CHAPTER 3

PROBLEM IDENTIFICATION

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Problem Identification

This chapter identifies the area of investigation's problems and needs and presents environmental restoration, source water protection and water quality improvements, historic restoration, flood damage reduction, erosion protection, recreation, economic development, lake operation, and water supply opportunities.

ENVIRONMENTAL RESTORATION

The various habitat cover types within the Cypress Valley Watershed are discussed in the *Cypress Valley Resource Inventory* and depicted in the vegetation/land cover map that was generated using satellite imagery, ground-truthing, and Geographic Information System technology. The land cover map is shown on Figure 3-1.

FOREST RESTORATION

The Cypress Valley Watershed is located within the Pineywoods vegetational area of Texas and was historically dominated by forested land. Currently, mixed pine-hardwood forest is the predominant forested cover type in the watershed. These forests occur on uplands and are dominated by loblolly pine mixed with water oak, willow oak, red oak, post oak, sweetgum, maple, elm and sugarberry.

Bottomland hardwood forests occur along drainages, floodplains, and at lower elevations where they are generally inundated or saturated with surface or groundwater periodically during the growing season. (Bottomland hardwoods can also be classified as wetlands, depending on hydrology, soil type, and vegetation composition). Bottomland hardwoods is the second most common forest type within the Cypress Valley Watershed. The predominant bottomland hardwood forest types that occur within the study area are the water oak/willow oak association and the elm/sugarberry association.

Because of their natural resource values and threat of conversion to other land cover types, bottomland hardwoods are the focus of forest restoration recommendations in this report.

Animals inhabit places where their food, water and cover requirements are met. Bottomland hardwood forests have particular importance to wildlife because all three of these requirements can be provided. The large amount of mast-producing trees and fruit-bearing shrubs and vines provide a food base for mammals and birds. Mature trees with a dense canopy cover, mid-story trees and shrubs, snags, and fallen logs create a multi-level physical structure that provides excellent cover for many birds and wildlife species. By definition, bottomland hardwood forests are located near water, and in fact, need the hydrologic conditions provided by fluctuating water levels caused by periodic flooding for their establishment and continued development.

Bottomland hardwood forests have other functions and values in addition to wildlife habitat. Among these functions are flood control (flood waters are slowed down and

absorbed), water quality (sediments are filtered out, soil erosion is reduced by rooted vegetation), and groundwater recharge.

Historically, the amount of loss of these valuable forests has been substantial. In the contiguous United States, bottomland hardwood forests have suffered a five percent loss from the mid-1970s to the mid-1980s. Prior to European settlement, bottomland hardwood forests covered approximately 21 million acres of the Mississippi River alluvial floodplain, compared to approximately 5 million acres today. Approximately 13 percent of these bottomlands are in public ownership. In the Pineywoods vegetational area of Texas (an area of approximately 15 million acres in East Texas and within which the study area is contained), there are approximately 1.8 million acres of bottomland hardwoods. Only 3 percent of these bottomlands are in public ownership.

Many of the bottomland hardwood forests that remain today are seriously fragmented and have lost many of their original functions. Loss of bottomland forest habitat is caused by clearing for development, conversion to pasture land or other types of agriculture, and timber production. Another threat to bottomland hardwood forests is construction of water control structures, primarily reservoirs. Restoration efforts within the Cypress Valley Watershed would involve revegetating bottomland hardwood species in areas that once supported this forest type and providing the hydrologic regime required for their establishment and development.

WETLAND RESTORATION

Bottomland hardwood wetlands are the principal wetland type in the Cypress Valley Watershed. Cypress swamps, shrub swamps, vegetated littoral zones of open water, and emergent wetlands or marshes are other types of wetlands that occur in the watershed. Wetlands perform multiple functions that are both valuable to man and the environment. These functions include flood flow alteration, sediment stabilization, sediment and toxicant retention, groundwater recharge, nutrient removal and transformation, production export, fish and wildlife habitat, and aesthetic and recreational opportunities. Wetlands are often located at the ecotones between dry terrestrial systems and aquatic systems. As such, they have an intermediate hydrology and generally high productivity and diversity.

Various estimates by researchers have been made over the years to determine the amount of wetlands in the United States. These estimates vary greatly depending on the information that was available at the time the estimate was made (maps, documented field studies, remote sensing), and for what purpose the estimate was made (in the early 1900's, the U.S. Department of Agriculture studied wetland abundance to determine “the amount and location of swamp and overflow lands in the United States that can be reclaimed for agriculture.”) Nevertheless, most of these studies indicate a rapid rate of wetland loss in the United States, particularly prior to the 1970's. It has been estimated that 53 percent of the wetlands in the contiguous United States have been lost since European settlement in the late 18th century. The State of Texas has lost approximately half of its original wetlands.

Wetland losses are due to clearing and filling for agriculture, urbanization and development, and construction of water control structures. Water impoundments alter the hydrology of downstream areas by reducing flood flows, thereby drying up the flood plain and increasing access and development of areas that were previously too wet. Hydrology is probably the most important defining factor of a wetland and the most crucial factor in wetland restoration. Wetland restoration efforts within the Cypress Valley Watershed should be focused in areas where hydrology can be manipulated, namely in floodplain areas. Small scale water control structures could be strategically placed in the floodplain to intercept and hold back flood water before it drains into the river. The amount and duration of flood water retention can be manipulated depending on the type and complexity of the control structure.

ENVIRONMENTAL PRESERVATION

One of the unique features of the Cypress Valley Watershed merits consideration in this section. In previous sections of this report, the importance of wetlands, including bottomland hardwood forests, and their functions and values to the natural environment have been discussed.

Caddo Lake, located at the eastern boundary of the study area, is characterized by its unique stands of bald cypress swamp, emergent wetlands, and shallow vegetated open water. The bald cypress swamp wetland habitat type at Caddo Lake occupies less than one percent of the Cypress Valley Watershed and represents one of the best examples of this habitat type in the state of Texas. Caddo Lake provides high value habitat for numerous fish and wildlife species, including restrictive wetland species such as the American alligator and river otter. The U.S. Fish and Wildlife Service (FWS) has designated Caddo lake as Resource Category 1. The mitigation planning goal of this resource category is "no loss of existing habitat value." The upper portion of Caddo Lake, namely the Caddo Lake State Park and Wildlife Management Area, has been recognized by the Ramsar Convention as a *Wetland of International Importance*. The Ramsar Convention, which went into effect in 1975, is an intergovernmental treaty that provides a framework for international cooperation for the conservation of wetland habitats. More than seventy countries from all regions of the world are now contracting parties to the Convention.

WATER QUALITY

FACTORS AFFECTING WATER QUALITY IN THE CYPRESS BASIN

The Cypress Basin is an agricultural and timber production area with significant industrial, manufacturing, and mineral production facilities. Its population was 125,500 people in 1990. The largest population center in the Basin is the City of Mount Pleasant, with a 1990 population of 12,291. Based on 1990 estimates of population, 42% of the people in the Cypress Basin lived in incorporated cities of greater than 1,000 population. The Texas Water Development Board estimates that the population of this area will increase by nearly 80% to 230,940 people by the year 2040.

In the Cypress Basin in Texas, there are 91 water rights permits with a total quantity of permitted water use of approximately 540,058 acre-feet annually. Of the total, 35 percent is for municipal purposes, 60 percent is for industrial uses, and the remaining 5 percent is allotted to mining, irrigation, flood control, and recreation. The outfalls are concentrated in the northwest quadrant of the Basin and along the course of Big Cypress Bayou.

Thirty-two Municipal Wastewater Discharge permits are issued in the Cypress Creek Basin in Texas. Of these, seven are no-discharge permits. The total volume of permitted flow is 8.54 million gallons per day (MGD).

There are 33 Industrial Wastewater Discharge permits issued in the Cypress Creek Basin in Texas. Of the total, 23 are non-discharge permits. The largest discharge is from electric power generation for cooling water which accounts for 85 percent of the one billion gallons per day of discharge that is permitted.

Approximately ten municipal landfills throughout the Cypress Basin are impacted by the Subtitle D Regulations of the Resource Conservation and Recovery Act (RCRA) of 1983, as amended. RCRA regulates management and disposal of hazardous materials and wastes currently generated, treated, stored, disposed of or distributed, while Subtitle D deals with state or regional solid waste plans. Regional Councils of Government are

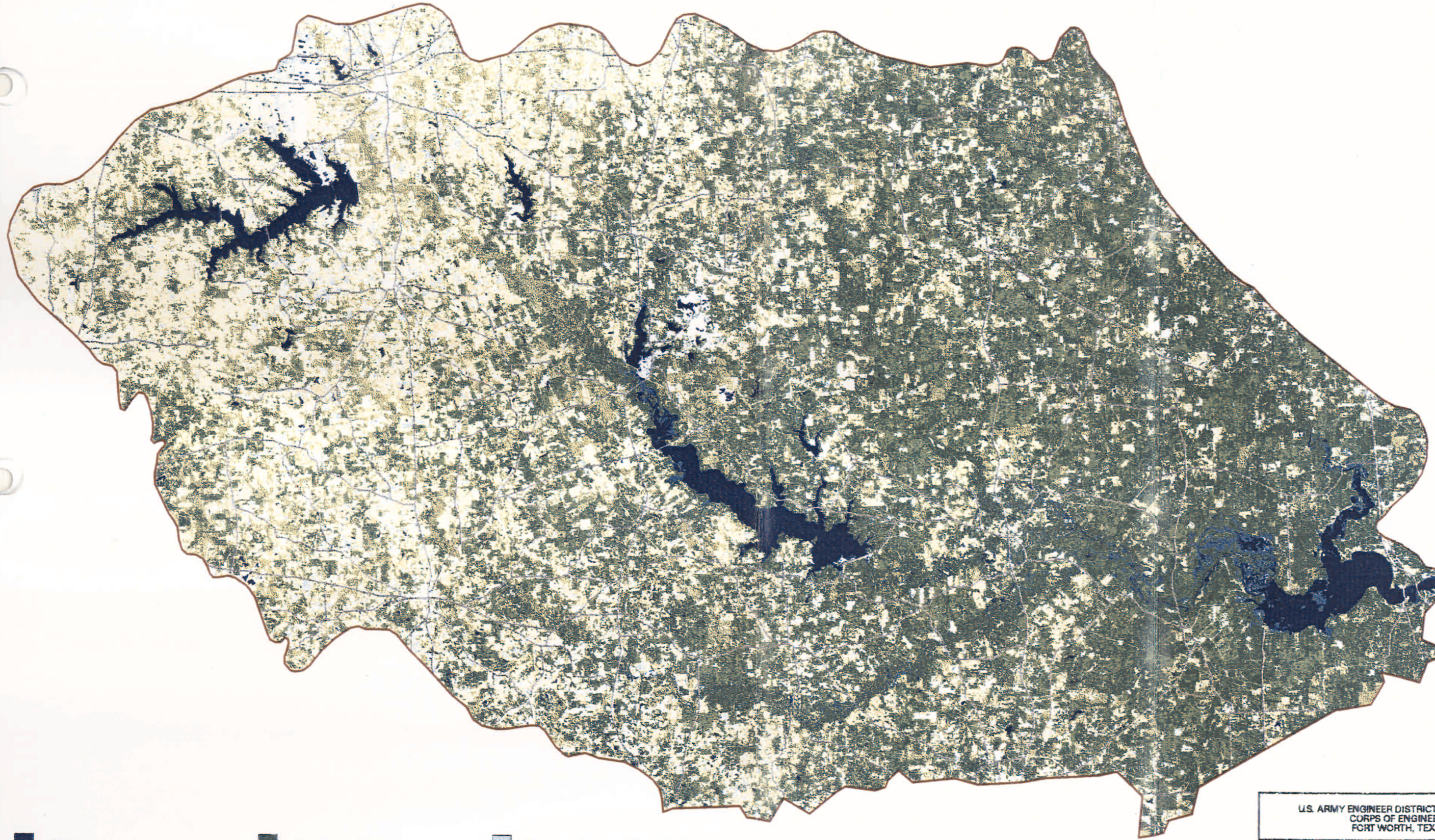
responsible for developing plans for regionalization of landfills and achieving compliance with Subtitle D.

Five EPA designated Superfund sites are located in the Cypress Basin: Double R Plating located in Cass County, and Fabsteel, Marshall Wood Preservatives, Longhorn Army Ammunition, and Steinco, all located in Harrison County. Superfund is the common term for the program operated under the legislative authority of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), as amended, and the Superfund Amendments and Reauthorization Act (SARA), as amended, that funds and carries out solid waste emergency and long-term removal remedial activities at hazardous waste sites. Sites are placed either on the CERCLA list or the National Priority List (NPL). Because funds are limited, only the highest ranking sites make the EPA's NPL. The USEPA and TNRCC jointly administer CERCLA in Texas.

There are numerous abandoned and existing oil wells within the Cypress Basin, each having an associated brine pit. A pit is needed to hold the concentrated brine which is mined along with crude oil for evaporation or removal. Each pit is a potential source of chloride contamination resulting from a spill caused by either failure of the pit containment, or more commonly, overflow due to intense rainfall. Most oil well permits are located in the southern half of the Basin.

Many industrial applications require various facilities to effectively prevent contamination, erosion, and general degradation of stormwater flows, all of which eventually enter navigable waters. Stormwater permits were developed with the goal of encouraging the maintenance of consistent and manageable technology for on-site control of stormwater runoff. Some of these permits are maintained permanently, while others are temporary due to the type of industrial activity taking place at a particular site.

Non-point source (NPS) pollution generally results from land runoff, atmospheric deposition, drainage, or seepage of contaminants. Major sources of non-point pollution include runoff from agriculture, urban areas, and silvicultural operations. Silt and nutrients are the pollutants responsible for most of the non-point source impact to the Basin's surface waters. An estimate of non-point source pollution from land runoff can be made using the Universal Soil Loss Equation (USLE). The USLE is a model that provides insight into the processes of soil loss and identifies those locations that may be at risk for erosion under certain conditions. Parameters considered in the model are rainfall intensity, soil erodibility, length of slope, degree of slope, cropping management, and soil conservation practices. These diffuse sources are often harder to identify, isolate, and control than traditional point sources. Other potential sources of non-point source pollution in the Cypress Basin are from cities, industries, oilfield operations, and on-site wastewater disposal communities which release improperly treated wastewater into the environment. There is also a basinwide non-point source pollution problem resulting from oil field operations and urban and rural stormwater runoff.



- Water
- Urban/Exposed Ground
- Improved Pasture
- Mixed Loblolly Pine/Oak
- Hardwood Forest
- Hardwood/Scrub Forest
- Pine Forest
- Cypress Stand
- Coarse Pasture/Grassland
- Cultivated/Managed Grassland
- Agriculture/Clearcut/Urban Area
- Road

U.S. ARMY ENGINEER DISTRICT, FORT WORTH
CORPS OF ENGINEERS
FORT WORTH, TEXAS

CYPRESS VALLEY WATERSHED
TEXAS

CYPRESS VALLEY WATERSHED LANDCOVER

Figure 3-1

AQUATIC POLLUTION

The natural state of the aquatic environment can be adversely affected by human activity. Parameters which tend to be most affected are temperature, dissolved oxygen, hydrogen ion (pH), conductivity, turbidity, suspended solids, dissolved solids, alkalinity, nutrients, biochemical oxygen demand, and metal concentration. Additional areas of concern resulting from municipal and industrial contamination are elevated populations of bacteria and chemical pollutants. Some contaminants which contribute to pollution of waters and sediments will be discussed briefly in this section.

Enrichment With Nutrients

Nutrient enrichment of an aquatic environment is commonly referred to as "eutrophication". Nitrogen and phosphorus are the most common nutrients contributing to enrichment, and while eutrophication is a natural, slow process that occurs as bodies of water age, the process can be grossly accelerated through human activity. Nutrient enrichment is exacerbated through additions of urban runoff, agricultural runoff, and industrial and sewage effluent (point and non-point sources). Enrichment creates the potential (and likelihood) of severe environmental problems which include: an increase in primary production (algae and plants), blooms of nuisance and/or toxin producing bluegreen algae (cyanobacteria), and reduction in summer water clarity. Increased biomass due to enrichment is the primary cause of summer oxygen depletion and resulting fish kills.

Phosphorus enters fresh waters from atmospheric precipitation and from groundwater and surface runoff, and enters a lake with inflowing water and leaves with outflowing water and by sedimentation. The loading rates of phosphorus vary greatly with patterns of land use, geology and morphology of the drainage basin, soil productivity, human activities, pollution, and other factors. The range of total phosphorous in fresh waters is large, from <0.005 mg/l in very unproductive waters to >0.1 mg/l in highly eutrophic waters. Most uncontaminated waters contain between 0.01 and 0.05 mg total phosphorous per liter.

Phosphate and essential inorganic micronutrients, particularly iron and manganese, form highly insoluble compounds and precipitate from the water column into the sediments. Rooted aquatic macrophytes often obtain phosphorous from the sediments and can release large amounts into the water both during active growth and upon senescence and death. In shallow lakes with large areas of vegetation, phosphorus release from sediment sources is much greater than in lakes that are deeper and more strongly stratified.

Metals Contamination

Metals are introduced into aquatic systems as a result of the weathering of soils and rocks, from volcanic eruptions, and from a variety of human activities involving the mining, processing, or use of metals and/or substances that contain metal contaminants and burning of fossil fuels. Some metals such as manganese, iron, copper, and zinc are essential micronutrients, while others such as mercury, cadmium, and lead are not required even in small amounts by any organism. Virtually all metals, including the essential metal micronutrients, are toxic to aquatic organisms as well as humans if exposure levels are sufficiently high. A table in Appendix H lists the maximum permissible concentrations in water recommended by the EPA for the protection of human health.

Priority Pollutants

The term "priority pollutants" refers to a list of 126 pollutants contained in industrial wastewater for which the EPA has developed test procedures for measuring. The priority pollutant list includes base, neutral and acid (BNA) compounds and volatile organic (VOA) compounds are listed in Appendix H.

Pesticides: These compounds include insecticides (insect killing), herbicides (plant killing), or fungicides (fungi killing). Intensive pesticide use is undertaken for reasons of public health, agricultural production, or silviculture. Synthetic chemical pesticides generally fall into one of the following categories:

Chlorinated organics: a class of persistent, broad spectrum insecticides that linger in the environment and accumulate in the food chain. Among them are DDT, aldrin, dieldrin, heptachlor, chlordane, lindane, endrin, mirex, and toxaphene. Other examples include TCE, used as an industrial solvent.

Organophosphates: chemicals that contain phosphorus, used to control insects, that are short lived and not associated with food chain transfer problems, but are toxic to almost all other organisms when first applied. Malathion and parathion are examples of organophosphates.

Carbamates: an organic hydrocarbon derivative of carbamic acid containing the functional group: $R\text{-}COO\text{-}NH_2$. These compounds are biodegradable and nonpersistent, although they are toxic to birds and bees when first applied. Aldicarb and carbofuran are examples of carbamates.

Pyrethroids: an insecticide containing synthetic compounds similar to pyrethrin compounds which occur in pyrethrum flowers (chrysanthemum). These compounds are toxic to beneficial insects and fish. Allethrin and dimethrin are examples of pyrethroids.

Polychlorinated biphenyl (PCB): The chemical structure of PCBs is similar to some pesticides, however these compounds were used primarily as a component in electrical transformers, capacitors, heat transfer systems, and hydraulic fluids. To a much smaller degree, they were used in paints, adhesives, caulking compounds, plasticizers, inks, lubricants, carbonless copy paper, sealants, coatings, and dust control agents. PCBs are known to accumulate in the tissues of aquatic organisms and have been found to be as toxic as some pesticides to certain organisms. An important concern over PCBs has been their high degree of persistence in the environment. It has been estimated that they are 50-300 times more persistent than DDT residues. Because of their apparent toxicity and persistence, the manufacture of all PCBs was voluntarily terminated by the manufacturer in 1977. The EPA, under authorization of the Toxic Substances Control Act, banned the manufacture, processing, distribution in commerce, and use of PCBs in the United States effective July 2, 1979. Presently, most PCBs discharged into aquatic systems are considered either to be degraded in the water column or buried in the sediments.

Oil: Oil contains carcinogenic compounds including benzene and polynuclear aromatic hydrocarbons (PAHs). Most human exposure to benzene comes from inhalation of automobile exhausts and cigarette smoke, while exposure to PAHs are more likely to occur through contaminated fish, shellfish, and other food items. Human exposure to PAHs through water, fish and shellfish is probably minimal, since the taste of the food item becomes unsavory at concentrations far below levels associated with chronic toxicity.

Other Pollutants: Additional sources of contamination to the aquatic environment include the manufacture of explosives, bacterial contamination (primarily fecal

coliforms) through inadequate sewage treatment, and thermal pollution generated predominately by power plants.

WATER QUALITY OF CYPRESS BASIN BY SEGMENTS

Twelvemile Bayou

A joint study by USGS and the USACE in 1991 and 1992 of water and sediments in this area indicated that Twelvemile Bayou has high levels of nutrients and coliform bacteria in the water column. Phosphorus was reported as having an average concentration of 0.08 mg/l, and average coliform bacteria levels exceeded the criteria of 200 colonies per 100 ml at the lower end of the bayou. Iron exceeded the domestic water supply criteria occasionally, but no other exceedances of water quality criteria were reported.

Sediment samples from the 1991-92 survey indicated that heavy metals, BNA and VOA compounds, PAH, PCB, and explosives contamination was not present in this segment. One pesticide, p'p'DDE, was detected in the sediments of Twelvemile Bayou at a concentration of 0.029 mg/kg.

Caddo Lake

Within the Cypress Basin, Caddo Lake has been most extensively studied. The Environmental Protection Agency (EPA), the State of Texas, and the U.S. Army Corps of Engineers (USACE) have conducted studies in the basin. Additional investigations involving water quality have been made by various private consulting firms and have been the subject of at least four masters theses. The lake waters have generally been found to be a good source of water supply, but occasionally State and Federal water quality criteria have been exceeded. The lake waters have exceeded the Texas drinking water criteria for chloride and the DO has dropped below the freshwater fish criteria of 5.0 mg/L. Low DO is found in the swampy region in the northwestern part of the lake and near the bottom in the main lake. The EPA's maximum contamination level (MCL) for copper, iron, and manganese have also been exceeded.

Among the past studies on Caddo Lake is a 1983 masters thesis, "Physico-chemical Limnology of Caddo Lake, Texas and Louisiana", by A.A. Hartung. The thesis examined the physio-chemical limnology of Caddo Lake and evaluated the possible affect of off-shore oil production on the lake's water quality. Mr. Hartung collected *in situ* and chemical data over a one year period from nine stations throughout Caddo Lake. He concluded that the lake was eutrophic due to high levels of nitrogen and phosphorus. In addition, he attributed the high sediment organic content to oil production within the lake.

A 1985 water supply study conducted by the Vicksburg District reported trace levels of several trinitrotoluene (TNT) derivatives in the surface waters of Caddo Lake. The Longhorn Ammunition Plant in Karnack, Texas, used TNT extensively in the 1940's. The drainage from the ammunition plant enters Caddo Lake through Goose Prairie and Harrison bayous. Although TNT was not detected in Caddo Lake sediments, the study recommended that any future studies look for TNT and its derivatives in the waters and sediments.

The Texas Water Quality Board (TWQB) reported the first sediment and water samples at Caddo Lake in 1977. These data were examined in document #IMS-50, "Intensive Surface Water Monitoring Survey for Segment 0401". This survey reported that data collected in the Texas portion of the lake was indicative of good water quality and reported no significant water quality problems in Caddo Lake. Water samples were not analyzed for heavy metals or pesticides.

The sediments collected in 1977 by the TWQB from Caddo Lake were reported to be rich in organic material and frequently contained slight hydrogen sulfide odors. Concentrations of chromium, mercury, and nickel were below those reported for natural soils. Arsenic, cadmium, copper, manganese, and silver only slightly exceeded the average levels reported for natural soils and were comparable to levels observed in other Texas reservoirs. Reported concentrations of lead and zinc exceeded average levels observed in natural soils. Pesticides were not detected in the sediments. PCB's were the only organic contaminants reported in the sediments. The highest sediment PCB concentration was 115 micrograms/kilogram (µg/kg) and the mean was 48.3 µg/kg. The report stated that this was the second highest PCB concentration for any of the lakes tested in Texas.

In August 1982, three sediment and water samples were collected by the Texas Department of Water Resources (TDWR). Ten additional sediment and water samples were collected by the USACE, Fort Worth District, in December 1982. Of the three stations sampled by the TDWR, only one station detected any PCB's. This station was located in the upper portion of Caddo Lake and contained the highest concentration (676 µg/kg) reported to date in the lake. Of the ten samples collected by the USACE, four reported detectable levels of PCB's. The four stations were scattered throughout Caddo Lake. The station reporting the highest concentration, 23.4 µg/kg, was in Goose Prairie Bayou. PCB's were reported only twice in the water column (5.06 and 0.17 µg/L) from sampling by TDWR and the USACE in 1982.

The 1991-92 USGS and USACE study of water and sediments in this area indicated that exceedances of temperature, pH, and DO criteria occurred occasionally in Caddo Lake. DO profiles frequently reported readings near saturation at the surface, with concentrations quickly falling below the criteria of 5.0 mg/l below the water surface. Phosphorus concentrations were high, with average values of 0.05 to 0.06 mg/l. No priority pollutants were detected in the water column, and, with the exception of iron, no metals were found to exceed drinking water standards in Caddo Lake.

The 1991-92 sediment analysis of Caddo Lake revealed low levels of lead, mercury, nickel, and zinc and may be of some concern. No BNA compounds, PCBs or explosives were detected in the sediments, however trace amounts of several PAHs and the pesticide p'p'DDT were found. The VOA compound, toluene was detected at one site in Caddo Lake at a concentration of 0.39 mg/kg.

Lignite coal power plants located upwind from Caddo Lake release mercury into the air which is then deposited into the lakes via precipitation events or surface runoff. Data from the TPWD shows elevated levels of mercury in fish tissue in Caddo Lake. The USFWS is currently conducting a contamination investigation which focuses on the disposition of mercury in biotic and abiotic samples within the Cypress River Valley in order to evaluate the risk to fish and migratory birds.

A fossil fuel burning power plant owned by Southwest Electric Power Company of Shreveport, is located on the north shore of Caddo Lake near the town of Mooringsport, LA. The plant operation time fluctuates with weather conditions so that peak operating times correspond to extreme temperatures. Thermal pollution of waters can contribute to low DO levels in the summer months, while death of organisms due to thermal shock is possible in the winter months. Death by thermal shock is only likely to happen when a sudden start-up or shut down occurs. There have been no reports of fish kills due to the effects of heating from this power plant.

The shallow upper end of Caddo Lake is densely populated with aquatic plants (macrophytes). Four groups of aquatic macrophytes can be distinguished on the basis of morphology and physiology. These groups are: 1) emergent 2) rooted, floating-leaved; 3)

submersed; and 4) freely floating. All of these forms are present in Caddo Lake. While many of the aquatic plants found here are native species, many are exotics that have been introduced (either accidentally or purposefully) to the lake. Water quality problems associated with dense growth of aquatic macrophytes include low DO, nutrient release to the water during active growth and senescence, and loading of organic matter to the environment. Additionally, the canopy of macrophytes becomes so thick in the Lake during the growing season that access to some areas is restricted.

Big Cypress Creek Below Lake O' the Pines

The State of Texas collected water quality data on Big Cypress Creek at Karnack from 1976 to 1988. They collected *in situ* and nutrient data approximately every 2 months and twice annually respectively. No metals or pesticide data were collected from the water column. Two sediment samples were collected in 1976 and 1978 and analyzed for pesticides, PCB's, and heavy metals, with no high levels reported. Comparing the available data to the Texas water quality criteria for drinking water, the water quality was good. There have been no reported exceedances of the water quality criteria in this segment. A comparison of historical data with more recent reports indicates that phosphorus concentrations in this segment have decreased since 1980 from an average concentration of 0.1 mg/l to 0.05 mg/l.

The USGS/USACE 1991-92 survey indicates that this segment of Big Cypress Creek has a high average concentration of phosphorus (from 0.03 to 0.05 mg/l), and extremely high levels of coliform bacteria (average values of 4,500-6,000 colonies/100ml) in the water column. The DO and pH occasionally fall below the minimum criteria. Iron and manganese were found to have average values exceeding the domestic water supply criteria of 300 and 50 g/l, respectively. No priority pollutants were detected in the water column in this segment.

Sediment samples from 1991-92 indicate that the BNA compound n-nitrosodimethyl amine was found in trace amounts at one site, but no VOA compounds, PCBs, PAHs, pesticides, or explosives were detected.

Lake O' the Pines

Water quality data has been collected in Lake O' the Pines by a number of agencies since 1975. The U.S. Geological Survey (USGS) collected water quality data in Lake O' the Pines from October 1975 through September 1984. Analyses of the samples included water temperature, specific conductance, sulfate, chloride, dissolved oxygen (DO), hydrogen ion (pH), dissolved solids, nitrate, ammonia-nitrogen, silica, fluoride, total and non-carbonate hardness, sodium, potassium, iron, manganese, total phosphorus (TP), carbonate, alkalinity, and carbon dioxide. Bacteriological analysis for fecal coliforms was also performed. The water quality was generally good, with the water meeting the Texas criteria for potable water. Occasional exceedances of the Texas criteria for chloride, sulfate, and dissolved oxygen were observed. During the winter, average concentrations of DO throughout the lake are more than 10 mg/L. During the summer months, average DO concentrations ranged from 0.3 mg/L near the dam to 2.0 mg/L near the headwater at the bottom of the lake. In addition, the Environmental Protection Agency's (EPA) maximum contaminant levels (MCL) were occasionally exceeded for the following metals: cadmium, chromium, copper, iron, lead, manganese, mercury, and zinc. High concentrations of iron and manganese were reported near the dam. In the deeper portion of the lake, near the bottom, iron and manganese were much higher than mean concentrations at the surface. Fecal coliforms were in compliance with the Texas Surface Water Quality Standards of 200 colonies/100 ml (log average). No previous studies on Lake O' the Pines have analyzed water samples for priority pollutants. The Texas Natural Resources Conservation Commission (TNRCC) analyzed sediment samples for polychlorinated biphenyl compounds

(PCBs) and pesticides and detected PCBs in one sample.

In 1991-92 the USGS and USACE survey indicated high average concentrations of phosphorus (0.02-0.10 mg/l) in Lake O' the Pines. The average coliform bacteria concentration was well above the criteria at the upper end of the lake, with the concentration substantially declining toward the dam. Manganese had a high average value (exceeding domestic water supply criteria) at the upper end of the lake, with the concentration declining toward the dam. No other exceedances were reported.

Sediment data from 1991-92 show that lead and zinc were at concentrations indicating contamination, and that arsenic, cadmium, and mercury were at concentrations of possible concern. PAHs are present in the sediments in the most upstream reaches of Lake O' the Pines and may exist for at least 0.5 mile downstream of the Lone Star Boat Ramp. Trace amounts of the pesticide p'p'DDT were detected in this segment. No BNA or VOA compounds, PCBs or explosives were found.

Big Cypress Creek Below Lake Bob Sandlin

Periodic dissolved oxygen violations occur in this segment due to hydrologic modifications, extremely sluggish velocity and point discharges. This segment does not meet the contact recreation criterion due to elevated levels of fecal coliform bacteria. Average nitrogen and phosphorus levels are elevated and contribute to dense phytoplankton growths as evidenced by elevated levels of chlorophyll *a*. Levels of pH have been recorded outside the minimum and maximum criteria. The discharge of treated wastewater appears to be the most significant source of nutrients and the cause of periodic depressed dissolved oxygen in the segment. Depressed dissolved oxygen levels are further aggravated by low stream discharge rates, sluggish stream velocities, high turbidity and high sediment oxygen demand.

A waste load evaluation for this segment was completed by the Texas Water Commission (TWC), now the TNRCC, in August 1988 and advanced waste treatment was recommended. A use attainability analysis was done in 1984. Due to naturally low dissolved oxygen levels, the aquatic life use was changed to "intermediate" and the criterion lowered to 4.0 mg/L.

The percentages of values outside State criteria for this segment include dissolved oxygen (24 percent of samples), temperature (2 percent of samples), pH (17 percent of samples), chloride (8 percent of samples), total dissolved solids (2 percent of samples), and fecal coliforms (25 percent of samples).

Lake Bob Sandlin

The TNRCC reports no water quality problems in this segment, with no values occurring outside the State criteria in this segment.

Lake Cypress Springs

Values outside the State criteria have not been measured, indicating that there are no water quality problems in this segment.

Black Bayou

Dissolved oxygen levels are known to vary widely and have been measured in violation of the criterion. These conditions are caused by algal photosynthesis and respiration. Treated wastewater is the most significant source of pollutants; however, naturally sluggish stream flow and the low assimilative capacity of the bayou contribute to

the low dissolved oxygen levels.

A waste load evaluation was done by the State in 1974 and revised in 1988 using recent and more complete water quality and stream hydraulic information. A use attainability analysis was done in 1984. Due to naturally low dissolved oxygen levels, it was recommended that the aquatic life use category was changed to "intermediate" and the criterion be lowered to 4.0 mg/L. Advanced treatment was recommended to maintain a dissolved oxygen concentration of 4.0 mg/L.

Values falling outside the State criteria are dissolved oxygen (33 percent of samples), and fecal coliforms (15 percent of samples).

James' (Jim's) Bayou

Depressed dissolved oxygen and pH levels have been observed, largely due to the sluggish nature of the stream and low rates of aeration. The low dissolved oxygen levels prevent attainment of the intermediate aquatic habitat life use. Values measured outside State criteria include dissolved oxygen (40 percent of samples), pH (20 percent of samples) and fecal coliforms (40 percent of samples).

Little Cypress Bayou (Creek)

Naturally low dissolved oxygen levels prevent attainment of the high quality aquatic life use in this segment. Average levels of nitrogen and phosphorus are elevated. A draft waste load evaluation has been completed by the State. The TNRCC reports that values outside State criteria occur for dissolved oxygen in 96 percent of samples.

Little Cypress Bayou has been routinely monitored by the USGS near Jefferson, TX since 1968. Between 1968 and 1984 the average phosphorus concentration was high (0.1 mg/l), and dissolved oxygen levels were reported below the 5.0 mg/l standard in 15 percent of samples. Metal concentrations were low, exceeding the water quality standards only three times, once each for cadmium, lead, and mercury. No manmade organics were found in the water column during this period, however, PCBs and some pesticides (including chlordane) were detected at low levels in the sediments.

Sediment analysis by the USACE in October 1991 indicated the presence of the pesticide chlordane at a concentration of 0.073 mg/kg. No other contaminants were reported for this location.

Summary of Water Quality

Monitoring of water quality parameters began in the Cypress Basin in the mid-1900s. The water quality data suggest that elevated nutrient levels occur throughout the Cypress Basin, with many of the segments being classified as eutrophic, based on average phosphorus levels. A comparison of historic data with more recent data indicates that phosphorus levels may have decreased in some areas over the last 10-15 years. Occasional exceedances of water quality criteria occur for temperature, dissolved oxygen, and pH. Coliform bacteria have been found at levels exceeding the domestic water supply criteria in some parts of the basin. Metals such as iron and manganese are found in concentrations exceeding water supply criteria in numerous locations throughout the basin. Although exceedances of water quality criteria develop on occasion, water quality in the Cypress Basin is considered to be good.

Metals such as arsenic, cadmium, lead, mercury, nickel, and zinc have been found at concentrations of concern in the sediments. Some PAHs and pesticides have been identified in sediments within the basin, however, the highest levels were reported in

sediments 8 to 12 inches below the water/sediment interface and should not pose any problems to aquatic life as long as they remain undisturbed. No detectible amounts of BNA or VOA compounds, PCBs, or explosives have been reported in the sediments in recent data.

AQUATIC PLANT GROWTH - CADDO LAKE

The effects that construction and operation of Lake O' the Pines have had on Caddo Lake are difficult to determine with any degree of certainty. To ascertain changes in water quality or aquatic plant growth and distribution due to Lake O' the Pines-mediated changes in flow, turbidity, or nutrient levels is difficult, if not impossible, using readily available information. However, the presence of hydrilla in Lake O' the Pines and the reportings in Big Cypress Creek indicates that, by providing a large expanse of aquatic plant habitat open to colonization by weedy species upstream of Caddo Lake, Lake O' the Pines may have contributed to some of the aquatic plant problems in Caddo Lake. By harboring populations of exotic weedy species such as hydrilla and Eurasian watermilfoil, Lake O' the Pines may have contributed to the invasion of these species into Caddo Lake. In the absence of Lake O' the Pines these troublesome species may not have become established in Big Cypress Creek, and their threat to the ecology of Caddo Lake would be much reduced.

It is obvious that past aquatic plant control operations have contributed to the spread of exotic submersed species. Eliminating or greatly reducing one component of the aquatic vegetation (floating plants) has created an opening for another component (submersed plants) to exploit. This is an often-repeated pattern in aquatic plant control. Unless the establishment of non-problem native plants is promoted to occupy the available niche, the cycle likely will continue.

Caddo Lake, since it is very shallow and fertile, will continue to support an abundance of aquatic plants. While we are unable to eliminate or even effect a long-term reduction in the amount of aquatic plant growth in the lake without harming the lake ecosystem, we may be able to choose the dominant species. Several exotic species greatly curtail our ability to use infested water resources and also cause severe water quality problems. These problems arise from their tendency to completely cover the water surface with a thick canopy or mat of leaves (Honnell, Madsen and Smart 1993). This canopy restricts wind-generated mixing of the water column and inhibits gas exchange at the water surface. These factors, in combination with a high respiratory demand associated with excessive biomass production, often result in depletion of dissolved oxygen and subsequent fish kills.

Four exotic species currently pose the most serious threats to Caddo Lake. Waterhyacinth by virtue of its extensive mat of interconnected plants is the worst offender (Honnell, Madsen, and Smart 1993). Waterhyacinth strongly dominated Caddo Lake in the past and has been under maintenance control for nearly 40 years. It is likely that TPWD's program of annual monitoring and treatment (when needed) is the primary factor limiting the explosion of the waterhyacinth population. Hydrilla, although a submersed species, also forms a thick mat of entangled shoots at the water surface (Haller and Sutton 1975) and can cause severe oxygen depletion problems. Eurasian watermilfoil and Brazilian elodea likewise form dense canopies and can cause oxygen depletion.

In contrast to the nuisance characteristics of these exotics, many native species do not form extensive surface canopies and thus do not cause water quality problems. If these native species could be established, they might occupy the niche, preventing the recurrence of exotic weedy species as well as providing fish and wildlife habitat.

HISTORIC RESTORATION

To assist in making recommendations on the development and utilization of cultural resources for eco-tourism, heritage tourism, and education for the study area, various interested parties and local officials were interviewed. In addition to being requested to identify issues that should be addressed by the study, the individuals interviewed were asked for their opinions regarding cultural resource needs in both Jefferson and the throughout the region. Following is a list of individuals and topics discussed:

Charles S. Chitwood, Director of the Texas Heritage Archives and Library

Mr. Chitwood advised the primary mission of this museum is the promotion, preservation, and interpretation of the history of Texas and the Southwest. Jefferson was selected as the site for the museum because, among other reasons, a big city would have "swallowed it up." Dallas was initially considered, but the B.B. Barr Foundation of Dallas, which is funding the creation of the museum, selected Jefferson. In Jefferson the museum will be a tremendous local and regional asset and will be sustained in large part by tourists.

The main issue that Mr. Chitwood identified is the fractious relationships in the historical community of Jefferson. There is a lack of coordination and cooperation between organizations [this is a problem identified also by the Texas Historical Commission (THC)]. He has little communication, therefore, with the Jefferson Historical Society Museum (JHSM). He said he would like to work with them as soon as his museum is up and running well. He recommended the creation of a Jefferson Association of Museums (JAM). He belongs to the Northeast Texas Museum Association (NTMA) and is familiar with the Museum Association of Waco. He believes the entire community would benefit from a local museum association. Such an association would encourage unity through communication, cooperation, and education.

He identified the museums of Jefferson: Alley Carlson Cottage, Ruth Lester Memorial, and Excelsior/Atalanta. He also named some house museums that could be associates of JAM: the Beard House, the Freeman Plantation, Twin Oaks, House of the Four Seasons, Secession Hall, Maison Bayou, Roseville Manor, and the Culberson House. He also identified a POC in town for African-American culture and history: Paulette Cooper.

Duke DeWare, President of the Historic Jefferson Foundation

Mr. DeWare discussed options for the Port of Jefferson restoration. He discussed constructing the new port where the existing boat landing is located. This would be a relatively small area compared to what existed. He was not supportive of this idea and, instead, favored development of a wharf area, downstream from the boat landing, below the railroad bridge, to be excavated and reconstructed. According to a 1983 archeological survey, a brick retaining wall, which may be associated with the wharf, still exists. He proposed this be viewed as an archeological-excavation/reconstruction project. In his opinion, the boat landing area would not be a good location for the reconstructed port because of silting problems. He also discussed the potential problem of riverboats clearing the railroad bridge to get to the boat landing area. A typical steam boat, of the type which traveled to Jefferson is shown in Photograph 3-1.

Mr. DeWare suggested the port to be fully functional. Since it was at one time the gateway to Texas, Mr. DeWare said he would like to see a memorial at the port to the pioneers who passed through Jefferson--like the arch at Saint Louis (but smaller, of course). He envisioned shallow-draft, glass-canopied boats, like those on the Seine River in Paris, being used for excursions from the port to Caddo Lake. Using these type of craft,

bridge clearance would not be a problem. He would also like Jefferson to obtain some ISTEA funding in relationship to the port, as well as work on the county courthouse and the historic brick streets of Jefferson.

The Caddo Lake Historical Research Committee (CLHRC)

Members Marsha Thomas (President), Linda S. Robinson (Secretary), Janette Pace Boswell, Bill H. Brannon, and Nathan H. McEachern were interviewed. The stated goals of CLHRC are:

1. Research and develop historical materials and information on Caddo Lake
2. Establish an archives for research materials and historical data.
3. Promote historical research of communities surrounding Caddo Lake in TX and LA
4. Develop and promote tourism pertaining to Caddo Lake.

The CLHRC is newly-registered with the state as a nonprofit organization. They have applied also as a federal 501(c)3 non-profit. The members have divided the Caddo Lake area amongst themselves, and each member is conducting historical research in their respective area.

Regarding reconstructing the Port of Jefferson, members said they thought it would be fine as long as it did not adversely effect the lake. The lake, they emphasized, is the focal point of the group. They are very concerned with silting problems at the lake. They believe that Ferrel's Dam is contributing to problems at Caddo Lake. The group was concerned that the port would adversely impact the lake. They did not want to see dredging or tree removal to make Cypress Bayou or Caddo Lake navigable for deep-draft boats. They thought only shallow-draft boats should be used.

The committee is currently seeking to locate an archives/museum facility on Caddo Lake. The facility would either be a new one or a restored historic building. The facility would focus on the cultural and natural resources of the lake region. They have planned a meeting with Congressman Chapman's office and Texas Parks and Wildlife Department to discuss their plans and goals.

Katherine Wise, local historian

Ms. Wise, a prominent member of the Historic Jefferson Foundation, has files that contain history reports prepared over the years, maps, newspaper clippings, and photographs.

She discussed historic preservation in Jefferson, the proposed historic preservation ordinance, and the Port of Jefferson study. She advised that a previous historic preservation ordinance study was conducted ca. 1979, and that a report from the study was available. Ms. Wise mentioned a failed facade-easement program in Jefferson. Lastly, she expressed concern about the collections at the Jefferson Historical Society and Museum and suggested they need a curator to itemize and protect the artifacts.

Photograph 3 - 1: R.T. BRYARLY--The R. T. Bryarly was operated by the New Orleans and Red River Transportation Company. The dates given for the boat are 1872 to 1876. This photograph has written on the front "Talfor Photo 107," and on the back "Ran Between New Orleans Shreveport Jefferson and Upper Red River to Fulton Ark and Beyond." The R. T. Bryarly is shown in this photograph entering the Red River through Sale and Murphy's Canal, an artificial waterway cut around the Red River Raft.

James P. Finstrom, President of the Marion County Historical Commission

Mr. Finstrom is city attorney and president of the Marion County Historical Commission, which was created by the State legislature. According to Mr. Finstrom, the commission oversees the historic marker program and publishes history books. He proposed studies be done on the manufacturing district located on the river, downstream from Jefferson. He noted a rendering yard and iron foundry previously located in the area. Other improvements he would like to see include the restoration of downtown businesses, historic buildings moved into town and restored, and a blending of cultural and natural resource development. He is very interested also in the proposed environmental education center.

Paulette Cooper, Prairie View A&M University Cooperative Extension Program

Ms. Cooper is a member of the Minority Coalition for the Advancement of Economic Development. She advised their primary goals are to develop minority skills and jobs in the area. This group is also involved with Black History. She discussed how the group could relate to the Cypress Bayou initiative. In the area of history, she said they are interested in identifying cemetery records and historical sites of the African-American community. Included would be the creation of an oral history project. She would like to see the construction of a cultural arts museum which focuses on minorities. This would be a multi-use facility with meeting and recreational space. It could have a store that sold crafts and books on minority cultures. It could also have classrooms for vocational education as well as cultural education. The meeting and recreational space could be used for family reunions. She mentioned several large family reunions of descendants of former slaves that have been held in North Carolina. She envisions this center as being capable of handling these large functions.

Ned Fratangelo, The Turning Basin Riverboat Tours

As an operator of tour boats on Cypress Bayou, Mr. Fratangelo was very supportive of the Port of Jefferson project. He would like to see the port reconstructed, but would not want any improvements made to Cypress Bayou from Jefferson to Caddo Lake.

He wants to see only small boats operating on the bayou. He is against dredging or tree removal. He said the natural beauty of the bayou and lake should not be touched, and all improvements should be restricted to the port area.

FLOODPLAIN DEVELOPMENT/FLOOD DAMAGE REDUCTION

The streams of the Cypress Bayou Basin are generally tortuous, unimproved, and overgrown in many locations by trees, saplings, and underbrush which cause these streams to frequently overflow. Caddo Lake dam has a spillway with a minimum elevation of 168.5 NGVD. Flows through Caddo Lake must pass over this spillway which creates backwater effects in Caddo Lake, and these effects extend up Big Cypress Bayou. Floods in the basin generally rise and fall slowly and have relatively low velocities since the heavily timbered basin and flood plains retard surface rapid runoff and overbank floodflows.

Twelve Mile Bayou which extends from Caddo Lake to Shreveport, is protected by Federal and non-Federal levees. Damages occur to agricultural operations, residences, farm buildings, and oilfield operations due to ponding of intense runoff during periods of high stages in Twelve Mile Bayou. The 1968 Comprehensive Basin Study for the Red River

Below Denison Dam determined solutions to the ponding problems were not economically feasible.

Development in the flood plains around Caddo Lake and along Big Cypress, Little Cypress, and Black Cypress Bayous is composed of roads, bridges, oilfield facilities, residences, and commercial businesses. Very little of the flood plain is utilized for agricultural purposes. The residences are a combination of year round homes placed linearly around the lake and along the stream to have access to water and take advantage of the aesthetic value of the watercourses. Development is not continuous but occurs in small clusters or communities. The businesses are related to the fishing and recreation pursuits of the area. The number and value of existing investments within the SPF flood plain (Caddo Lake, Little Cypress Bayou, Big Cypress Bayou and Black Cypress Bayou) are estimated to be 707 residential structures ($33.5 million), 38 commercial structures ($0.8 million), and 20 others ($5.6 million).

In past years various Federal and state projects have been constructed in an effort to reduce the flood threat throughout the basin. Some of the more effective of the projects from a flood reduction standpoint have been Lake O' the Pines (Corps of Engineers' lake), and construction of the city of Jefferson levee (non-Federal). However, these projects have only partially eliminated flooding problems within the Cypress Valley.

The non-floodflow channel capacity of Big Cypress Bayou from the confluence of Little Cypress Bayou to Caddo Lake is 7,000 cubic feet per second (cfs). Flows in excess of this will cause flood damages. Floodflows first cover access roads, damaging them and creating a hazardous situation for the homes and businesses serviced by these roads. Higher flows begin to damage structures.

Lake O' the Pines, the only flood control lake in the study area, began to impound water in 1957. However, since that time, the uncontrolled tributary watersheds of the Little and Black Cypress Bayous have caused floodflows to occur along Big Cypress Bayou 13 times. The dates of these occurrences are:

April 1957	December 1973
May 1958	June 1974
December 1960	February 1975
April 1966	April 1979
May 1968	May 1979
April 1973	January 1980
	May 1989

FLOOD OF 1945

The week of April 1995, marked the 50th anniversary of the flooding of Jefferson which, according to the April 5, 1945 issue of the *Jefferson Jimplecute*, "touched every building and business in the downtown area." According to an article on the front page of that week's paper, "There was no Easter Parade of fine frocks and new hats in the streets of Jefferson this year." "The parade seen on these streets Sunday, April 1, was of boats, and people wading water knee-deep and automobiles plowing through the shallowest places.

The story continues, "A general alarm was sounded at about 3:30a.m. as the water threatened to come over the bank at Dallas Street, and by daylight men stood on main street and backed away as the flood waters moved in. All day long the water rose and before the crest was reached about the middle of the day Monday, Jefferson saw its worst flood in history. The water this time reached 30 feet on the government gauge in the middle

of Big Cypress bridge. The flood in 1930 was probably the worst to this date when the water reached 28 feet on the gauge and only a portion of Polk Street was covered. This time, however, water flowed, as if in a separate stream, in every street and alley downtown. The high point downtown seemed to be at the intersection between Denton and Sedberry Drug, the bank and Jefferson Dry Goods Co., and here the water met in the gulleys next to the sidewalk and water was in the two drugstores. The bank and dry goods store were the only business houses in which water did not flow in the floors."

"The spirit of cooperation exhibited by people was credited with avoiding worse consequences of the flooding."

FLOOD OF MAY 1989

The Lake O' the Pines Project had a small portion of its flood control storage (7 percent) utilized in May, during the first of the storm events. During the May 16-18 rains, the project experienced significant increases, going to 26 percent of flood pool. Evacuation of the flood waters was progressively increased as downstream channel capacity became available. Releases from lake waters were curtailed for several days due to downstream flooding at Caddo Lake. Several homes in low lying areas experienced minor flooding and several roads were flooded. On the Big Cypress, which flows into Lake O' the Pines, the flows peaked at about 25,000 cfs in May and at about 15,000 cfs in June. Two counties (Marion and Upshur) reported some damages from this flood event.

EROSION PROTECTION

The causes of bank erosion (steep face) and recession (top) vary according to each site, but within the United States, wave erosion is viewed as the chief culprit, whether by wind or by passing boats. The degree to which such erosion occurs depends on a multitude of factors, including the fetch, wind (and boat) velocity, duration of the wind, and the shoreline and bank characteristics. Next to wave erosion, however, rainsplash and runoff tend to be of second importance, except for the northern areas where frost/thaw failure can be more important. The effectiveness of rain and runoff depends on storm intensity and duration, snowmelt rate, the steepness and height of the bank, and the properties of the bank material. Sandy and silty sediment, for example, are very susceptible to erosion by rain and runoff, silty and clayey sediment are more susceptible to frost/thaw failure. Freezing-of such sediment disrupts the structure of sediments and increases the resulting water volume. Thawing leads to failure by sliding, slumping and flowing. Such failure depends also on the depth of freezing, the number of freeze-thaw cycles and the structure of the bank material.

Ground water can also be a significant factor in bank recession, especially in the more humid eastern U.S. In such areas, a fluctuating lake level often causes more recession than any other factor. With high lake levels water from the lake recharges the adjacent water table. causing it to rise. Upon lowering of the lake level, excess ground water (pore water) pressure weakens the bank and failure often results. In semi-arid to arid regions, the lake always serves to recharge the water table, as it is characteristically lower than the lake during all seasons. Perched water tables can be important in all regions, but may be the only cause of failure due to ground water in dry regions. Such perched water tables are the result of infiltrating water being intercepted by relatively impermeable beds above the main water table. Spring seepage occurs where such beds intersect the banks.

Wind typically is an insignificant direct cause of bank recession despite the fact that on some windy days fine sand is removed from bank faces and carried over the top. Fine

sand is the easiest grain size to be picked up by wind and if the bank contains no sand, wind is rarely ineffective.

Specific areas identified within the study area which are experiencing severe erosion are Lake O' the Pines and the Big Cypress Bayou (specifically at the Jefferson Powder Magazine). These areas area discussed in more detail in the following paragraphs.

LAKE O' THE PINES

Fluctuating reservoir water levels and waves tend to contribute to the destruction of shoreline vegetation. Often the vegetation existing when the reservoir was impounded was intolerant of the periodic flooding and drying resulting from routine reservoir operations and of large waves. Bare areas are highly susceptible to erosion and contribute to turbidity and poor water quality. They also provide little fish and wildlife habitat in comparison with vegetated shorelines.

Over 65 percent of the more than 460 Corps of Engineers (CE) reservoir projects experience loss of vegetation and accelerated erosion associated with fluctuating water levels and other factors. This includes many of the reservoirs in the Fort Worth District, such as Lake O' the Pines. The US Army Engineer Waterways Experiment Station (WES) and some CE Districts have conducted field studies and demonstrations over the last 10 years to identify flood-tolerant plant species and planting methods for reestablishing shoreline vegetation. Study results and demonstrations indicate that low-cost methods using flood-tolerant vegetation and construction materials for reservoir shoreline erosion control have promise, but must be tailored to the situation and used at the correct time of the year.

Damages/Problems

In many cases, eroded banks are at the back door of private properties. Many of the banks at Lake O' the Pines have exceeded Federal boundaries, coming close to various facilities. Throughout the Corps millions of dollars have been spent condemning private property and purchasing it, due to the erosion. Receding shorelines have also encroached on Federal properties, undermining buildings and other structures on our own recreational facilities. The costs of this erosion are reflected in not only correcting the problem, but also in terms of lost revenues from the users of these facilities.

One result of erosion can be poor water quality. Turbid water does not appeal to the general public who use our facilities for swimming, skiing, and taking part in other water-related activities. Another impact caused by turbidity is sedimentation that often covers spawning habitats. Fisheries researchers have determined that the fluctuation zone of a reservoir often becomes an infertile ground and erosion can lead to barren nutrient-limited zones in the reservoirs. These effects on the aquatic food chain ultimately affect fishing, again impacting the public. Shoreline erosion also destroys wildlife habitat. Ironically, if it were not for the presence of the reservoir, much of this habitat would not otherwise be there.

Sedimentation from eroding shorelines can contribute to reducing the design life of reservoirs, or alternatively, cause an increased expenditure for dredging.

Erosion destroys many archaeological and cultural resources. According to the National Reservoir Inundation Study done a few years ago by the National Park Service, perhaps the most important set of reservoir processes affecting the archaeological preservation equation are the physical erosion and deposition processes associated with any large body of water. Included in this category are the affects of wave action along the vertically fluctuating shoreline; saturation and slumping of shoreline and submerged

geologic strata; and siltation from back shore runoff and stream inflow. Of these, the most destructive form of impact occurred along the fluctuating shoreline of the reservoir where the mechanical forces of wave action and near shore occurrence within the beach can drastically alter shoreline topography and any cultural resources occurring on that topography.

Traditional methods alone, such as rip-rapping and classically engineered bulk-heading, can be very expensive. The Corps has been and continues to seek less expensive ways of protecting the shorelines and these resources. Limited Corps funds prohibit addressing every mile of shoreline erosion in all reservoirs. Even given the resources, it would be impractical.

Description of the Problem

The damages to the Lake O' the Pines shoreline is typical at the lakes in east Texas. Examples of the damage is shown in photographs 3-2 and 3-3. It is estimated that for the almost 144 miles of shoreline around Lake O' the Pines has experienced some loss of area due to erosion since the lake was completed in 1957.

JEFFERSON POWDER MAGAZINE

History and Description

The Jefferson Ordnance Magazine is a small, one and one-half story, single room, square brick building with shed roof constructed during the Civil War primarily for the storage of powder and munitions. It is on property confiscated by the US Government and sold by the US Treasury Department through Special Agent, H.B. Hawkins, in a Bill of Sale dated February 10, 1866. This document does not mention this particular structure, but does reference a large eight room frame Ordnance building that would have been used to store non-explosive supplies and larger weapons. The extant brick magazine is the sole remaining building standing on this entire property and the exact location of this larger frame building is unknown. The Jefferson Ordnance Magazine's simple functional design underscores its primary use. It is constructed to safely store munitions and contains engineering details designed to create air spaces inside its lower walls. The brick work consists of a variant of American bond with from four to six courses of stretchers between each row of headers in the lower walls and from eight to nine in the upper walls. The building is moderately well preserved and retains its integrity of location, setting, materials, feeling and association. It is surrounded by undeveloped lands containing no other improvements or 20th century distractions and, thus, still retains most of its natural setting once associated with the mid 19th century. However, as a result of streambank erosion caused by varying streamflows, the integrity of this site is being threatened.

Technical assistance was received under the Water Operations Technical Support (WOTS) Program by representatives from the U.S. Army Engineer Waterways Experiment Station Environmental Laboratory and Hydraulics Laboratory. The purpose of the assistance (investigation and field visit) was to aid the Fort Worth District in formulating identifying measures which might be undertaken to minimize future erosion on the right bank of the Big Cypress Bayou adjacent to the historic powder magazine near Jefferson, Texas. A copy of the draft trip report of the WOTS investigation is enclosed as Exhibit K.

Following various meetings and an on-site visit, the WOTS team described the nature of the erosion problem at the site. Photographs of the site (Photographs 3-4 & 3-5) and observations by the WES-WOTS staff members from the July 10, 1995 field visit follow:

• The area of concern is a reach of the east bank of the Big cypress Bayou approximately 600 ft long about 4 miles downstream of the Federal HW 59 bridge. At the time of the site visit, the bayou was exposing an over steepened section of bank about 25 ft in height from the top bank to the water's edge. A nearly vertical section 8 to 10 ft high existed near the top of the slope. The site is located in a fairly straight reach with the exception of a bend several hundred feet upstream from it.

• Soils comprising the riverbank in this area appeared to be predominantly fine sand overlying a bed of clay. The clay bed varies in its position from the water's edge as one traverses the site.

• Several recreational and sightseeing motor boats were observed going by the site during the site visit and motor boat wakes were creating toe-scour. Subsequent flow events then loosened soil from the toe contributing to over steepening and subsequent caving of the bank.

• Vegetation on the shore of the bayou upstream and downstream of the eroded site consisted primarily of bald cypress and oaks and appeared to be fairly stable. In contrast, there was very little vegetation at the eroded site, indicating instability.

• Examination of the streamflow data reveals a wide variation in flows over 71 years, ranging from a low of 1.2 cfs to a high of 2930 cfs. There were times when flows dropped dramatically from very high flows to much lower flows. This type of action would cause sudden drawdown or "saturated bank" type failures. These types of failures probably occur following periods of high water when the inability of the streambank to drain combined with the over steepening of the bank described above results in instability. This failure mechanism is supported by the general shape of the bank which include a vertical scarp near top bank and an obvious shelf further downslope.

STUDY AREA RECREATIONAL NEEDS

Ample existing outdoor recreational facilities are available to the residents throughout the area. Projections show that the demand for recreational facilities will continue to increase. More details on recreational use at facilities within the study area are presented below.

RECREATION TRAVEL PATTERNS

Regions 5 and 6 are projected to be the most popular destination regions by residents in 1995 in resource-based activities. Of the total resource-based recreation participation projected to occur in Region 5 in 1995, 60 percent will be by Region 5 residents. The remainder of the participation will come from Regions 4, 6, 9, 16, 22, and all others combined, respectively. In Region 6, of the total resource-based recreation participation projected to occur in 1995, 56 percent will be by Region 6 residents. The remainder of the participation will come from Regions 4, 5, 13, 14, 16, and all others combined, respectively.

PROJECTED PARTICIPATION

The activities projected to have the highest total participation occurring in Region 5 in 1995 will be walking for pleasure, bicycling, pool swimming, freshwater fishing, and

playground use, respectively. The popularity of these activities shows the importance of trail activities, water-based recreation, and family-oriented activities to Region 5 residents. A large amount of the participation projected to occur in Region 5 will be from other regions. Every activity but hiking shows significant participation by visitors, and for one activity, camping, visitor participation will exceed that of residents. In Region 6, the activities projected to have the highest total participation in 1995 will be walking for pleasure, bicycling, pool swimming, playground use, jogging/running, and freshwater fishing, respectively.

NEEDED FACILITIES AND RESOURCES

Facilities needed in Region 5 by 1995 are, in order of priority, soccer/football fields, multi-use trails, swimming, playground areas, horseback riding trails, and offroad vehicle riding acres. Other priorities include basketball goals, softball fields, golf courses, tennis courts, and hiking trail miles. In 1995 facility needs per thousand population, Region 5 is expected to exceed the statewide average for basketball goals, campsites, hiking trails, horseback riding trails, off-road vehicle riding areas, equipped playground areas, soccer/football fields, softball fields, swimming, tennis courts, and multi-use trail miles.

Facilities needed in Region 6 by 1995 are, in order of priority, multi-use trails, soccer/football fields, swimming, playground areas, and horseback riding trails. Other priorities include off-road vehicle riding acres, tennis courts, softball fields, basketball goals, fishing structures, and hiking trail miles. In 1995 facility needs per thousand population, Region 6 is expected to exceed the statewide average for basketball goals, campsites, freshwater fishing structures, hiking trails, horseback riding trails, off-road vehicle riding areas, equipped playground areas, soccer/football fields, softball fields, swimming, tennis courts, and multi-use trails.

PROVIDERS' RESPONSIBILITIES

Federal and state agencies should be the primary suppliers of facilities that serve statewide and regional needs and secondary suppliers of facilities that meet local needs. By 1995, the Corps of Engineers should be a primary supplier of fishing structures and secondary supplier of needs for hiking trails, off-road vehicle riding acres, playgrounds, and multi-use trail miles. The Texas Parks and Wildlife Department should be a secondary supplier of hiking trails needs. City and county governments should have the major responsibility in meeting the needs for local facilities such as basketball goals, boat lanes, hiking trails, playgrounds, soccer/football fields, softball fields, tennis courts, and multi-use trails. In addition, local governments should help meet the needs for fishing structures.

The commercial sector should furnish facilities from which it can reasonably expect to make a profit, including fishing structures, horseback riding trails, off-road vehicle riding acres, and tennis courts.

LAKE OPERATIONS

The existing lakes in the area are operated for the purposes of cooling water for lignite fueled steam-electric generating plants, water supply, recreation, and flood control. None of the existing lakes have hydroelectric facilities.

Photograph 3 - 2: Typical Shoreline Erosion at Lake o' the Pines
Note: Loss of Pine Trees

Photograph 3 - 3: Typical Shoreline Erosion at Lake o' the Pines
Note: Height of Eroded Bank

Photograph 3 - 4:
Photographs of Bank Erosion at Powder Magazine

Photograph 3 - 5:
Photographs of Bank Erosion at Powder Magazine

COOLING WATER LAKES

Lake Bob Sandlin, Monticello Reservoir, Johnson Creek Reservoir, and Welsh Reservoir are operated for cooling water and serve primarily to supply water to steam-electric plants. Current lakes are deemed adequate for current and projected future demands.

WATER SUPPLY LAKES

Lake O' the Pines, Lake Cypress Springs, Lake Bob Sandlin, Ellison Creek Reservoir, and Caddo Lake serve as municipal and/or industrial water supply. The city of Marshall has a pipeline and outlet works in the upper end of Lake O' the Pines. Water flows from Caddo Lake are picked up downstream by the city of Shreveport, who also has the right to pump water directly from Caddo Lake (but does not do so at this time). The owners of the other municipal/industrial lakes are listed in Chapter 2.

FLOOD CONTROL LAKES

Lake O' the Pines, a Corps of Engineers lake, is the only lake in the watershed with flood control storage. Approximately 587,200 acre-feet is available to contain flood flows. Flood flows that are released must pass through Caddo Lake on the way to the Gulf of Mexico. Past history indicates there is a continuing struggle between balancing the need to release flood waters as soon as possible from Lake O' the Pines, while not causing flooding in Caddo Lake. Numerous meetings with the public attest to this situation being an unresolved problem.

HYDROELECTRIC

No existing hydroelectric generating facilities are in the watershed. The Cypress Bayou Basin is located in the Southwest Power Pool (SPP) area which is comprised of the entire states of Kansas, Oklahoma, Arkansas, and Louisiana, and portions of Mississippi, Missouri, Texas, and New Mexico. The SPP is well interconnected electrically, and energy generated in one part of the SPP could be used in another part.

BASINWIDE OPERATING PLAN

As noted in Chapter 2, an operating agreement is in effect for lakes in the watershed. Although the results have been generally favorable, local interests have expressed a desire to have both Lake O' the Pines and Caddo Lake under a single Corps District (i.e., Fort Worth District has jurisdiction over Lake O' the Pines, while Vicksburg District has jurisdiction over Caddo Lake). Consideration of this option was beyond the scope of this study, and was not considered at this time.

WATER SUPPLY NEEDS

The quantity of water used for a variety of purposes by various regions and urban/rural areas of the State of Texas is highly dependant on the demographic, economic, climatologic, and water availability conditions. These factors distinguish each city and region from one another, and when combined, provide a summation and overview of the

State's total water use and supply. The Texas Water Development Board periodically publishes a document entitled “Water for Texas, Today and Tomorrow” which describes and quantifies these factors both in the Northeast Texas Region and throughout the state. The draft 1996 edition of “Water for Texas” was used as a reference for this section of the report, Water Supply Needs.

FUTURE WATER USES

Total water use in the Northeast Texas Region, which includes 21 counties in portions of the Red, Sulphur, Sabine, Trinity, Neches, and Cypress basins, is projected to reach nearly 800,000 acre-feet (ac-ft) by the year 2050. This represents a 45 percent increase above the 1990 total water use. During this same time period, the general population of the area is projected to rise 30 percent to about 1,080,000. The greater per capita demand for water is due to the expectation that industrial use, which includes manufacturing, steam-electric power cooling, and mining, will grow by 61 percent between the years 1990 and 2050. In addition to industrial usage, the other major use category is municipal. Together they account for almost 77 percent of the total water use of the region.

Directly affecting the water supply of the Cypress Valley Watershed is the city of Shreveport and its growth pattern and needs. As stated in the Red River Compact, and quoted previously in Chapter 2 of this report, Texas and Louisiana shall each have the unrestricted right to fifty (50) percent of the conservation storage capacity of any future enlargement of Caddo Lake. Shreveport anticipates their future demands to increase sufficiently to require an enlargement of the lake that would result in a dependable yield of 84 mgd in the year 2040.

REGIONAL WATER-RELATED PROBLEMS AND NEEDS

In many areas, shallow ground water has high concentrations of iron and is acidic, which makes the water undesirable for municipal use and many manufacturing processes. These problems generally can be solved by completing wells in deeper water-bearing zones or by expensive treatment of water from shallow wells. Surface water and ground-water resources are potentially available to meet projected needs, if projects are planned and developed on schedule.

LOCAL WATER-RELATED PROBLEMS AND NEEDS

A brief narrative of the Texas Water Development Board's evaluation of the current and future water resources situation of major urban areas and large utility suppliers in the Northeast Texas Region is described below. Also included are other entities that could effect the water supply resources of a region. Data on other cities and suppliers may be obtained from the Board's files.

Regional Water Suppliers

Sulphur Municipal Water District. The Sulphur Municipal Water District was created in 1955 and serves Delta, Hopkins and Hunt counties. The SRMWD owns 26.282 percent of the storage space in Lake Cooper and will use that water to fulfill the needs of its customer cities (Cooper, Commerce, and Sulphur Springs). Over the next 50 years, the member cities could have excess supplies in Lake Cooper. In fact, the Upper Trinity Regional Water District has entered into an agreement with the city of Commerce for the temporary, interim purchase of water from Commerce's share of the Lake Cooper water. The interim water would be used by UTRWD to meet the need in Denton County by trading

Cooper water to the city of Dallas for more water from Lake Lewisville. Any other excess water the district's member cities have could be used in the Dallas/Fort Worth metroplex area through interbasin transfer.

Northeast Texas Municipal Water District. The Northeast Texas Municipal Water District (NTMWD) was created in 1953 and serves Marion, Upshur, Morris, Cass, and Camp counties. The District owns storage rights in Lake O' the Pines Reservoir and supplies water to its customer cities, as well as industrial and steam power plants in the basin and in the Sabine River Basin. The District currently supplies water to the Brandy Branch cooling lake which is located in the Sabine River Basin and has contracted to supply up to 20,000 acre feet of Lake O' the Pines water to the city of Longview in the Sabine Basin.

A wastewater treatment facility operated by the District is slated for improvements necessary for compliance with the new safe drinking water regulations, and applications for SRF funding is underway.

Sabine River Authority. The Sabine River Authority was created by the Texas Legislature in 1949 as a conservation and reclamation district to control, store, preserve, and distribute the waters of the Sabine River and its tributaries for beneficial purposes. The service area of the SRA includes all or parts of nine counties (Rains, Woods, Gregg, Panola, Shelby, Sabine, Newton, Orange, and Jasper). The SRA owns and operates three reservoirs, two (Lake Fork and Lake Tawakoni) lie within the Northeast Texas Region, while the third (Toledo Bend Reservior) lies within the East Texas Region. The SRA has contracted to provide water supplies to numerous municipalities, water supply corporations, and industrial users in the region.. In addition, the SRA has contracted to provide Dallas Water Utilities (in the Trinity River Basin) over 300,000 acre-feet per year from Lake Fork and Tawakoni Reservoirs.

Municipal Water Customers

City of Tyler. Water needs for the city are met by surface water from Lake Tyler and from wells completed in the Carrizo-Wilcox Aquifer. It is anticipated that withdrawals will remain at approximately present levels, while increasing needs will be met by increased use of Lake Tyler. The city also holds contracts for water from Lake Palestine, if needed. The city of Tyler owns two wastewater treatment facilities: the Westside WWTP has a 13mgd capacity and the Southside WWTP has a 9 mgd capacity. Both plants have recently undergone upgrades to comply with the more stringent permit standards.

City of Longview. The City of Longview holds contracts for water in Lake Cherokee and Lake Fork, as well as having water rights to flows in the Sabine River. In general, the majority of their water needs in the past have been met by Lake Cherokee and the Sabine River. The city also holds contracts to water from Lake O' the Pines in the Cypress River Basin for 20,000 ac-ft per year and has expressed an interest in increasing that to 40,000 ac-ft to solve their long term needs (and has authorization for the associated interbasin transfer). Longview has not, as of yet, needed to use water from this source, but plans to in the future. The City of Longview operates a wastewater treatment plant and collection system which is presently being rehabilitated with funding from the State Water Pollution Control Revolving Fund. The facility is currently permitted for 16.5 mgd but has plans for expansion in the near future to meet the city's needs through the year 2014.

City of Texarkana. The water needs for the city of Texarkana are met by Lake Wright Patman (formerly Lake Texarkana). The city also serves as a water supplier for several communities and water supply companies located in Bowie and Red River counties, and in southwestern Arkansas. Interbasin transfers have been authorized, where required, for these supplies. Texarkana operates three wastewater treatment facilities: the New

Regional South WWTP, recently expanded to 16.5 mgd from 11.7 mgd, the 2 mgd Wagner Creek WWTP, and the 0.05 mgd Rollingwood WWTP which serves a small, isolated subdivsion. All three facilities have recently undergone modifications and improvements to meet stricter permit requirements.

City of Paris. Water needs for the city of Paris are met from Lake Crook and Lake Pat Mayes (involve an authorized interbasin transfer from the Red River Basin). The city operates a 7.25 mgd wastewater treatment facility. The collection system is presently undergoing rehabilitation to correct infiltration/inflow problems.

City of Marshall. The city of Marshall has water rights to flows in the Cypress Creek. The diversion point for the city is in the backwater of Caddo Lake, and because of the elevation of this intake and the current level of Caddo Lake, the city must incur additional expenses to acquire water if the flows in Cypress Creek are low. The city of Marshall owns and operates a 5.91 mgd wastewater treatment plant. The city has plans to expand the plant to a capacity of 9 mgd and will also upgrade to meet stricter permit standards. Apllications for SRF funding is underway.

City of Kilgore. The city of Kilgore meets its water needs from groundwater well completed in the Carrizo-Wilcox aquifer and from water obtained from the city of Longview. The city also purchases water from the Sabine River Authority. The city operates a 3mgd wastewater treatment facility recently upgraded to comply with stricter permit requirements.

JEFFERSON AREA ECONOMIC DEVELOPMENT

MARKET ASSESSMENT

To determine the market area for recreational and ecotourism in the Jefferson area, on-site investigations were conducted during the summer of 1994, including interviews of local residents, visitors, local officials, businesses, and community leaders. These interviews were conducted to determine the relative importance of market areas, the types of community features that attracted visitors to the area, and to provide preliminary input into the types of new developments that might be desirable for the area.

The results of these preliminary investigations revealed that the main source of visitors were from the Dallas-Fort Worth area, the immediate eight county area, Caddo Parish, Louisiana including the city of Shreveport and Harris County, Texas including the city of Houston. The interviews indicated that visitors were attracted to the ambience and friendly atmosphere of the area. Recreational features and tourist interests included fishing and boating (generally in nearby Caddo lake), antique shopping in Jefferson, historical sightseeing and non-consumptive recreational use such as hiking and birdwatching.

Future developments of interest as mentioned by residents, officials and visitors included hiking and nature trails, educational centers for environmental and folklife interests, and water-based tourism (steamboats and tour boats). Other non-consumptive recreational developments were also of interest such as bike and horseback trails, bird watching and increased access to camping and canoeing areas. Many of these interests can be classified as ecotourism related. Ecotourism is a growing class of tourist activity and is seen by many communities as a way to provide for sustainable economic development while protecting valued natural resources and ways-of-life.

The results of these preliminary investigations were used to develop and direct a telephone survey of present and potential users. The four page survey, which took approximately 5 to 7 minutes to conduct, asked questions about past visitation to the Jefferson area, potential future visitation after development of recreational amenities, and background economic and demographic information. The survey was completed during August and September 1994. Before the telephone survey was conducted, informational packets were sent to a randomly selected sample in the market areas. The pre-survey packet informed the individuals about the purpose of the study and gave them information to orient them to the types of questions that would be asked. The actual surveys occurred typically one week after the pre-survey forms were received. Over 1,000 completed surveys (1,034) were recorded with the following breakdown: Dallas-Fort Worth, 49.5 percent; Jefferson area, 28.5 percent; Houston, 12 percent; and Shreveport, 10 percent.

VISITATION

The results indicated that 31 percent of those interviewed had visited Jefferson at least once with the highest rates found for those from the local area and Shreveport. Most visits are one or two days and occur once or less than once annually. Those who are older and more educated are more likely to have visited Jefferson. Spending per visit is low with most parties spending less than $200 per visit, though those visitors from Dallas-Fort Worth and Houston are likely to stay longer and spend more money per visit.

LOCAL INPUT

Early coordination meetings were held with potential sponsors and Jefferson residents throughout the spring and summer of 1994, followed by a more structured public involvement process which formally got underway with a week-long workshop held in Jefferson in October of that year. This “Visions” workshop was proposed to promote and enhance communication and cooperation among government agencies, citizens, and other groups involved in planning for the historic Port of Jefferson and the larger Cypress Valley Watershed and to develop a conceptual framework for Jefferson and the port including recreation, education, and interpretive links to the larger region.

To encourage the participation of diverse interests in the workshop’s evolution, it was structured as a “charette.” A French word meaning “little cart,” charette refers to the final intense work effort of architects to meet a project deadline. The term evolved in the 19th century at the Ecole des Beaux Arts in Paris, France. Proctors circulated with little carts to collect student drawings, and students would jump on the “charette” to add final details to their drawings minutes before the deadline. Today, a charrette provides a unique forum for ideas, and creates the unusual advantage of immediate feedback while giving mutual authorship to the plan by all whom participate.

Twenty-five professionals from throughout the nation formed the core charrette team. Members contributed expertise in many areas and included landscape architects, architects, park and recreation planners, economists, sociologists, archeologists, historians, natural resource planners, and visitor use management specialists. Organizations represented included the U.S. Army Corps of Engineers, National Park Service, Texas Parks and Wildlife Department, Texas Historical Commission, University of Houston, and Stephen F. Austin State University. A number of private consultants assisted throughout the week. During all phases of the charrette, the public provided ideas that were incorporated into the visions. In addition, over seventy-five school children from the Jefferson Independent School District participated in developing ideas for the port.

Because the charrette was held in the centrally located Jefferson Carnegie Library, local citizens had continuous access to the workshop. A special public meeting was held early in the process so the public's ideas could be incorporated from the beginning. In addition, focused public meetings were held on the second and third days and twice at the end to provide ample opportunities for the public to be involved and to review the ideas.

The public had many excellent suggestions related to regional education initiatives on Caddo Lake and Big Cypress Bayou: a cultural center, recreation facilities, and Jefferson and its waterfront. They had specific ideas for the town and the port, and voiced many concerns about ecological impact. Their ideas are presented in detail in the Big Cypress Bayou "Visions" Workshop Booklet and are summarized below:

Education Initiative:

-provide a visitor center
-provide a Caddo Lake facility focused on science, nature, and cultural history
-provide a convention center for up to 200 people
-create high-tech exhibits with computers
-provide nature trails, meetings rooms, research facilities
-incorporate the schools and create a world-wide attraction

Caddo Lake:

-Upgrade the wastewater system and ensure availability of high quality water
-Include a park and wildlife area at Potter's Point
-Keep Caddo Lake as natural as possible
-Create public access at Thompson's Landing

Big Cypress Bayou:

-Promote passive uses such as canoeing and fishing
-Create an access point between Lake O' the Pines and Jefferson
-Add camping
-Create public access to Clinton and Carter Lake

Cultural Center:

-create an artists' and cultural center close to downtown
-provide a theater that presents a range of plays relating to the area's history
-include diverse racial, ethnic and age groups in the interpretive programs
-represent all the major historic eras, tell the whole story

Trails/Recreation:

-create an equestrian center with public facilities, campgrounds, and routes for day and overnight trips
-create biking, hiking, and equestrian trails that link the area
-add campgrounds and cabins
-encourage more boat and nature tours

Jefferson and Jefferson Waterfront

-link the Civil War powder magazine to the project
-interpret the 1870's port with wharf and warehouses
-convert the old railroad bridge to a pedestrian link to the south shore
-landscape and beautify the waterfront
-create activities for children
-encourage boat tours
-keep the waterfront natural

SITE ANALYSIS

Existing Conditions Map

In order to understand the physical conditions of the waterfront in Jefferson, a series of maps were created which organize the natural and manmade features present. The natural resources which are included on the existing conditions map include major water elevation changes, drainages, natural depressions, and estimates of the erosion and deposition patterns of the bayou. Also indicated on this map is the topographic survey (2' level of accuracy) performed for this study. Manmade resources such as the location and size of the historic and active railroad lines, roads, paths, structures, and utility lines are also included. A view of the historic port location may be seen in Photograph 2-1. It should be noted that at this same site is the location of two railroad bridges, one abandoned and one active (Photograph 2-2). Additionally, adjacent to the historic port location is the City of Jefferson raw water intake structure on Big Cypress Bayou (Photograph 2-3).

Waterfront Resources

The waterfront resources map identifies features and facilities which should be incorporated into the plan. These resources include potential pedestrian areas such as the historic railroad bridge, the levee walks, and raised roadbed which provides access to the Bayou adjacent to the Junior Historians Building. Additional assets which are proximate to the waterfront include the B.B. Barr museum, the Jefferson Museum, the Jay Gould railroad car, the Excelsior House and the train ride.

Potential viewing areas are also important, especially since much of the area is enclosed and provides few opportunities for distant or bayou views. The potential viewing areas identified on the waterfront resources map include the historic railroad bridge, the open space on east Dallas Street and areas along the east levee.

Heavily wooded areas are also considered a resource due to their potential to provide shade in a park atmosphere as well as the potential for ecological interpretation of the bayou environment. The area west of Polk Street has excellent potential as an ecological interpretive area, while the woodland on the east side of Polk Street provides opportunities for shade and parkland as well as interpretation.

Waterfront Constraints

The waterfront constraints map was developed to understand many of the problems needing resolution if the port were to be successfully restored as a place for visitors to recreate and learn. One of the biggest constraints is the large boat launch ramp and parking area located directly on the Bayou at the south entry to the City of Jefferson. This area is highly visible and distracts from the otherwise pleasant and historic character of the historic downtown. Other features which detract from the ambiance include the raw water intake and treatment plant, and the City maintenance storage facility.

Other concerns that were identified during the site analysis include Polk Street, which lacks landscaping and roadway design features which would integrate it into the historic fabric of the community, and the new railroad bridge which detracts from the natural character along the bayou. The railroad tracks pose problems for pedestrians wishing to access the eastern portion of the waterfront. The unlandscaped parking lot at the County Courthouse, and the vacant, somewhat-disturbed appearance along east Dallas Street was also identified. The overhead power lines and large power poles also significantly detract from the historic character and aesthetic quality of the site.

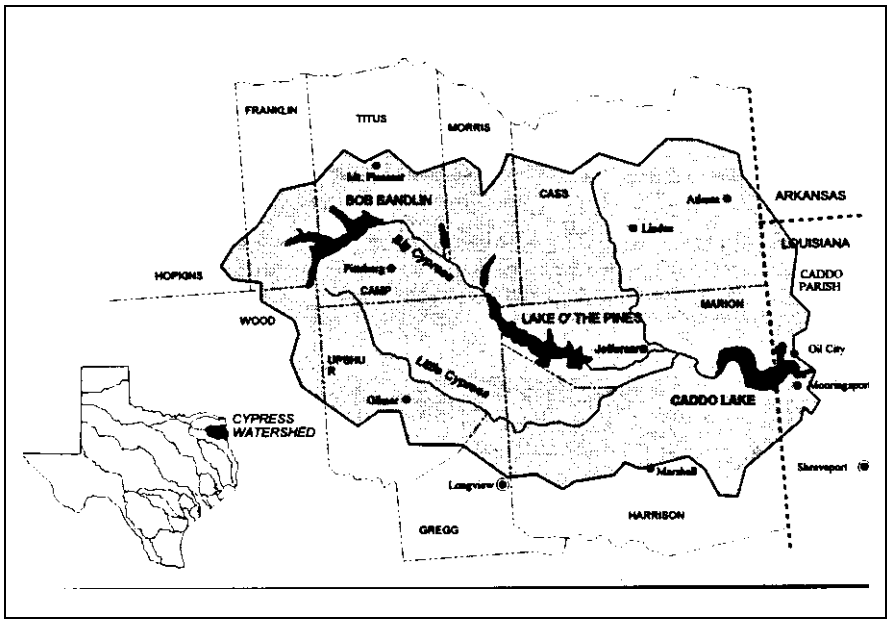
Another important constraint that had to be carefully considered were the lands which are within the typically-fluctuating water level of the bayou. When not underwater, these areas may be muddy and unattractive.

PUBLIC ENVIRONMENTAL EDUCATION

The Cypress Valley Watershed occupies approximately 6,000 square miles in northeast Texas and Northwestern Louisiana, which includes all or part of Caddo parish in Louisiana, and eleven counties in Texas: Camp, Cass, Franklin, Gregg, Harrison, Hopkins, Marion, Morris, Titus, Upshur and Wood. The major lakes, Lake O' the Pines and Lake Bob Sandlin, drain into Caddo Lake; a bald cypress swamp occupying approximately 25,400 surface acres. In 1994, the U.S. Fish and Wildlife Service designated Caddo Lake a Resource Category One, their highest valued classification of wetland, and a RAMSAR wetland of international importance. The area is one of the most biologically diverse habitats in Texas. Coupled with a rich cultural history illustrating man's interdependence with nature, the ecology of the Cypress Valley River Basin represents an extraordinary opportunity for environmental educators.

Many educational institutions are taking advantage of this resource in teaching children about our natural and built environments. In December 1994 and later in March 1995, a questionnaire covering operation, facilities, programs, and curriculum was mailed to 220 schools throughout the Cypress Valley Watershed. Intended as a compilation of existing programs in the arts, sciences and humanities, the questionnaire served to highlight the possibilities open to schools interested in environmental education programming.

One of the most accessible tools for incorporating environmental education into the curriculum is through backyard habitat programs, including wild flower gardens, nature trails, community gardens and study gardens. Harmony ISD, Hughes Springs ISD, Hudson PEP School, and Marshall ISD schools all combine nature trails, greenhouses, gardens, and/or historic buildings to complement their programs. Jefferson ISD implemented a Wetland Project in 1994 that involves elementary students (K-3) in a variety of projects designed to increase their environmental awareness. Students participate in monthly science themes, water quality monitoring at Caddo Lake and weather monitoring with an on-campus weather station. They are also involved in the Texas Parks & Wildlife Department's backyard habitat program, *Texas Wildscapes*, and have installed nature trails and bat boxes.



Schools also focus on student clubs or cooperative programs to enrich the standard curriculum. The Environment Club, sponsored by Huntington High School in Shreveport, Louisiana sponsors various recycling projects, the Boys and Girls Club of Harrison County sponsors a nature study program and Jefferson Middle School participates in the Forestry Association's *Walk in the Forest* program. As mentioned earlier, many schools incorporate Project WILD and Learning Tree materials into their curriculum.

Environmental education in higher education typically focuses on science education and lacks an interdisciplinary perspective. The Department of Geology and Geography at Centenary College in Shreveport combines environmental science with an option for a minor in environmental studies open to non-science majors as well. Dr. Mary Barrett is Advisor to the Environmental Studies Minor which focuses on the knowledge and skills required to address the multi-disciplinary nature of environmental issues.

Private organizations, both profit and non-profit, have a great deal to offer in terms of formal and informal education for the environment. A few organizations in the Cypress Valley merit special note:

- **River Basins Institute, Inc., Atlanta, Texas.**

A private, non-profit collaborative established to increase scientific literacy and promote conservation of natural and cultural resources. The Institute is primarily involved in offering training and support to public school science teachers implementing reform in the classroom. RBI sponsors teacher in-service workshops endorsed by the Texas Environmental Education Advisory Committee.

- **Caddo Lake Scholars, Headquarters, Aspen, Colorado.**

A private, non-profit organization funded by Don Henley to support local community and academic scholarship to protect the Caddo Lake ecosystem. The Scholars program seeks to encourage research on Caddo Lake by establishing partnerships between regional colleges, universities, and secondary schools, including, East Texas Baptist University and Wiley College in Marshall, Panola College in Carthage, and Stephen F. Austin State University in Nacogdoches. Students are matched with a faculty mentor from a partner regional college or university. Caddo Lake Scholars is also the sponsor for Project WET in Texas.

- **Walter B. Jacobs Memorial Nature Park, Blanchard, Louisiana.**

Jacobs Memorial Nature Park is operated by Caddo Parish Parks and is located on 160 acres of Louisiana bottomland. The Center provides interpretive exhibits, nature trails, and special programs dedicated to the preservation and the study of nature.

- **Maison-Bayou Plantation Bed & Breakfast and Riding Stable, Jefferson, Texas.**

A for-profit bed & breakfast and recreation area that exemplifies the nature tourism movement, Maison-Bayou Plantation offers patrons interpretive tours and nature activities, including hiking, equestrian, and canoe trails, in a historic setting.

Although it is outside the watershed boundaries, Camp Tyler in Whitehouse, Texas is a long-standing outdoor education program operated by a division of the Tyler ISD. Camp Tyler opened its doors in 1949 and is approximately 360 acres of working farm and gardens. With a staff of nine, the facility operates a 4-day residency camp for 5th grade students, and day programs for all other grade levels. The longevity of the program is evidence of the viability of outdoor education as one component of environmental education.

A private, non-profit organization formed in 1994, the Caddo Lake Historical Research Committee, is documenting the ecological, natural and cultural history of the Caddo Lake region. Members collect oral histories on a diverse list of subjects; including, steamboats/watercraft, trails/roads, logging/sawmills, exploration, geography/geology, hunting/fishing and communities. The stories collected by the Committee provide adults and children with an important link between the study of the environment in general and the study of my environment. This is an important resource for environmental educators throughout the Caddo Lake area. The experience of place and home illuminated by personal stories moves education about environment from an abstract concept to education about real, personally meaningful places.

REGIONAL ECONOMIC DEVELOPMENT

In order to understand the strengths of the region, a comprehensive Baseline Conditions Report was prepared for each county. (The ***Baseline Conditions: An Interim Report*** was prepared in 1995 as part of the economic development study conducted by the Technology and Economic Development Division of the Texas A&M Engineering Extension Service under a Memorandum of Agreement with the Fort Worth District.) The Baseline Conditions Report is the foundation for the CrossMatch selection process, and it provides an objective viewpoint of what the area can offer in terms of both financial and non-financial incentives as well as overall quality of life. The information gathered for the Baseline Conditions Report is the basis of the rating system used during the analysis or “matching” phase where the best targets are selected. The purpose is to assess the readiness of the area to become a viable industrial target for new business.

The Baseline Conditions Report is divided into the following three sections:

- County History and Population Demographics gives a brief overview of the background of the county and outlines its unique properties, personality and goals. The demographics breakdown includes total population by ethnicity, age, sex and level of education.

- County Industrial Profile provides a narrative snapshot of the county as part of a larger regional portrait. Using sources such as the Directory of Texas Manufacturers, Ward's Business Directory, Dun and Bradstreet and the local chambers of commerce, major employers are located by product type (four-digit SIC code), number of employees and gross sales.

- County Audit assesses the county's current economic health, including its financial vitality; infrastructure; employment; agriculture outlook; educational opportunities; crime rate; health facilities and other factors. The review includes broader quality-of-life issues as well.

ANALYSIS PROCESS

Based on the Baseline Condition Reports, the study team determines the region's relative strengths in areas such as labor, transportation, utilities and other factors of importance to industry. In this study, other factors include a positive environmental sensitivity and an inclination to move to rural areas. For each of these factors, a rating from one to ten was given based on comparative analysis of other parts of Texas and the nation.

Forecasting computer models are used to determine which industries are growing the fastest annually in order to locate target companies most likely to expand and to create jobs the most quickly. In this study, these targets originally numbered in excess of 60. No consideration is given at this stage as to whether or not they are appropriate for the region, but it provides the first-cut priority list that will be "matched" to the regional attributes.

To narrow the number of targets, the products are sorted according to category, and further secondary literature research is done to isolate those that are clearly inappropriate. Reasons for eliminating potential targets include seasonal volatility, trendiness, capital intensity, acute overseas competition, the need to be in an urban environment, inappropriate agricultural climate and other unsavory intuitive rationales.

For this study, a short list of 22 targeted industries was decided upon, and intensive research was done to verify the industry's needs and compare them to the ratings of the study area. All 22 targets are appropriate to the region, but only those that presented the most opportunity were further examined. Even though only a few became targets on which to concentrate, the region is attractive to these "short list" companies. The following table shows identified industries with growth opportunities in manufacturing (which is emphasized most in this methodology due to its greater economic impact on an economy in general), and agriculture-related production.

Table 3-1 presents the "short list" of manufacturing targets identified by the *CrossMatch* analysis process. From this list, the industries with the best regional and local fit were determined. Further research into any specific sector, not just the final targets, by area economic developers should yield worthwhile contacts for recruitment as all of the short list industries are in a growth mode. With sufficient local infrastructure improvements and multi-county dedication, they could be easily attracted to the Watershed. In the *CrossMatch* system, the difference between being a target and being on the following short list is simply the number of obstacles--usually not insurmountable, or they would not have made it this far--that must be overcome to make the region appealing to a specific industry.

Table 3-2 presents the new manufacturing opportunities which were further analyzed and are highly recommended for targeting. Also included are the counties which would be most conducive to development of these industries. It should be noted that all of the region's counties would be a good site for the industries identified, however, the counties shown in the table have a competitive advantage in targeting.

Table 3-1.
Prospective Manufacturing Target Industries for the Cypress Bayou Watershed
"the short list"

SIC	Annual Growth Rate	Industry
3073	9%	Reinforced plastics
3074	115%	Plastic liners
3074	82%	Compression wrap
3075	38%	Plastic industrial parts
2451	17%	Mobile homes
3076	38%	Construction plastics
3079	41%	Medical plastics
3541	17%	Metal working machinery
3544	33%	Tools, molds & precision equipment
3564	22%	Air pollution equipment
2000	220%	Food & Kindred products
2033	20%	Hot sauces, fiery foods
2432	246%	Hardwood, plywood & veneers
2611	42%	Recycled pulp
2611	24%	Woodpulp and related goods
2611	34%	Market woodpulp
2821	50%	Polyamide resins
2821	17%	Degradable plastics
2821	8%	Acrylic resins
2821	24%	Polyethylene

Table 3-2
New Manufacturing Opportunities
Target Industries and Counties

Industry	Counties
Stretch film and blow-molded plastic containers	Caddo, Gregg and Marion
Medical plastics and devices	Caddo, Gregg, Harrison and Marion
Air pollution equipment	Caddo, Gregg, Harrison and Marion
Manufactured homes	Titus, Camp, Franklin, Wood and Upshur
Construction materials	Cass, Morris, Franklin and Wood