 2491.0050, 2491.0100, 2491.0200, 2491.0300, 2491.0400, 2491.0500, 2491.0600

INTENSIVE SURVEYS: 11 Dec 1984 F,C,W,S,B,I LP-86-09 (Webster: Nov 1986) Port Isabel Harbor

PERMITTED FACILITIES (FINAL):

Domestic	22 outfalls	22.21 MGD
Industrial	12 outfalls	1.35 MGD
Total	34 outfalls	22.56 MGD

KNOWN WATER QUALITY PROBLEMS/WATER QUALITY STANDARD COMPARISON:

Dissolved oxygen levels are occasionally slightly depressed. A portion of this segment near the Arroyo Colorado is closed for oyster harvesting due to elevated fecal coliform bacteria. The Intracoastal waterway between Port Mansfield and Port Isabel is closed for oyster harvesting due to potential fecal coliform contamination.

POTENTIAL WATER QUALITY PROBLEMS:

Supersaturated dissolved oxygen levels occur rarely. Total phosphorus and inorganic nitrogen are periodically elevated, orthophosphorus is frequently elevated, and chlorophyll a is rarely elevated near the Arroyo Colorado.

WATER QUALITY STATUS:

THE FOLLOWING TABLE ILLUSTRATES THE LAST FOUR YEARS (OCT. 1, 1985 THRU SEPT. 30, 1989) OF WATER QUALITY INFORMATION FOR SEGMENT 2491.

PARAMETER	CRITERIA	NUMBER SAMPLES	MINIMUM	MAXIMUM	MEAN	NUMBER OF VALUES OUTSIDE CRITERIA	MEAN VALUES OUTSIDE CRITERIA
DISSOLVED OXYGEN (MG/L)	5.0	99	3.8	9.3	6.5	13	4.5
TEMPERATURE (F)	95.0	99	45.2	88.1	74.7	0	0
PH	6.5-9.0	90	7.3	8.8	8.1	0	0
CHLORIDE (MG/L)	N/A	97	5476	31100	19993	0	0
SULFATE (MG/L)	N/A	94	56	3864	2614	0	0
TOTAL DISSOLVED SOLIDS (MG/L)	N/A	99	14850	34924	26502	0	0
FECAL COLIFORMS (#/100 ML)	14	61	2	10	6	0	0

TOTAL DISSOLVED SOLIDS WERE ESTIMATED BY MULTIPLYING SPECIFIC CONDUCTANCE BY .50

Figure 3-24 (cont.).

Segment 2492 of the Bays and Estuaries

NAME: Baffin Bay/Alazan Bay/Cayo del Grullo/Laguna Salada

DESCRIPTION:

SEGMENT CLASSIFICATION: Effluent Limited

SURFACE AREA: 49.8 square miles (129.0 square kilometers)

DESIGNATED WATER USES: Contact Recreation
High Quality Aquatic Habitat
Shellfish Waters

MONITORING STATIONS: 2492.0100, 2492.0200

INTENSIVE SURVEYS: None

PERMITTED FACILITIES (FINAL):

Domestic	13 outfalls	11.07 MGD
Industrial	8 outfalls	3.50 MGD
Total	21 outfalls	14.57 MGD

KNOWN WATER QUALITY PROBLEMS/WATER QUALITY STANDARD COMPARISON:

None.

POTENTIAL WATER QUALITY PROBLEMS:

Fecal coliform bacteria were elevated on one occasion. Supersaturated dissolved oxygen levels occur rarely. Orthophosphorus is occasionally elevated.

WATER QUALITY STATUS:

THE FOLLOWING TABLE ILLUSTRATES THE LAST FOUR YEARS (OCT. 1, 1985 THRU SEPT. 30, 1989) OF WATER QUALITY INFORMATION FOR SEGMENT 2492.

PARAMETER	CRITERIA	NUMBER SAMPLES	MINIMUM	MAXIMUM	MEAN	NUMBER OF VALUES OUTSIDE CRITERIA	MEAN VALUES OUTSIDE CRITERIA
DISSOLVED OXYGEN (MG/L)	4.0	31	4.8	10.9	6.5	0	0
TEMPERATURE (F)	95.0	31	58.1	85.9	74.2	0	0
PH	6.5-9.0	31	7.4	8.6	8.0	0	0
CHLORIDE (MG/L)	N/A	30	15882	32800	24457	0	0
SULFATE (MG/L)	N/A	28	2258	4533	3424	0	0
TOTAL DISSOLVED SOLIDS (MG/L)	N/A	31	19625	39350	30572	0	0
FECAL COLIFORMS (#/100 ML)	14	12	2	15	2	1	15

TOTAL DISSOLVED SOLIDS WERE ESTIMATED BY MULTIPLYING SPECIFIC CONDUCTANCE BY .50

Figure 3-24 (cont.).

Segment 2493 of the Bays and Estuaries

NAME: South Bay

DESCRIPTION:

SEGMENT CLASSIFICATION: Effluent Limited

SURFACE AREA: 7.8 square miles (17.6 square kilometers)

DESIGNATED WATER USES: Contact Recreation
Exceptional Quality Aquatic Habitat
Shellfish Waters

MONITORING STATIONS: 2493.0100

INTENSIVE SURVEYS: None

PERMITTED FACILITIES (FINAL):

Domestic	1 outfalls	0.02 MGD
Industrial	0 outfalls	0.00 MGD
Total	1 outfalls	0.02 MGD

KNOWN WATER QUALITY PROBLEMS/WATER QUALITY STANDARD COMPARISON:

A portion of this segment is closed for oyster harvesting due to elevated fecal coliform bacteria.

POTENTIAL WATER QUALITY PROBLEMS:

Dissolved oxygen was slightly depressed on one occasion.

WATER QUALITY STATUS:

THE FOLLOWING TABLE ILLUSTRATES THE LAST FOUR YEARS (OCT. 1, 1985 THRU SEPT. 30, 1989) OF WATER QUALITY INFORMATION FOR SEGMENT 2493.

PARAMETER	CRITERIA	NUMBER SAMPLES	MINIMUM	MAXIMUM	MEAN	NUMBER OF VALUES OUTSIDE CRITERIA	MEAN VALUES OUTSIDE CRITERIA
DISSOLVED OXYGEN (MG/L)	5.0	16	4.6	7.9	6.6	1	4.6
TEMPERATURE (F)	95.0	16	61.4	81.9	72.8	0	0
PH	6.5-9.0	14	7.8	8.4	8.1	0	0
CHLORIDE (MG/L)	N/A	15	2180	27750	18858	0	0
SULFATE (MG/L)	N/A	15	57	4350	2416	0	0
TOTAL DISSOLVED SOLIDS (MG/L)	N/A	16	19200	28200	25121	0	0
FECAL COLIFORMS (#/100 ML)	14	12	7	13	8	0	0

TOTAL DISSOLVED SOLIDS WERE ESTIMATED BY MULTIPLYING SPECIFIC CONDUCTANCE BY .50

Figure 3-24 (cont.).

Segment 2494 of the Bays and Estuaries

NAME: Brownsville Ship Channel

DESCRIPTION:

SEGMENT CLASSIFICATION: Effluent Limited

SURFACE AREA: 1.5 square miles (3.9 square kilometers)

DESIGNATED WATER USES: Noncontact Recreation
Exceptional Quality Aquatic Habitat

MONITORING STATIONS: 2424.0100

INTENSIVE SURVEYS: 14 Jun 1982 F,C,S,I,B IS-55 (Bowles: Aug 1983)

PERMITTED FACILITIES (FINAL):

Domestic	19 outfalls	13.71 MGD
Industrial	3 outfalls	266.65 MGD
Total	22 outfalls	280.36 MGD

KNOWN WATER QUALITY PROBLEMS/WATER QUALITY STANDARD COMPARISON:

None.

POTENTIAL WATER QUALITY PROBLEMS:

Orthophosphorus is rarely elevated.

WATER QUALITY STATUS:

THE FOLLOWING TABLE ILLUSTRATES THE LAST FOUR YEARS (OCT. 1, 1985 THRU SEPT. 30, 1989) OF WATER QUALITY INFORMATION FOR SEGMENT 2494.

PARAMETER	CRITERIA	NUMBER SAMPLES	MINIMUM	MAXIMUM	MEAN	NUMBER OF VALUES OUTSIDE CRITERIA	MEAN VALUES OUTSIDE CRITERIA
DISSOLVED OXYGEN (MG/L)	5.0	14	5.4	8.3	6.8	0	0
TEMPERATURE (F)	95.0	13	57.6	84.4	73.5	0	0
PH	6.5-9.0	12	7.9	8.3	8.1	0	0
CHLORIDE (MG/L)	N/A	13	5478	22500	16489	0	0
SULFATE (MG/L)	N/A	13	54	3226	1999	0	0
TOTAL DISSOLVED SOLIDS (MG/L)	N/A	14	16200	29433	23961	0	0
FECAL COLIFORMS (#/100 ML)	200	11	7	20	9	0	0

TOTAL DISSOLVED SOLIDS WERE ESTIMATED BY MULTIPLYING SPECIFIC CONDUCTANCE BY .50

3.10 San Antonio Missions National Historical Park

San Antonio Missions National Historical Park is located in San Antonio, Texas. The park was established in 1978 to stabilize and preserve the chain of missions created by the Spanish along the San Antonio River in the 18th century. These missions formed the foundation for the current city of San Antonio, and are reminders of one of Spain's most successful attempts to extend its New World dominion northward from Mexico.

Numerous missions and other structures are preserved or restored in an area south of downtown San Antonio. The locations offer primarily interpretive and historical recreational experiences.

3.101 River Basin[112]

The San Antonio River basin drains about 4,100 square miles including the urbanized area around the city of San Antonio (Figure 3-25). Water quality in the upper reaches of the San Antonio River, which extends into the city is relatively poor, particularly during periods of low flow. Under such conditions, flow consists largely of treated municipal wastewater from the city of San Antonio's wastewater treatment plants. Significant improvements have been in the City's wastewater treatment plants so that the non-fishable status of the river has been lifted.[113]

3.102 Water Uses

Interpretation and protection of the acequia system (Spanish colonial irrigation system) and agricultural uses of the water are the primary water-dependent resource needs of the park.

3.103 River Segments and Water Quality Standards

One stream segment (#1911) covering a distance of 86 miles, extends above and through the park (Figures 3-26 and 3-27). This segment includes all of the City of San Antonio. Designated uses include contact recreation and high quality aquatic habitat. Facially, these designated uses appear to adequately protect park activities, yet serious water quality problems are known to exist. The segment does not meet swimmable criteria due to elevated levels of fecal coliform bacteria (Figures 3-28 and 3-29).

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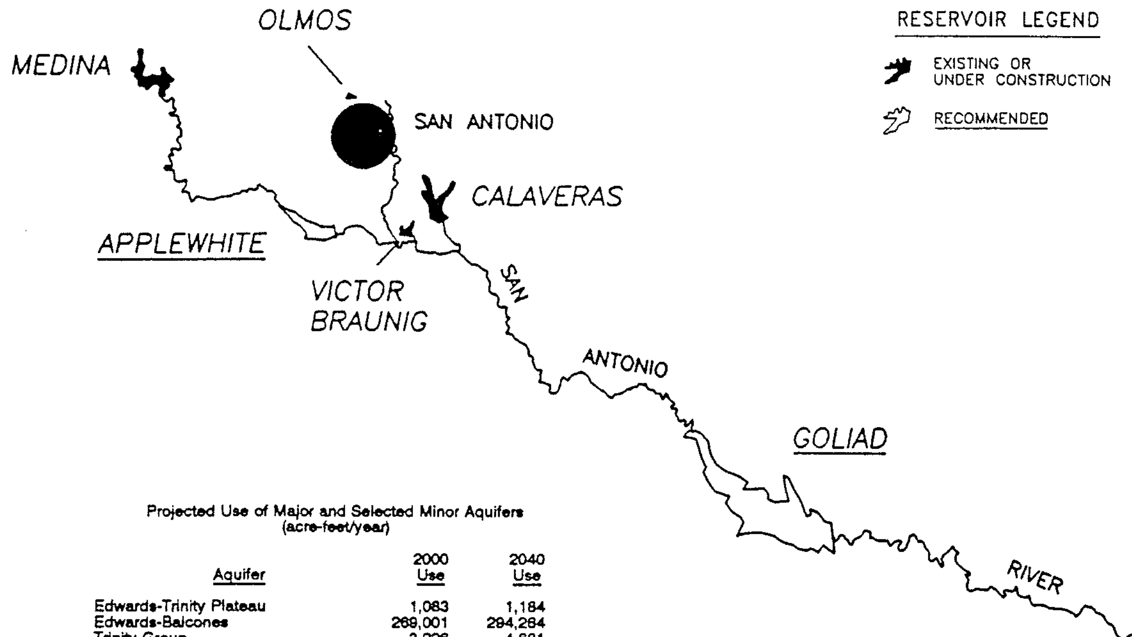
[112] *See* Appendix A for greater detail on the basin.

[113] *See* Texas Water Commission. 1990. *The State of Texas Water Quality Inventory*. 10th ed. Seg. 1911 of the San Antonio River Basin.

Figure 3-25. San Antonio River basin.



Projected Use of Major and Selected Minor Aquifers
(acre-feet/year)

Aquifer	2000 Use	2040 Use
Edwards-Trinity Plateau	1,083	1,184
Edwards-Balcones	269,001	294,264
Trinity Group	3,228	4,681
Carrizo-Wilcox	21,493	26,371
Gulf Coast	5,795	6,133

Projected Supply and Use of Major Water Supply Reservoirs
(acre-feet/year)

Reservoir	2000 Supply	2000 Use	2040 Supply	2040 Use
Medina	39,200	19,099	39,200	31,001
Applewhite	7,900	7,900	7,900	7,900
Goliad	0	0	148,400	148,400

PROJECTED WATER DEMANDS AND SUPPLIES
(acre-feet/year)

ITEM	2000	2040
IN-BASIN DEMAND		
Municipal	359,754	688,959
Manufacturing	19,295	43,993
Steam Electric	36,000	59,000
Mining	3,162	7,972
Irrigation	44,493	35,922
Livestock	6,554	6,554
Total In-Basin Demands	469,258	842,400
IN-BASIN SUPPLIES		
Ground Water	302,165	334,716
Surface Water	127,829	129,468
Total In-Basin Supplies	429,994	464,184
TRANSFERS		
Import Supplies	84,284	172,330
Export Demands	39,470	58,544
ADDITIONAL NEW SUPPLIES	36,872	286,155
AGRICULTURAL SHORTAGE	0	0
NET AVAILABILITY	42,422	21,725

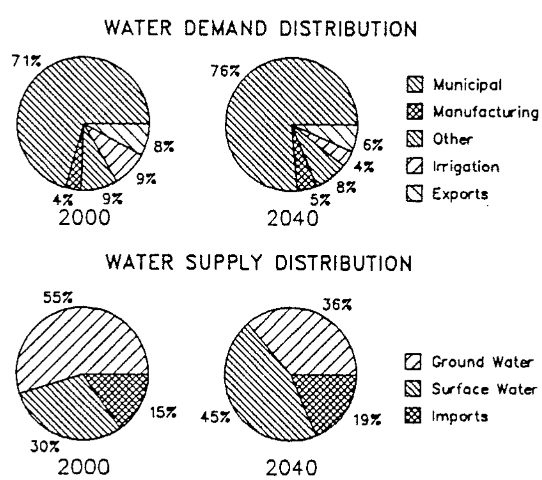


Figure 3-26. River segments and park locations, San Antonio River basin.

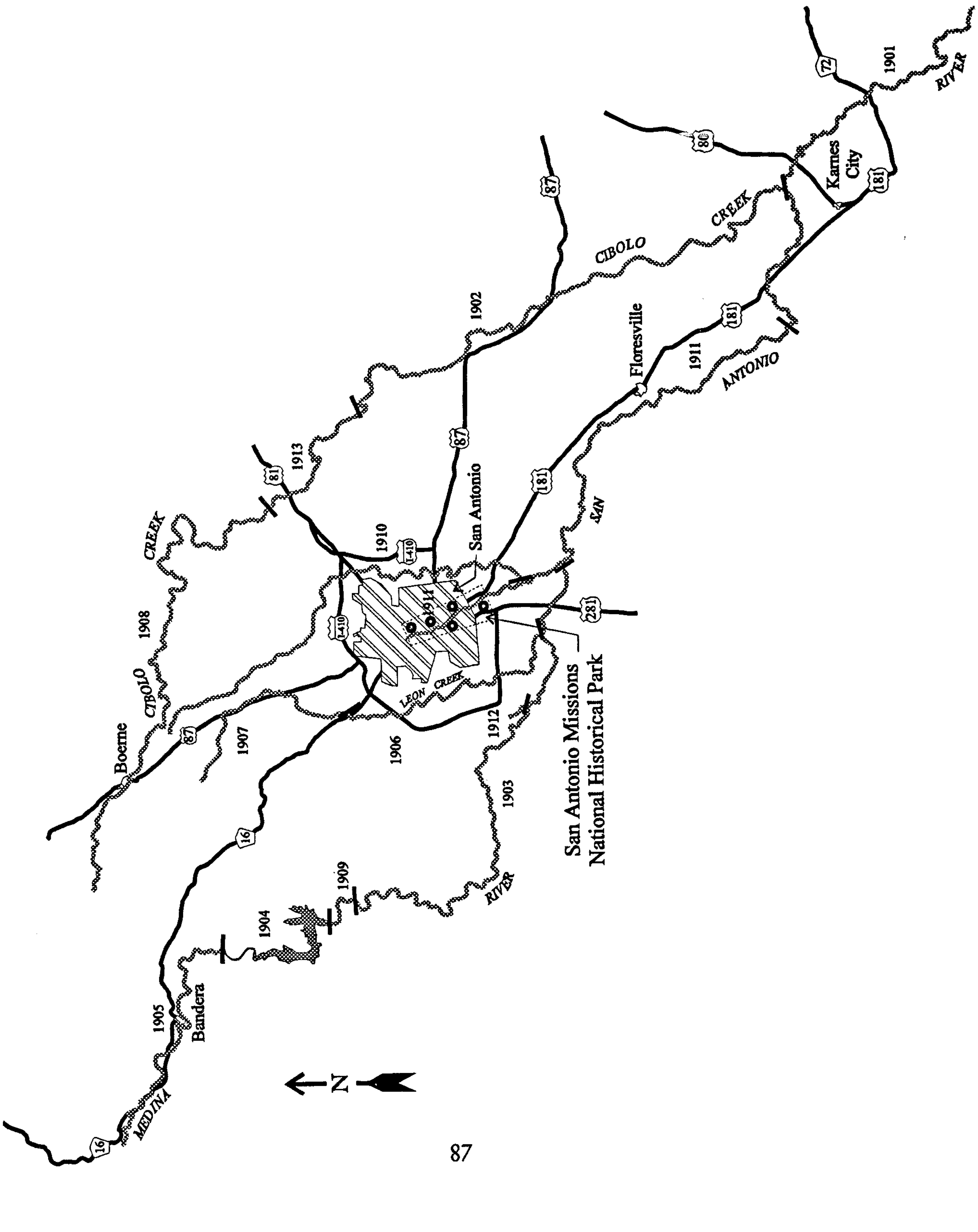


Figure 3-27. River segments for the basin.

19 SAN ANTONIO RIVER BASIN

1901 Lower San Antonio River - from the confluence with the Guadalupe River in Refugio/Victoria County to a point 600 meters (660 yards) downstream of FM 791 at Mays Crossing near Falls City in Karnes County

1902 Lower Cibolo Creek - from the confluence with the San Antonio River in Karnes County to a point 100 meters (110 yards) downstream of IH 10 in Bexar/Guadalupe County

1903 Medina River Below Medina Diversion Lake - from the confluence with the San Antonio River in Bexar County to Medina Diversion Dam in Medina County

1904 Medina Lake - from Medina Lake Dam in Medina County to a point immediately upstream of the confluence of Red Bluff Creek in Bandera County, up to the normal pool elevation of 1064.2 feet (impounds Medina River)

1905 Medina River Above Medina Lake - from a point immediately upstream of the confluence of Red Bluff Creek in Bandera County to the confluence of the North Prong Medina River and the West Prong Medina River in Bandera County

1906 Lower Leon Creek - from the confluence with the Medina River in Bexar County to a point 100 meters (110 yards) upstream of SH 16 northwest of San Antonio in Bexar County

1907 Upper Leon Creek - from a point 100 meters (110 yards) upstream of SH 16 northwest of San Antonio in Bexar County to a point 9.0 kilometers (5.6 miles) upstream of Scenic Loop Road north of Helotes in Bexar County

1908 Upper Cibolo Creek - from the Missouri-Pacific Railroad bridge west of Bracken in Comal County to a point 1.5 kilometers (0.9 mile) upstream of the confluence of Champee Springs in Kendall County

1909 Medina Diversion Lake - from Medina Diversion Dam in Medina County to Medina Lake Dam in Medina County, up to the normal pool elevation of 926.5 feet (impounds Medina River)

1910 Salado Creek - from the confluence with the San Antonio River in Bexar County to Rocking Horse Lane west of Camp Bullis in Bexar County

★ 1911 Upper San Antonio River - from a point 600 meters (660 yards) downstream of FM 791 at Mays Crossing near Falls City in Karnes County to a point 100 meters (110 yards) upstream of Hildebrand Avenue at San Antonio in Bexar County

1912 Medio Creek - from the confluence with the Medina River in Bexar County to a point 1.0 kilometer (0.6 mile) upstream of IH 35 at San Antonio in Bexar County

1913 Mid Cibolo Creek - from a point 100 meters (110 yards) downstream of IH 10 in Bexar/Guadalupe County to the Missouri-Pacific Railroad bridge west of Bracken in Comal County

Figure 3-28. Texas water quality standards by river segment.

SAN ANTONIO RIVER BASIN		USES				CRITERIA						
SEGMENT NUMBER	SEGMENT NAME	RECREATION	AQUATIC LIFE	DOMESTIC WATER SUPPLY	OTHER	CHLORIDE (mg/L) Annual average not to exceed	SULFATE (mg/L) Annual average not to exceed	TOTAL DISSOLVED SOLIDS (mg/L) Annual average not to exceed	DISSOLVED OXYGEN (mg/L)	pH RANGE	FECAL COLIFORM (#/100 mL) Thirty-day geometric mean not to exceed	TEMPERATURE (°F) Not to exceed
1901	Lower San Antonio River	CR	H			180	140	750	5.0	6.5-9.0	200	90
1902	Lower Cibolo Creek	CR	H			170	275	900	5.0	6.5-9.0	200	90
1903	Medina River Below Medina Diversion Lake	CR	H	PS		120	120	700	5.0	6.5-9.0	200	90
1904	Medina Lake	CR	H	PS/AP		80	75	350	5.0	6.5-9.0	200	88
1905	Medina River Above Medina Lake	CR	E	PS		50	100	400	6.0	6.5-9.0	200	88
1906	Lower Leon Creek	CR	H	PS		120	120	700	5.0	6.5-9.0	200	95
1907	Upper Leon Creek	CR	H	PS/AP		55	240	550	5.0	6.5-9.0	200	95
1908	Upper Cibolo Creek	CR	H	PS/AP		50	50	400	5.0	6.5-9.0	200	90
1909	Medina Diversion Lake	CR	H	PS/AP		50	75	400	5.0	6.5-9.0	200	90
1910	Salado Creek	CR	H	PS/AP		140	200	600	5.0	6.5-9.0	200	90
★ 1911	Upper San Antonio River	CR	H			95	95	620	5.0	6.5-9.0	200	90
1912	Medio Creek	CR	I			100	125	550	4.0	6.5-9.0	200	95
1913	Mid Cibolo Creek	CR	L			80	90	650	3.0	6.5-9.0	200	90

Figure 3-29. Surface water quality data by river segment.

Segment 1911 of the San Antonio River Basin

NAME: Upper San Antonio River

DESCRIPTION: from a point 600 meters (660 yards) downstream of FM 791 at Mays Crossing near Falls City in Karnes County to a point 100 meters (110 yards) upstream of Hildebrand Avenue at San Antonio in Bexar County

SEGMENT CLASSIFICATION: Water Quality Limited

LENGTH: 85 miles (136 kilometers)

DESIGNATED WATER USES: Contact Recreation
High Quality Aquatic Habitat

MONITORING STATIONS: 1911.0200, 1911.0210, 1911.0213, 1911.0215, 1911.0220, 1911.0225, 1911.0250, 1911.0350, 1911.0352, 1911.0375, 1911.0400, 1911.0450, 1911.0600, 1911.0650, 1911.0720, 1911.0735, 1911.0800, 1911.0880, 1911.0900, 1911.0902

INTENSIVE SURVEYS:

01 Sep 1975	Q,F,C,P,S,I,B	IMS-30	(Twidwell)
20 Jun 1983	Q,X,D,F,C,B	IS-59	(Twidwell: Apr 1984)
16 Nov 1983	I,N	IS-59	(Twidwell: Apr 1984)
23 Jul 1984	Q,X,D,F,C,B	IS-72	(Twidwell: Jul 1985)
05 Jun 1984 to 15 May 1985	F,C,B,I	IS-87-04	(Twidwell: Mar 1987)

PERMITTED FACILITIES (FINAL):

Domestic	5 outfalls	36.88 MGD
Industrial	7 outfalls	0.73 MGD
Total	12 outfalls	37.61 MGD

KNOWN WATER QUALITY PROBLEMS/WATER QUALITY STANDARD COMPARISON:

Poor water quality conditions existed in the past. Depressed dissolved oxygen levels occurred in the segment. Since the completion of the City of San Antonio Dos Rios wastewater treatment facility and the termination of the Rilling Road facility, the dissolved oxygen level in the San Antonio River has increased to levels above the stream standard. Due to the increase in dissolved oxygen levels throughout the segment, the non-fishable status has been lifted. Nutrient levels continue to be elevated. The segment does not meet swimmable criteria due to elevated levels of fecal coliform bacteria.

POTENTIAL WATER QUALITY PROBLEMS:

Supersaturated dissolved oxygen levels occur in the inner city portion of the river. Chlorophyll a levels in this area are slightly elevated. Levels of chloride and sulfate are occasionally outside the segment criteria. Elevated levels of chromium in water have been monitored.

RELATIVE SIGNIFICANCE OF POINT AND NONPOINT SOURCE POLLUTANTS:

Water quality in the segment is dominated by treated domestic wastewaters discharged by the three large City of San Antonio plants.

CONTROL PROGRAMS:

A. Existing: Four intensive surveys and a year-long seasonal study under varying flow conditions have been conducted. The results indicate the poor water quality conditions in the segment are due to effluent domination. A use attainability analysis conducted on the segment indicates that a high quality aquatic life habitat is appropriate for the segment. A dissolved oxygen criterion of 5 mg/L is required in the Texas Surface Water Quality Standards to protect this use. The new Dos Rios treatment facility is completed, and the Rilling Road discharge has been terminated.

B. Programs still to be implemented: A waste load evaluation has been completed for Segment 1911.

FACTORS NEEDING CLARIFICATION WITH RESPECT TO CAUSE/EFFECT RELATIONSHIPS:

None.

KNOWN RELATIONSHIPS TO OTHER ENVIRONMENTAL PROBLEMS:

None.

Figure 3-29 (cont.).

WATER QUALITY STATUS:

THE FOLLOWING TABLE ILLUSTRATES THE LAST FOUR YEARS (OCT. 1, 1985 THRU SEPT. 30, 1989) OF WATER QUALITY INFORMATION FOR SEGMENT 1911.

PARAMETER	CRITERIA	NUMBER SAMPLES	MINIMUM	MAXIMUM	MEAN	NUMBER OF VALUES OUTSIDE CRITERIA	MEAN VALUES OUTSIDE CRITERIA
DISSOLVED OXYGEN (MG/L)	5.0	415	.6	17.8	5.5	184	3.2
TEMPERATURE (F)	90.0	528	50.0	93.2	74.6	2	92.3
PH	6.5-9.0	382	6.7	8.6	7.7	0	0
CHLORIDE (MG/L)	95	289	1	139	57	34	105
SULFATE (MG/L)	95	287	3	296	56	17	120
TOTAL DISSOLVED SOLIDS (MG/L)	620	155	121	670	416	1	670
FECAL COLIFORMS (#/100 ML)	200	231	1	174000	463	154	1257

TOTAL DISSOLVED SOLIDS WERE ESTIMATED BY MULTIPLYING SPECIFIC CONDUCTANCE BY .50

3.104 Synopsis of Park Concerns

The park staff expressed concerns over unauthorized discharges and spills from a petroleum refinery located adjacent to one of the units of the park.

4.0 SUMMARY AND RECOMMENDATIONS

Texas has made significant improvements in protecting surface waters from point-sources of pollution.[114] The causes of major reductions in water quality ranked by the number of river miles affected for rivers not fully supporting uses include: pathogenic bacteria, salinity, total dissolved solids, chlorides, and organic enrichment. Sources contributing to major reductions in river water quality include municipal point-sources, natural sources, and nonpoint sources in the form of runoff.[115] While conventional point-sources remain a concern, more attention is being focused on the control of toxic and nonpoint sources of pollution associated with improper land management practices. It is in this water quality context that the National Park Service must operate in Texas.

In protecting water-related recreational activities and water-dependent park resources in the nine national parks in Texas, the staff in each park must closely work with the staff of the Texas Natural Resources Conservation Commission (TNRCC) to establish and enforce water quality standards. This requires that each park take a more active role in:

(1) developing methods for evaluating park water quality standards in light of resource protection mandates, and

(2) communicating its concerns to the Texas Natural Resources Conservation Commission to help protect the unique water needs and requirements for each park within the state.

The NPS should begin this task by taking these actions:

- Review the adequacy of the Texas Water Quality Standards;

- Forge partnerships to insure water quality monitoring;

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[114]In the TWC's most recent water quality assessment of classified surface waters, 84 percent of classified stream miles, and 88 percent of the classified reservoirs in the state exhibit suitable water quality to support the major uses designed by the TWC (i.e., contact recreation, aquatic habitat and public water supply). About 89 percent of the classified streams and 99 percent of the classified reservoirs meet the "swimmable" goal of the Clean Water Act. The "fishable" goal of the Act is achieved in more than 99 percent of the classified waters. *See* Texas Water Commission. 1990. ***The State Of Texas Water Quality Inventory***. 10th ed. (LP 90-06). Austin: Texas Water Commission.

[115]*See* Texas Water Development Board. 1990. *Water for Texas: Today and Tomorrow*. Austin: Texas Water Development Board. pp. 1-9.

- Seek ONRW designations for selected waters in Texas; and
- Develop interagency linkages with the TNRCC.

4.01 Adequacy of Texas Water Quality Standards

While the designated uses adopted by the TNRCC for the stream segments of concern to the nine units of the National Park Service in Texas may protect the recreation uses of those waters, they may not offer a level of protection to leave park water-dependent resources "in an unimpaired state for future generations." The NPS "unimpaired state" mandate is a zero-tolerance standard for reductions in water quality. Thus, the NPS must seek antidegradation standards to be consistent with its statutory mission.

Although the use-designations may be adequate to protect recreation uses, questions were raised at a number of parks regarding the length the stream segments and the adequacy of the numerical criteria to protect existing resources and values not accounted for by the designated uses. As part of its triennial review of Texas Surface Water Quality Standards, the TNRCC is seeking preliminary comments from interested parties regarding changes in the standards. This is an appropriate time for the NPS to recommend changes in the Texas Surface Water Quality Rules to increase the protection for park resources.

Recommendations:

(1) Park managers at Big Thicket National Preserve, Big Bend National Park, and Lake Meredith National Recreation Area should recommend changes in numerical criteria on existing classified segments and be prepared to supply technical justifications for suggested changes in order to provide enhanced protection for ecosystem resources and values.

(2) The water resources in Guadalupe National Park are crucial to maintaining a riparian environment in McKittrick Canyon. Presently, the waters in the park are not segmented or classified. Park staff should work with the TNRCC on site specific investigations to determine if classifying and designating water uses, or ONRW nomination in the park is appropriate. This would strengthen the water quality protection for park resources.

(3) The length of designated stream segments at Big Bend National Park and Big Thicket National Preserve make it difficult to monitor water quality. Park staff should work with the TNRCC to subdivide segment designations on some streams.

4.02 Water Quality Monitoring

There is no question that exhaustive and precise water quality monitoring is an essential step in the water protection process. The Texas Surface Water Monitoring program collects water quality data from over 700 sites statewide.[116] Sampling includes collections of physico-chemical, biological and hydrological data at varying frequencies. Samples are collected from 359 designated stream, reservoir and bay segments to monitor the attainment of uses and numerical criteria. This monitoring data is used to developed remediation programs and to make decisions on the awarding of wastewater discharge permits.

Fiscal and physical constraints on the TNRCC limit the expansion of water quality monitoring. Without monitoring, waters are left with inadequate protection. Because no substitute for monitoring exists, a solution to this dilemma must be identified and successfully implemented.

Recommendations:

(1) Many parks in Texas have monitoring programs for water quality. One problem is that they do not share the data with the TNRCC. Park managers should be encouraged to develop water quality monitoring programs consistent with the parameters of the TNRCC and to share the collected data with the TNRCC.

(2) Park managers should be encouraged to develop TNRCC volunteer monitoring programs for their parks. Successful volunteer water monitoring programs involve, energize, educate, and train citizens in the intricacies of water monitoring. Planned and executed properly, these programs can provide park resource personnel with a wealth of valid and reliable water quality data while helping to free up park staff for other tasks. In addition, the positive rapport which develops with citizens will be invaluable to the future interests of the National Park Service. Thus, the two over-arching goals of a volunteer program are: First, to collect water quality information needed to make environmentally sound decisions; and second, to improve communication with the public about environmental issues.

4.03 Outstanding Natural Resource Waters

When considered in conjunction with the antidegradation policy, the Texas Outstanding Natural Resource Water classification system offers a significant management tool for the

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[116]The executive director of the TWC has the responsibility for establishing a water quality monitoring program and all other state agencies shall coordinate their water monitoring programs with the TWC. Tex. Water Code Ann. § 26.127.

protection of water quality.[117] In Texas, these waters are defined as "high quality waters within *or adjacent to* national parks... and other designated areas of *exceptional recreational and ecological* significance."[118] The adjacent water designation provides a means to protect national parks from the so- called "external threats."

The Texas ONRW rules are definitional in nature and are not self-executing; that is, they do not provide the criteria nor the process for designating waters as ONRW's. *As of January 1, 1994, no waters within, or adjacent to, national parks in Texas, carry the ONRW designation.* The burden is on the NPS to seek designation for any such waters. Once a request is made, the TNRCC will undertake a review. This review may result in the development and adoption of criteria for ONRW's (see Appendix B for TNRCC background paper on ONRW's).

Recommendations:

(1) As part of its triennial review of Texas Surface Water Quality Standards, the TNRCC is seeking preliminary comments from interested parties on any and all aspects of its' water quality rules. This is an appropriate time for the NPS to seek a designation of selected streams in Texas for ONRW designations.

(2) Based on a review of park planning literature, existing water quality, water-dependent park resources and administrative considerations within the TNRCC, the NPS should seek ONRW designation for all or selected portions of the waters in Guadalupe Mountain National Park, Big Thicket National Preserve, Padre Island National Seashore, and Big Bend National Park.

(3) ONRW designations can be sought as part of the triennial review process associated with the EPA approval of Texas Surface Water Quality Standards or through the rule amendment process. Under either approach, the process is instituted by filing a notice of intent with the Executive Director of TNRCC.

4.04 Linkages with Regulatory Agencies

Management and protection of park resources is not confined to park boundaries. Although the NPS may have responsibility for management of many of the resources within the park's boundaries, water quality and water resource-related laws and programs are administered by

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[117] 31 Tex. Admin. Code § 307.5.

[118] *Id.* § 307.5(b)(3).

agencies other than the NPS.[119] Therefore, park managers in Texas must aggressively seek to work with the staff of the TNRCC and other agencies to protect park resources.

The importance of developing linkages with other agencies was given greater impetus by the Texas Legislature with the passage of the Clean Rivers Program in 1991.[120] The Act seeks to provide for a more comprehensive, holistic method of assessment and action by requiring that regional water quality assessments are to be made, and are due every two years to the TNRCC. The focus of the program will be on pollution prevention, citizen involvement, local solutions to problems and overall water quality improvements.

Recommendations:

(1) To assist park managers in building a working rapport with officials from the TNRCC, a seminar series should be developed between the NPS and the TNRCC. This seminar series can begin to familiarize the NPS staff with the process and procedures of the TNRCC in promulgation and enforcement of water quality standards. Correspondingly, the seminar series can serve to familiarize TNRCC staff with the NPS and the opportunities for cooperative partnerships. Both agencies may find a new ally rather than a familiar foe.

(2) In seeking to work with the TNRCC, park managers should consider the following principles:[121]

   a. Share water resource information. For example, many parks undertake water monitoring programs, but few share their data with the TNRCC. The more information provided to the TNRCC on water quality, on the ways in which the water functions in the park's ecosystem, and on the way in which visitors and wildlife use the resources the more likely the TNRCC will be in becoming an ally.

   b. Prepare comprehensive planning documents. Continuous research and analysis are required by the TNRCC prior to revisions of water quality standards. Park documents can provide the basis for improvements in water quality protection for parks.

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[119]The Clean Water Act requires that all federal agencies (including the NPS) comply with the requirements of state law for water quality management regardless of jurisdictional status or land ownership.

[120]See Tex. Water Code § 26.013.

[121]These principles are derived from the sagacious recommendations given to park managers in West, B. 1989. *Outstanding Natural Resource Waters: A Resource Management Tool.* Denver: Water Resources Division. National Park Service, U.S. Department of the Interior. pp. 5-6.

APPENDIX A

Projected River Basin Demands, Supplies and Facility Needs*

*Data from Texas Water Development Board (1990). *Water for Texas: Today & Tomorrow*. Austin: Texas Water Development Board.

Basin Description. The Rio Grande Basin is bounded on the north by New Mexico and on the south by Mexico and stretches southerly toward the Gulf of Mexico (Figure 1-4). The basin economy is based on agriculture, agribusiness, manufacturing, mineral production, trades, government, and tourism. The 1980 basin population totaled about 781,000 people. The current basin population is estimated at 929,900, up about 19 percent since 1980. By 2040, the basin population is projected to range between 2.0 and 2.4 million residents. Major population centers include the Cities of El Paso, Laredo, Del Rio, Eagle Pass, Pecos, Rio Grande City, Fort Stockton, Monahans, Kermit, Alpine, and the Fort Bliss military installation.

Current Water Uses. Total annual basin water use is currently 770,997 acre-feet. The largest demand placed on the basin's supplies is for export to other basins, currently estimated at 1.1 million acre-feet. Much of these exports are delivered for irrigation use in the adjoining Nueces-Rio Grande Coastal Basin. Water for irrigation is the largest basin water demand with a current use of 538,133 acre-feet. Municipal use in the basin is currently 196,090 acre-feet.

Current Water Supplies. In the northern basin, ground water is the major supply source. The City of El Paso is primarily supplied from the Hueco-Mesilla Bolson Aquifer and, to a lesser extent, with Rio Grande surface water. Other important aquifers include the Bone Spring-Victorio Peak, Cenozoic Pecos Alluvium, Edwards-Trinity (Plateau), and West Texas Bolsons. In the El Paso area, supplies (primarily for agriculture) are provided by the Rio Grande Project of New Mexico-Texas with water from Elephant Butte Reservoir in New Mexico. Problems with sedimentation, flooding, and water quality below the dam in New Mexico are or may be affecting river conditions and supplies delivered to Texas. Below Lake Amistad, most water used is from Lakes Amistad and Falcon and the Rio Grande. The 57,292 acre Amistad Recreation Area is a unit of the National Park Service, managed for national park purposes under a cooperative agreement with the International Boundary and Water Commission. Ground-water sources in the middle/lower basin include the Carrizo-Wilcox and Gulf Coast aquifers. Growth along the border in Mexico and New Mexico also places water demands and water quality treatment needs on the rivers and aquifers, thus affecting available water supplies in the basin in Texas, although these are not fully considered in the Board's analysis.

Current Water Quality. Riverine water quality varies significantly in the basin. Effluent and irrigation return flows dominate river volumes below El Paso. Saline inflows increase riverine dissolved solids levels between the confluence of the Pecos River and Lake Amistad. Both of these influences become less severe with more dilution from intervening inflows to the river. Below Amistad, saline irrigation return flows, suspected contaminated agricultural runoff, and municipal and industrial wastewater discharges are or may be impairing downstream water quality. Ground-water quality ranges from fresh to moderately saline in the major aquifers with threat of increased salinity encroachment from declines in ground-water levels.

Future Water Uses. The current basin water use pattern should not change significantly in the next 50 years, as exports are projected to remain the major water use for the basin's water supply. However, water needs for municipal purposes are projected to more than double by 2040. Annual municipal water savings through conservation practices should reach 22,274 acre-feet by 2000, and 83,162 acre-feet by 2040.

Future Water Supplies. In El Paso County, the Board projects additional water reuse will increase available supplies by about 40,000 acre-feet per year. However, without further additional supplies, the El Paso County area will have an overall deficit of over 176,000 acre-feet annually by 2040. The Board's forecast indicates a water deficit of about 70,000 acre-feet per year for the City of El Paso by 2040. A water management plan near completion, being conducted for the city service area by the El Paso Public Service Board and El Paso County Water Improvement District No. 1, indicates slightly higher conservation savings and slightly lower or no water supply deficit results by 2040 (given the degree of ground-water availability from nearby Bolson deposits) when compared to the Board's forecast.

In the lower basin, a new channel dam (Site A) on the river below Brownsville, which would provide for local supplies, is recommended. Various studies indicate that total annual project supplies could range from 15,000 to 200,000 acre-feet. The Board estimates the project's U.S. supply availability at about 85,000 acre-feet annually based on gaged flows in the river near Brownsville. The ultimate availability will be determined during the State permitting process and considering negotiations with Mexico. Concerns about aquatic and terrestrial habitat, water quality, "no charge" pumping, flooding, and off-channel storage options should also be given full consideration in the permitting process.

Even with the Board's projected conservation savings, additional reuse, and the provision of a new reservoir, a supply deficit of about 100,000 acre-feet per year is projected for the basin by 2040.

Basin Description. The Neches River Basin is bounded on the north and east by the Sabine River Basin, on the west by the Trinity River Basin, and on the south by the Neches-Trinity Coastal Basin (see Figure 1-4). The economy of the area is based on manufacturing, forestry, agriculture, agribusiness, oil and gas production, and retail and wholesale trade. The population of the basin totaled about 506,400 people in 1980. The current population of the basin is estimated at 553,400 residents, representing an increase of about nine percent above the 1980 basin population. The basin population is projected to range between 930,100 and 1,076,100 residents by the year 2040. Major population centers within the basin include the Cities of Beaumont, Tyler, Port Arthur, Lufkin, Nacogdoches, Palestine, Nederland, Groves, Port Neches, and Jacksonville.

Current Water Uses. Total annual water use in the basin is currently 298,293 acre-feet. The largest water demands in the basin are for manufacturing and municipal purposes with a combined use of 242,279 acre-feet. Other major water demands placed on the basin's water supplies are exports for use in other basins and irrigation.

Current Water Supplies. There are ten major water-supply reservoirs in the basin. These projects, along with run-of-the-river flows, are capable of supplying 1,281,400 acre-feet per year of dependable surface water supplies. Several of the reservoirs provide water to cities out of the basin. Lake Athens provides water to the City of Athens in the Trinity River Basin. Lake Pinkston provides water to the City of Center located in the Sabine River Basin. Over 53 percent of Lake Palestine is owned by the City of Dallas in the Trinity River Basin and will be needed by the Dallas utility before 2010.

Ground water from the Carrizo-Wilcox, Queen City, Sparta, and Gulf Coast aquifers is used to meet about 40 percent of the current needs of the basin. Localized ground-water declines are a problem in some areas of the basin.

Other water supply-related problems in the basin include environmental concerns associated with the Big Thicket and other bottomland hardwood habitats, and salt water intrusion in the tidally-influenced reaches of the Neches River.

Current Water Quality. Surface water quality in the basin is generally excellent, although localized areas of higher salinity from oil field run-off are present. Poorer stream quality in the form of low dissolved oxygen and pH may result in the headwaters of Sam Rayburn Reservoir, on the Angelina River, and the Neches River, upstream of Lake Palestine during low flow conditions due to municipal and industrial discharges. In the tidal portion of the basin, reduced waste loadings have substantially improved water quality. Water quality from the Carrizo-Wilcox, Gulf Coast, Queen City, and Sparta aquifers is generally good (less than 500 mg/l TDS), although salinity may increase downdip and high iron and acid concentrations may be present in the shallow water-bearing sands of the Carrizo-Wilcox and Queen City formations.

Future Water Uses. The current water use pattern of the basin is not expected to change significantly over the 50-year planning period, as export demand and manufacturing water requirements are projected to account for about 73 percent of the basin's total water requirements by the year 2040. With implementation of municipal water conservation programs and practices, annual savings in municipal water are projected to reach 8,997 acre-feet by the year 2000, and about 28,328 acre-feet by the year 2040.

Future Water Supplies. In the future, the total quantity of ground water use will increase, but will comprise less than 30 percent of the total water use in the basin. The Angelina and Neches River Authority has received a permit to construct the Eastex Reservoir Project on Mud Creek. This project could supply 75,290 acre-feet per year to municipal and manufacturing entities currently on ground water that may choose to convert to surface water in the future and provide for future additional steam-electric and manufacturing water uses. A salt water barrier is also recommended on the lower Neches River to protect municipal and industrial water supplies in the lower basin from sea water intrusion.

Basin Description. The Canadian River Basin is located in the northern portion of the Texas Panhandle and consists of all or part of 15 counties (see Figure 1-4). The economy of the basin is based on agriculture, oil and gas production, agribusiness, manufacturing, and retail and wholesale trade. In 1980, the population of the basin totaled 167,500 people. Currently, the population of the basin is estimated at 171,800 residents, representing an increase of 2.6 percent from the 1980 population. By the year 2040, the basin population is projected to range between 225,300 and 257,200 residents. Major population centers in the basin include the Cities of Amarillo, Pampa, Borger, Dumas, Perryton, Dalhart, Spearman, Canadian, and Stinnett.

Current Water Uses. Total annual water use in the basin is currently 1,299,574 acre-feet. Water for irrigation purposes is the largest water demand category in the basin with a current use of 1,203,182 acre-feet. Other major water demands on the basin supplies are exports for use in other basins, municipal, and manufacturing water use.

Current Water Supplies. The basin is supplied primarily by ground water from the large multi-state Ogallala Aquifer, which ranges in saturated thickness from 20 to 540 feet, but is realizing long-term declining water level trends. Yields of large capacity wells average about 700 gallons per minute (gpm) and locally can produce up to 1,200 gpm. The City of Amarillo operates well fields in Carson, Randall, and Deaf Smith counties. Other aquifers in the basin include the Rita Blanca and the Dockum.

There are three major reservoirs located in the basin, of which two are water-supply reservoirs. Lake Meredith, constructed by the Bureau of Reclamation and operated by the Canadian River Municipal Water Authority, supplies water within the basin to the Cities of Borger and Pampa. The Authority also supplies water to the City of Amarillo, located partially in the Red River Basin; Plainview, Lubbock, Levelland, Slaton, Tahoka, and O'Donnell in the Brazos River Basin; and Brownfield and Lamesa in the Colorado River Basin. The 44,977 acre Lake Meredith Recreational Area is a unit of the National Park Service, managed by the NPS under a cooperative agreement with the U.S. Bureau of Reclamation. There is a proposal in Congress to designate it a National Recreation Area, although in any case, Lake Meredith is operated to conserve the recreational feature of the unit. Lake Palo Duro, currently under construction, will provide water to the member cities of the Palo Duro River Authority. Rita Blanca Lake, constructed by the U.S. Soil Conservation Service, is operated by Dallam and Hartley Counties for recreational purposes.

Current Water Quality. Major surface water quality problems in the basin are the high dissolved salt and solids concentrations (400 mg/l chloride levels and total dissolved solids (TDS) ranging from 1,000 mg/l and higher) in Lake Meredith. Domestic discharge of wastewater is made directly into Rita Blanca Lake, and as a result, the lake has experienced algal blooms, increased pH levels, and winter fish kills. The quality of the Ogallala Aquifer is generally good, although some areas of the aquifer in this basin have fluoride concentrations that exceed regulatory standards while other areas are experiencing saline intrusion as higher quality water supplies are withdrawn.

Future Water Uses. The basin's current water use pattern is not anticipated to change significantly over the 50-year planning period, with irrigation water needs continuing to be the major water use category of the basin. The reduction in irrigation water requirements is reflective of the expected improvements and implementation of more efficient water use irrigation equipment and management practices. With implementation of municipal water conservation programs and practices, annual savings of municipal water in the basin is projected to reach about 3,049 acre-feet by the year 2000, increasing further to about 8,868 acre-feet by 2040.

Future Water Supplies. Due to the scarcity of locally-developable surface water supplies, any additional supplies needed for the basin will likely come from reuse of present supplies and development of additional well fields in the Ogallala. In areas of current salinity problems, continued or expanded use of the aquifer could result in additional saline-water encroachment. It is estimated that by 2040 about 24,810 acre-feet per year of the basin needs will be supplied by reuse. Assuming additional water resources development in New Mexico, the long-range estimate of supplies from Lake Meredith is about 60 percent of the permitted diversion. This is the subject of a Supreme Court lawsuit with Texas and Oklahoma seeking to prevent New Mexico from even further depleting Canadian River flows in alleged violation of the interstate compact. Also, in order to insure the continued suitability of water from Lake Meredith for municipal and manufacturing purposes, the salinity control project proposed by the Bureau of Reclamation near Logan, New Mexico needs to be constructed.

Basin Description. The Colorado River Basin is bounded on the north and east by the Brazos River Basin, on the south and west by the Lavaca, Guadalupe, Nueces, and Rio Grande basins (see Figure 1-4). The economy is based on mineral production, agriculture, agribusiness, manufacturing, trades, and government. The 1980 basin population totaled 1.1 million people, increasing to a current level of 1.3 million (an increase of more than 18 percent). By 2040, the basin population is projected to range between 2.2 and 2.8 million. Major basin population centers include the Cities of Austin, Midland, Odessa, San Angelo, Big Spring, and Brownwood.

Current Water Uses. Total annual basin water use is currently 941,905 acre-feet. Irrigation water use is the largest demand placed on the basin's supplies with a current use of 561,184 acre-feet. Other major basin water demands are exports for use in other basins and municipal water use.

Current Water Supplies. Several aquifers provide water to the basin. The Ogallala, along with the Edwards-Trinity and Dockum aquifers, occur in the upper part of the basin. The Edwards-Trinity and Lipan aquifers are in the west-central part. Lowering of Edwards-Balcones water levels is of concern in areas in the central basin. The Trinity, Edwards-Balcones and Carrizo-Wilcox are in the south-central basin along with minor aquifers which include the Hickory, Ellenberger-San Saba, Marble Falls, Queen City, and Sparta aquifers. The Gulf Coast Aquifer occurs in the lower basin. Use of this aquifer raises concerns over related land subsidence and its attendant problems.

The basin has 26 major reservoirs, which along with the river flows below Austin, can provide over 1,203,380 acre-feet per year of supply. The Canadian River Municipal Water Authority provides water to Brownfield and Lamesa from Lake Meredith. Major suppliers in the basin are the Colorado River Municipal Water District (CRMWD), the Lower Colorado River Authority (LCRA), and irrigation companies in the lower part of the basin. The LCRA and irrigation companies export water to areas in the Brazos-Colorado, Colorado-Lavaca, and Lavaca basins. A study is underway to examine the feasibility of transfers from the Garwood Irrigation District in the Colorado Basin to Lake Texana in the Lavaca Basin. At the mouth of the Colorado, an under-construction river diversion would reestablish the historic flows of the Colorado River back into Matagorda Bay would provide for non-consumptive navigation and environmental water uses. Environmental water use benefits of this diversion are estimated by the Corps at over $9 million annually.

Current Water Quality. Surface water quality ranges from good to poor in the upper reaches of the basin primarily due to salinity intrusion from natural and man-made (primarily oil and gas development) sources. While a recent accidental spill of highly saline water, brought about by more than 80 inches of rain falling within the drainage area of a normally unproductive lake, has adversely affected riverine water quality, overall salinity control projects carried out by the CRMWD continue to significantly improve the riverine quality of the upper basin. The water quality of the Concho, Llano, and Pedernales rivers is excellent with sporadic dissolved oxygen and fecal coliform violations. Surface water quality below Austin has been poor due to wastewater discharges, although with recent upgrades and new construction of wastewater treatment facilities, the quality of the river below Austin is improving. Water quality in the many aquifers that traverse the basin ranges from fresh to highly saline.

While ground-water quality is good in many areas, high dissolved solids (Ogallala and Edwards-Trinity Aquifers) and fluoride (Ogallala) affect some ground-water supplies in the upper portions of the basin. High fluoride and nitrate levels in ground water in the upper basin currently exceed the Interim Primary Drinking Water Standards. In the lower basin, the Sparta and Queen City aquifers have generally high dissolved solids concentrations. Salinity in the Dockum Aquifer results from both natural poor quality and man-made contamination from oil field activities.

Future Water Uses. Current water use patterns of the Colorado Basin are expected to change over the next 50 years, as water use for irrigation decline to only 34 percent of the basin's total water requirements by 2040. Municipal and manufacturing water demands are projected to increase significantly over the planning period, nearly doubling from current usage levels. With implementation of municipal water conservation programs and practices, annual savings of municipal water are projected to reach 28,413 acre-feet by 2000, increasing further to 95,871 acre-feet by 2040.

Future Water Supplies. Ground water will continue to provide over 30 percent of available supply for the basin. However, certain cities in the western and central portions of the basin will need to find alternate supplies due to increasing quality problems with their present supplies. With the projected water conservation savings, there are adequate ground-water and surface water supplies available. If the Board's projected conservation savings are not attained, the Shaws Bend Reservoir would be needed to provide supplies for the middle and lower basin.

Basin Description. The San Antonio River Basin is bounded on the north and east by the Guadalupe River Basin, and on the south and west by the Nueces River Basin and the San Antonio-Nueces Coastal Basin (see Figure 1-4). The economy of the basin is based on agriculture, agribusiness, retail and wholesale trade, services, manufacturing, government, and tourism. In 1980, the basin population totaled about 1.1 million people. The current population of the basin is estimated at 1.3 million residents, representing an increase of about 18 percent from the 1980 population. By the year 2040, population of the San Antonio River Basin is projected to range between 2.6 and 3.4 million residents. Major population centers of the basin include the Cities of San Antonio, Leon Valley, Universal City, Live Oak, Schertz, Converse, Kirby, Alamo Heights, and the military installations of Fort Sam Houston, Brook Army Medical Center, Kelly, Lackland and Randolph Field Air Force Bases.

Current Water Uses. Total annual water use supplied by the basin's water resources is currently 319,088 acre-feet. The largest demand placed on the basin's water supplies is for municipal purposes with a current use of 242,041 acre-feet. Other major water demands in the basin are irrigation, steam-electric power generation, and export for use in other basins.

Current Water Supplies. Currently the San Antonio basin is supplied by pumpage from the Edwards-Balcones, Edwards-Trinity (Plateau), Trinity, Carrizo-Wilcox, Queen City, Sparta, and Gulf Coast aquifers. The Edwards Aquifer provides almost all of the supplies in the San Antonio area. Dependence on the Edwards-Balcones Aquifer in the upper portion of the basin and the effects of this pumpage on the ground-water reservoir levels, dependable supplies, and spring flow in the Guadalupe Basin are considered a major problem and are receiving considerable scrutiny from both local users and local, state, and federal governments. The Trinity Aquifer provides a minor amount of variable quality water to the upper part of the basin. Water level declines are common during dry periods.

Existing reservoirs in the basin provide water for irrigation (Lake Medina), cooling for steam-electric generation (Braunig and Calaveras Reservoirs), and flood protection (Olmos Reservoir).

Current Water Quality. Improved wastewater treatment facilities have greatly improved surface water quality in the upper reaches of the river. Water quality is stressed or poor in the lower portions of the Leon Creek and the lower Medina River (below the Leon Creek confluence) and mid-Cibolo Creek due to municipal point source discharges. Ground-water quality in the basin ranges from fresh (Edwards-Trinity, Trinity, Edwards-Balcones aquifers with TDS levels generally less than 500 mg/l) to fair (Carrizo-Wilcox and Gulf Coast aquifers with TDS generally below 1,000 mg/l). Excessive declines in water levels, potential cessation of springflow, saline water encroachment, and subsidence are problems in use of some of the aquifers in the basin.

Future Water Uses. The current water use pattern of the San Antonio River Basin is not anticipated to change significantly over the planning period, as water requirements for municipal purposes are projected to account for about 77 percent of the basin's total water requirements by the year 2040. Water requirements for municipal purposes are projected to more than double from current municipal use by the year 2040. With implementation of municipal water conservation programs and practices, annual savings of municipal water are projected to reach about 29,130 acre-feet by the year 2000, and increasing to about 121,496 acre-feet by the year 2040.

Future Water Supplies. If the spring flows in the Guadalupe Basin are to be protected, additional surface water supplies in the San Antonio and Guadalupe River basins will need to be developed for use in the San Antonio area, even with the Board's projected water conservation savings. In the San Antonio Basin, the Goliad and Applewhite reservoirs are recommended for development. These projects will provide over 156,000 acre-feet per year of supplies. Medina Reservoir is also recommended to be converted from only an irrigation supply source to a municipal and irrigation supply source. Among the recommendations for the development of four new surface water reservoirs is the proposed Applewhite Reservoir, scheduled for near-term construction. With the City's proposed operations plan, this project would provide at least 7,900 acre-feet per year during a replication of the historical critical drought. The project could supply about 14,900 acre-feet per year operated on a firm yield basis, and about 45,700 acre-feet per year on a long-term average availability basis. In addition to new reservoirs, the San Antonio area will also need to develop and implement an aggressive reuse program. For the Board's with-conservation forecasts, over 97,000 acre-feet of reuse per year would be needed to meet San Antonio urban area demands. If the projected savings are not attained, Cibolo Reservoir and about 167,000 acre-feet of reuse would be needed to meet the higher area water demands and protect Edwards Aquifer spring flows.

APPENDIX B

TNRCC Briefing Paper on ONRW's*

*Statement furnished by Jim Davenport, Texas Natural Resources Conservation Commission, Water Quality Standards and Evaluation Section.

PROTECTION OF OUTSTANDING NATIONAL RESOURCE WATERS

OVERVIEW

As required by EPA regulation, 40 CFR Part 131.12(a)(3), the TSWQS contain an Antidegradation Policy. One provision of this policy states that "the quality of outstanding national resource waters will be maintained and protected." Outstanding national resource waters are defined as "high quality waters within or adjacent to national parks and wildlife refuges, state parks, wild and scenic rivers designated by law, and other designated areas of exceptional recreational or ecological significance". These waters are often regarded as the highest quality waters in the United States: That is clearly the thrust of 131.12(a)(3). However, ONRW designation also offers protection for waters which are extremely unique or sensitive ecologically, but whose water quality may not be particularly high as measured by traditional parameters (such as dissolved oxygen or pH), or whose characteristics cannot be adequately described by these parameters (such as wetlands).

Outstanding National Resource Waters (ONRWs) are provided the highest level of protection under the antidegradation policy. In essence, this policy means that no increase in pollutant loading will be allowed to a waterbody which has been designated as an ONRW. Existing wastewater discharges may be allowed to continue at their current level, but no increased pollutant load or new discharges are permitted within the ONRW boundary. New dredge and fill operations are also generally prohibited in an ONRW, and other actions that would degrade water quality may also be affected. Only limited activities which result in temporary and short term changes in water quality within an ONRW may be allowed. For example, if it's necessary to replace a defective septic tank-drainfield system in a campground located adjacent to an ONRW, then the construction could occur so long as best management practices were conscientiously followed to minimize any disturbance of water quality or aquatic habitats. Similarly, maintenance and or repair of existing boat ramps, docks, seawalls or bridges could occur. Such activities must not permanently degrade water quality nor result in water quality lower than that necessary to protect the existing uses in the ONRW. In practice, protection of ONRWs in other states has been implemented primarily through permitting of wastewater discharges and Federal Clean Water Act Section 404 dredge and fill operations.

ONRW protection also regulates and may prohibit activities in tributaries to ONRWs that would permanently degrade the water quality of the ONRWs. Procedures to address discharges in these adjacent waters have sometimes been difficult to define and implement in other states. New direct point source discharges to these adjacent waters would need to be individually assessed to determine their degree of impact.

ONRW STATUS IN TEXAS

At the present time, there are no waterbodies in Texas which have been specifically designated as an "outstanding national resource water" by the TNRCC. Such designation would normally be established by a public hearing and explicit classification as an ONRW in the water quality standards. For the 1993/1994 triennial standards revisions, the Water Quality Standards Team is proposing Christmas Bay, South Bay, the waters within the Guadalupe Mountains National

Park and Caddo Lake for ONRW status. TNRCC staff are also assimilating data on other waterbodies which have been recommended as ONRWs in order to assess the economic and environmental impacts of ONRW status.

EVALUATING A WATERBODY FOR ONRW DESIGNATION

Qualification Criteria

There is presently no state or federal policy that dictates ONRW selection criteria. The primary requirement is simply that the waterbody have exceptional value as a recreational, scenic, or ecological resource. Factors that support this designation may include the following:

1. Location in or adjacent to a national park, national wilderness area, or national wildlife refuge.

2. Location in or adjacent to a state park, state natural area, or state coastal preserve.

3. Other special designations, such as a national wild and scenic river.

4. Existing water quality that is very high, pristine, or unusually sensitive.

5. Exceptional ecological value, such as (1) the presence of threatened or endangered species, (2) unique or rare ecological assemblages, or (3) critical wildlife habitat.

6. Exceptional recreational or aesthetic values, such as the presence of an outstanding recreational fishery or extraordinary scenic qualities.

Factors Included in TNRCC Evaluation

1. Available information on the water quality and ecological characteristics of the proposed ONRW.

2. The extent to which the above qualification criteria are applicable.

3. A review of existing and proposed wastewater discharges, dredge and fill operations, and other activities which could be affected by ONRW status.

Information Included in an ONRW Designation

1. A description of the geographic boundaries of the ONRW.

2. The primary reason(s) for the designation, and the key features that require ONRW protection of water quality.

3. An indication of how permitted activities will be controlled to protect water quality in the ONRW.

OTHER OPTIONS FOR PROTECTING OUTSTANDING WATERS

States have typically become cautious in designating ONRWs. There are many resources which are deserving of additional protection, however, in some cases, the resulting restrictions on federal and state discharge permits have been more stringent than was originally envisioned. Some states are also exploring the development of "outstanding state resource waters," which can be governed by more flexible regulatory policies that do not automatically invoke EPA's stringent requirements for ONRWs.

Watershed rules, which generally specify various "across-the-board" treatment requirements for permitted discharges in a particular area, provide an additional regulatory means to protect waters of special concern. Existing TNRCC watershed rules address Lakes Travis and Austin, Lakes Inks and Buchanan, Clear Lake, Lake Houston, Colorado River and tributaries from Austin to Smithville, Lakes Lyndon B. Johnson and Marble Falls, and Lakes Worth, Eagle Mountain, Bridgeport, Cedar Creek, Arlington, Benbrook and Richland-Chambers.

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As the nation's principal conservation agency, the Department of the Interior has the responsibility for most of our nationally owned public lands and natural and cultural resources. This includes fostering wise use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people. The Department also promotes the goals of the Take Pride in America campaign by encouraging stewardship and citizen responsibility for the public lands and promoting citizen participation in their care. The Department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.

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