subarea is limited due to the poor soils and the generally rocky terrain. In the Big Bend area, ground water occurs in alluvial deposits along the Rio Grande and intermittent streams. These areas provide important sources of water for wildlife and habitat for the endangered Big Bend Gambusia . In some areas sufficient yields can be obtained for domestic, stock, and public-supply uses. Geothermal springs are also a local tourist attraction in Big Bend National Park. River rafting and other forms of recreation are popular along the Rio Grande; contact recreation occurs both in the river and at hot springs along the river's edge in the subarea

Water Quality

Undertreated sewage from Presidio/Ojinaga and border villages, livestock grazing in riparian areas, limited agricultural runoff, mining activities, and atmospheric deposition are factors affecting the water quality of the Rio Grande, Amistad Reservoir, and Rio Grande tributaries within the subarea.

The data base available reveals the presence of toxic contaminants and elevated densities of fecal-coliform bacteria. These data represent a compilation of water-quality data for stream sites sampled by the Texas Natural Resources Conservation Commission (TNRCC), U.S. Section of the IBWC, and U.S. Geological Survey (USGS). The TNRCC periodically assesses available data and has identified several constituents of concern in the subarea: arsenic, cadmium, chromium, copper, lead, mercury, nitrogen, phosphorus, selenium, silver, zinc, DDD, DDE, DDT, dieldrin, endrin, hexachlorobenzene, PCB's, and total PAH's (Texas Water Commission, 1992a, 1992b; Texas Natural Resource Conservation Commission, 1994a, 1994b) . The TNRCC has designated the Rio Grande upstream from Langtry (TNRCC Segment 2306) for public-water supply; contact recreation; and high-quality, aquatic-habitat protection (Texas Natural Resources Conservation Commission, 1995).

Except for atmospheric deposition, the largest potential sources of toxic contaminants are upstream rather than within the subarea. These point and nonpoint sources of toxic contaminants include agricultural runoff and irrigation return flows in the upstream watershed areas of the Rio Grande and Rio Conchos; drainage from past and current mining activities in the upstream watershed area of the Rio Conchos and from past underground mining for mercury in Big Bend National Park and near Terlingua; and urban runoff and treated and untreated municipal and industrial wastewater from metropolitan areas, such as El Paso/Ciudad Juarez and Chihuahua.

Surface-water-quality data needed to fully quantify the effects of these factors, both within and upstream from the subarea, are limited as is information pertaining to the condition of biological resources and aquatic habitats. Particularly limited are data needed to characterize spatial and temporal occurrence, distribution, and trends of toxic constituents, such as trace elements, pesticides, and industrial organic compounds in water, sediment, and biological tissue. However, recent binational sampling surveys (Texas Natural Resources Conservation Commission, 1994c) and research activities designed to assess the level of toxic contaminants in reservoir sediments (Van Metre and others, 1997) are beginning to provide some insight into existing water-quality conditions as well as identify water-quality concerns within the subarea.

In the late 1980's, Bestgen and Platania (1988) conducted a survey of fish and aquatic habitats in the upper portion of the subarea (from upstream of the Rio Conchos to Big Bend National Park) and compared their results with an earlier fisheries survey conducted by Hubbs and others (1977). A comparison of data from these surveys indicated that the density and diversity of fish populations in the Rio Grande downstream from the Rio Conchos have decreased markedly since 1977, possibly due to a decline in water quality (Bestgen and Platania, 1988).

Figure 4. International Amistad Reservoir near Rough Canyon (photo courtesy of NPS).

Irwin (1989) reported the presence of DDT, DDD, and DDE in fish and wildlife sampled from the Rio Grande within Big Bend National Park. The results of a more recent binational study of toxic contaminants in the Rio Grande and its tributaries further define the occurrence and spatial distribution of toxic constituents in water, sediment, and biological tissue. The binational study team initially reviewed available historical data for the Rio Grande in the reach that extends from the confluence of the Rio Conchos to 10 miles downstream (Texas Natural Resources Conservation Commission, 1994c). This retrospective analysis indicates that in the late 1970's elevated concentrations of DDT, DDD, DDE, endrin, dieldrin, and PCB's in bottom sediment and fish tissue existed. The source of the contaminants, in particular DDE and DDT, was identified as primarily from the Rio Conchos watershed. Data for the 1980's indicates that concentrations of these constituents in the Rio Grande had decreased substantially, but in 1992, the TNRCC (1994c) reported the possibility that top predators such as the peregrine falcon may be moderately affected through accumulation and biomagnification of pesticide residues .

The binational study team conducted the first synoptic