

WATERSHED CONTAMINATED SOURCE DOCUMENT

MOUNTAIN CREEK LAKE

March 5, 2003

SITE AND SETTING

Mountain Creek Lake is a public reservoir located between Dallas and Grand Prairie, Texas. The 2,710 acre lake was completed in 1929 to provide cooling water for the adjacent Texas Utilities, power plant (formerly Dallas Power and Light). The lake was created by constructing a dam across Mountain Creek. The lake consists of two parts, a small upper lake (Cottonwood Bay), formed when Cottonwood Creek (a tributary to Mountain Creek Lake) was dammed, and the larger main portion of the lake. Cottonwood Bay is connected to the main body of the lake via a manmade channel referred to as the diversion channel. Heavy siltation reduced the lake's storage capacity from its original 40,000 acre-feet to 25,720 acre-feet by 1963, and to approximately 20,200 acre-feet at present.

Mountain Creek Lake is surrounded by relatively undeveloped wooded land, and the local urban-industrial and residential developments of the cities of Grand Prairie, Duncanville, and Dallas. The lake is bordered on its northern shore by the former Naval Air Station (NAS) Dallas (NASD) and a concrete dam. Properties bordering the lake on the east, south and west include residential properties, municipal parks, a power plant, and a golf course. NWIRP Dallas and undeveloped land border the north side of Cottonwood Bay, while the former NASD borders the south side of Cottonwood Bay. The area around Mountain Creek Lake has a long agricultural history dating back to the mid-1800s. Much of the wooded bottom land along the southern lake shore is currently undeveloped land. Figure 1 depicts the lake and the surrounding land uses.

In general, the subsurface beneath and surrounding Mountain Creek Lake is characterized by soils, Quaternary deposits, and fluvial alluvium developed from and deposited over Cretaceous age shale and sandstone beds. Shallow groundwater moves along the interface between Cretaceous rock and overlying unconsolidated fluvial alluvium. Shallow groundwater can connect directly to surface water in areas with the correct topography.

Surface water enters the lake through at least five named creeks: Mountain Creek, Cottonwood Creek, Fish Creek, Artesian Creek, and O'Quinn Creek. These creeks receive drainage from the undeveloped and urban-industrial areas within the lake watershed.

Sediment in Mountain Creek Lake and Cottonwood Bay is predominantly composed of silt and clay, with most sediment samples having greater than 90% silt and clay, although some have much less. Figure 2 shows the distribution of samples with varying amounts of fines throughout the lake.

MOUNTAIN CREEK LAKE WATERSHED

Limited information is available regarding the Mountain Creek Lake watershed. However, based on data available from the USGS gauging station for Mountain Creek Lake (http://waterdata.usgs.gov/tx/nwis/nwisman/?site_no=08050050&agency_cd=USGS) the watershed encompasses 295 square mile (188,800 acres). Much of that watershed is located upstream of Lake Joe Pool, which drains to Mountain Creek and ultimately Mountain Creek Lake. Mountain Creek Lake drains a 46,130-acre watershed downstream from the dam on Lake Joe Pool. The Cottonwood Creek watershed comprises approximately 8,100 acres out of the total watershed (Figure 3)

Mountain Creek Lake received runoff predominately from undeveloped, rural, and agricultural areas between its impoundment and the construction of Lake Joe Pool immediately upstream in 1985. Extensive development has occurred west of Mountain Creek Lake since 1985. The watershed is currently 60 percent urban and 35 percent agriculture/undeveloped land use (*Implementation Plan for Dallas and Tarrant County Legacy Pollutant TMDLs, For Segments 0805, 0841, and 0841A*, TNRCC, August 2001).

Basic calculations were performed to assess what percentage of the annual flow into Mountain Creek Lake comes from Navy facilities. NWIRP Dallas occupies approximately 314 acres, and virtually the entire site drains to Cottonwood Bay. Much of this drainage occurs through two outfalls referred to as the east and west lagoons. NASD occupies approximately 827 acres. However, careful study of a topographic map (Duncanville Quad, 7.5 Minute USGS - 1:24,000 scale) indicates that approximately 110 acres of NASD drains to the northeast and into

Mountain Creek below the lake dam. Consequently, only 717 acres drains to Mountain Creek Lake. The total acreage the Navy areas comprise of the watershed is approximately 1,031 acres, or approximately 0.55% of the total watershed. Navy areas make up approximately 2.2% of the watershed downstream of Lake Joe Pool. The 314 acres that comprise NWIRP Dallas represent approximately 3.7% of the total area that drains to Cottonwood Bay.

However, as NWIRP Dallas and NASD contain a large amount of pavement relative to the rest of the watershed; conservative runoff coefficients were used to adjust the calculation of the Navy's contribution to flow into the lake. The following runoff coefficients were used:

- Mountain Creek Lake watershed – 0.35
- NWIRP Dallas – 0.8
- NASD – 0.7

The Navy areas were then multiplied by their coefficients and summed, and the result divided by the total area of the watershed multiplied by its general coefficient to calculate an estimated Navy contribution to the watershed. For the entire Mountain Creek Lake watershed, this calculation is summarized by the equation below:

$$\frac{(314 \times 0.8) + (717 \times 0.7)}{(188,800 \times 0.35)} = 0.011 = 1.1\%$$

The same approach was followed below to calculate an adjusted estimate of the Navy contribution to the portion of the watershed located downstream of Lake Joe Pool:

$$\frac{(314 \times 0.8) + (717 \times 0.7)}{(46,130 \times 0.35)} = 0.047 = 4.7\%$$

The same approach was again used to calculate an adjusted estimate of the Navy contribution to the total inflow to Cottonwood Bay:

$$\frac{(314 \times 0.8)}{(8,100 \times 0.35) + (314 \times 0.8)} = 0.081 = 8.1\%$$

Using gross generalizations regarding the amount of runoff from Navy property relative to the rest of the watershed indicates that the Navy facilities contribute approximately 1.1% of the total inflow to Mountain Creek Lake.

CONTAMINANT SOURCES, COCs AND DISTRIBUTION

There are various sources around the lake for a variety of chemicals of concern (COCs) that may adversely impact the lake environment. The former NASD and NWIRP Dallas both had documented use and past releases of petroleum products, volatile organic compounds (VOCs), polychlorinated biphenyls (PCBs), and metals. Releases at these sites occurred from various industrial and aircraft support operations, production buildings, solid waste management units, and storage areas. The largest single source of Navy contamination into the lake was the west lagoon at NWIRP Dallas, which discharges to Cottonwood Bay. From the early 1940s until the early 1970s, the west lagoon received and discharged a variety of industrial wastes and treated sanitary sewage. Other sources of contamination from the Navy facilities include the NWIRP Dallas east lagoon and various storm water outfalls. VOC contaminated groundwater beneath NWIRP Dallas also flows toward and seeps into Cottonwood Bay.

Petroleum compounds [including polyaromatic hydrocarbons (PAHs) and other semi-volatile organic compounds (SVOCs)], other volatile compounds, and pesticides/herbicides are all widely used in the mixed urban, agricultural, and industrial areas around the lake. Sources for urban and industrial COCs include outdoor storage areas, above and underground storage tanks, and roadways. Documented soil and groundwater impacts from releases of VOCs are present at a number of industrial sites in the areas surrounding the lake. Agricultural chemicals and herbicides are associated with the surrounding agricultural land use and the adjacent golf course. Various petroleum compounds and/or pesticides/herbicides are used by nearby homeowners.

The distribution of the various COCs in sediment, surface water, and fish has been documented in previous Navy, Texas Commission on Environmental Quality (TCEQ), and Texas Department of Health (TDH) studies. Much of the data generated by these studies is summarized in the following documents:

- *Chemical Quality of Water, Sediment, and Fish in Mountain Creek Lake, Dallas, Texas, 1994-97* (USGS, September 1997)
- *Draft Affected Property Assessment Report, Mountain Creek Lake, Dallas, Texas* (EnSafe, August 2001)
- *Implementation Plan for Dallas and Tarrant County Legacy Pollutant TMDLs, For Segments 0805, 0841, and 0841A* (TNRCC, August 2001)
- *Screening Site Inspection Report for Mount Creek Reservoir, TXD000605377, Grand Prairie, Dallas County, Texas* (TNRCC, September 2001)

Key findings from these studies include the following:

- The vast majority of contamination was found in sediment. Relatively little contamination was found in surface water.
- Concentrations of selected heavy metals in surficial sediment in Cottonwood Bay were two to four times greater than the main lake. Concentrations in deeper sediments in Cottonwood Bay were up to 20 times higher than in the main body of the lake.
- Elevated concentrations of PAHs, compared to the main lake, were detected in Cottonwood Bay and elevated concentrations of PAHs, indicative of urban sources, were detected in Cottonwood Creek. Higher concentrations of PAHs were found in deeper, older sediments than in surficial sediments in Cottonwood Bay.
- Sedimentation rates in Cottonwood Bay (Bay-13) have varied from the current rate of 1.0 cm/yr (from 1974 to 1995) to 4.2 cm/yr (from 1964 to 1974). Sedimentation rates increased from approximately 2.7 cm/yr prior to the damming of Cottonwood Bay to 2.9 cm/yr immediately after damming. Sedimentation rates in the bay correlate well with operational changes at NWIRP Dallas. Sedimentation rates in the main body of the lake (MCL-4) appear to have been more consistent, around 2 cm/yr (from 1929 to 1994).

The distribution of COCs in the lake at levels above human health standards is confined to sediment in the eastern and central portions of Cottonwood Bay, adjacent to the NWIRP Dallas storm water lagoons.

TRANSPORT MECHANISMS, EXPOSURE ROUTES AND RECEPTORS

Transport of COCs into Mountain Creek Lake involves the following pathways:

- Surface water
- Suspended sediment
- Groundwater

Currently, surface water and suspended sediment transport into the lake occurs primarily from the five creeks that drain to the lake. Other sources include storm water drainage into the lake along the Highway 303 storm sewer outlet, and from the TXU generating facility that has a TPDES permit for the release of cooling water, storm water and waste water into the lake from two outfalls (through a total of nine separate discharge points). The creeks receive drainage and storm water runoff from roads, parking lots, housing developments, industrial buildings, and storage and construction yards. The dissolved COCs and COCs sorbed to suspended soils and solids in the water are expected to be primarily petroleum compounds (including PAHs) and pesticides/herbicides. Some overland sheet flow of storm water containing the same dissolved COCs and COCs on solids moves across the land surface and directly enters the lake. Dissolved COCs in surface water enter the lake water directly and disperse. Beyond its initial point of entry into the lake, surface water velocity decreases and suspended sediment settles to the lake bottom.

Storm water is also discharged to the lake and Cottonwood Bay through multiple storm drain outfalls located on NWIRP and NAS Dallas. Releases from the NWIRP facility include discharges from two lagoons adjacent to Cottonwood Bay. Historically, non-storm water discharges also occurred through these lagoons. The COCs released included VOCs, PAHs, petroleum compounds, metals, and PCBs. The non-storm water sources at the two lagoons are no longer active.

Groundwater flow to surface water and sediment in the lake is documented at both Navy facilities. At NWIRP Dallas, contaminated groundwater has been prevented from entering the lake with the installation and operation of a collection trench system. Offsite groundwater contaminant plumes have been documented at other nearby industrial facilities. These plumes could possibly connect to surface water via creeks and storm drains, contributing dissolved COCs to the lake.

The primary receptors for COCs in the lake are humans and ecological receptors. Exposure to human and ecological receptors occurs primarily in the affected property area in Cottonwood Bay. Direct human contact with affected sediments and surface water in the affected portions of Cottonwood Bay is very unlikely due to the inaccessibility of that portion of the lake, and the security around the present and former Navy facilities. Benthic and free-swimming organisms are exposed to COCs in both sediment and water. Benthic organisms transfer COCs from sediments and water to animals higher on the food chain. Human exposure also occurs through fishing and fish consumption. This pathway has been restricted by a fish advisory and consumption ban issued by the TDH.

OBSERVATIONS

Based on the above information, the following "observations" have been made regarding Mountain Creek Lake:

Observation 1: Contaminants are bound to sediments (both inorganic and organic fractions) and primarily migrate with sediments that move as a result of hydraulic energy. Due to their affinity to bind to sediment, all of the primary COCs (PCBs, PAHs, and metals) are expected to move at similar rates within the lake.

Observation 2: The eastern portion of Cottonwood Bay, adjacent to Navy property (east of the diversion channel), is a low energy water body that effectively serves as a sedimentation basin. Deposition rates within Cottonwood Bay increased following its damming and the construction of the diversion channel. Within Cottonwood Bay, sediment transport primarily occurs during major storm events.

Observation 3: Sediment transport within the diversion channel is driven by surface water flow, which is dominated by Cottonwood Creek which contributes approximately 91.9% of the water in the channel. The northeastern portion of the watershed that includes NWIRP Dallas contributes approximately 8.1% of the flow into the diversion channel.

Observation 4: Within the main body of the lake, sediment transport is governed by multiple sources and dynamics. In fact, more than 95% of the flow into the lake originates from the southern portion of the watershed. Navy properties conservatively contribute just over 1% of the total flow into Mountain Creek Lake.

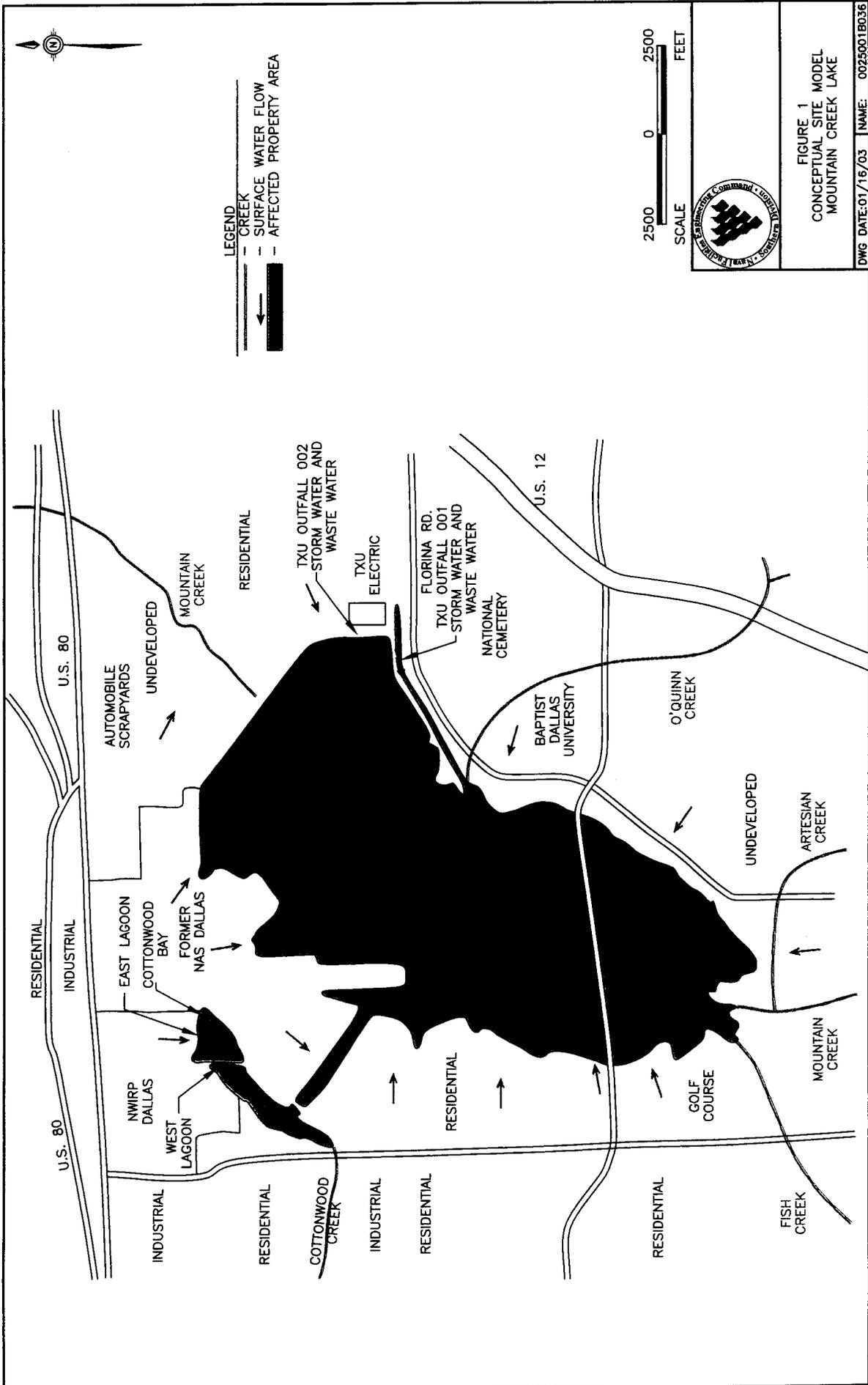
Observation 5: Within the eastern portion of Cottonwood Bay, the main sources of sediments are Navy related. However, the majority of sediments within Mountain Creek Lake originate from other parts of the watershed.

Observation 6: Cottonwood Bay and Mountain Creek Lake represent mixtures of multiple populations due to variable contaminant sources, sediment grain size, and sediment organic content.

HYPOTHESIS

Based on the above observations, the following hypothesis has been generated regarding the extent of Navy generated contamination in Mountain Creek Lake:

The majority of Cottonwood Bay has been impacted by Navy activities. Impacts to the main body of Mountain Creek Lake are limited to the immediate proximity of two NASD outfalls.



LEGEND
 - CREEK
 - SURFACE WATER FLOW
 - AFFECTED PROPERTY AREA

2500 0 2500
 SCALE FEET



FIGURE 1
 CONCEPTUAL SITE MODEL
 MOUNTAIN CREEK LAKE
 DWG DATE: 01/16/03 NAME: 0025001B036



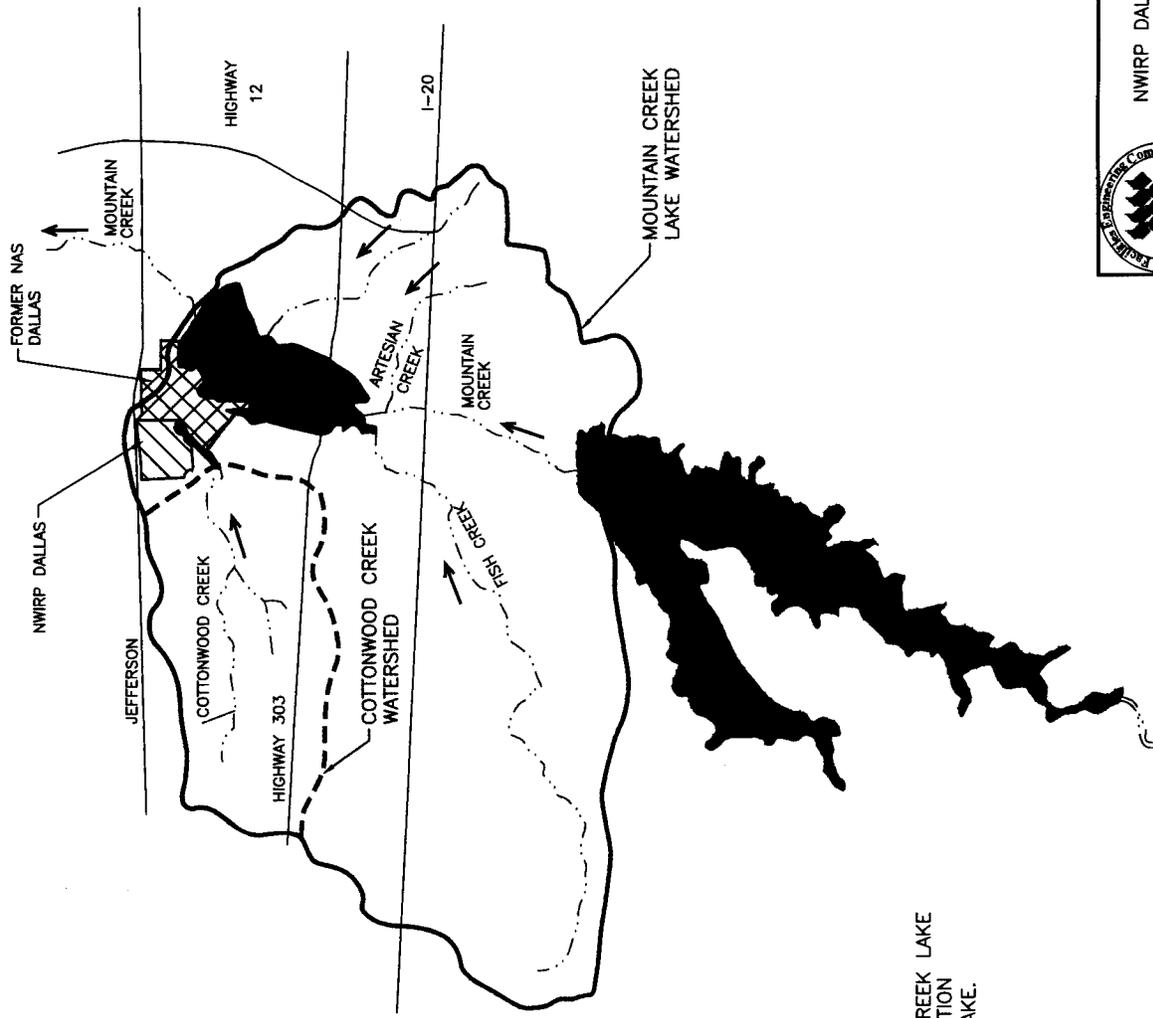
3000 0 3000 6000 Feet



Grain Size Distribution
Percent Fines (Clay & Silt)

- 0 - 10
- 10 - 20
- 20 - 30
- 30 - 40
- 40 - 50
- 50 - 60
- 60 - 70
- 70 - 80
- 80 - 90
- 90 - 100

Figure 2
Grain Size Distribution



LEGEND

- WATERSHED OUTLINE
- - - SURFACE WATER FLOW DIRECTION



NOTE:
FIGURE SHOWS THE MOUNTAIN CREEK LAKE
WATERSHED EXCLUDING THE PORTION
UPSTREAM AROUND JOE POOL LAKE.



NWIRP DALLAS

FIGURE 3
LOCATION AND WATERSHED MAP
MT. CREEK LAKE
DALLAS, TEXAS
DWG DATE: 02/24/03 NAME: 0025001B050