Draft Benbrook Lake 2021 Master Plan

Trinity River Basin: Clear Fork Trinity River
Tarrant County, Texas
March 2021

US Army Corps of Engineers®

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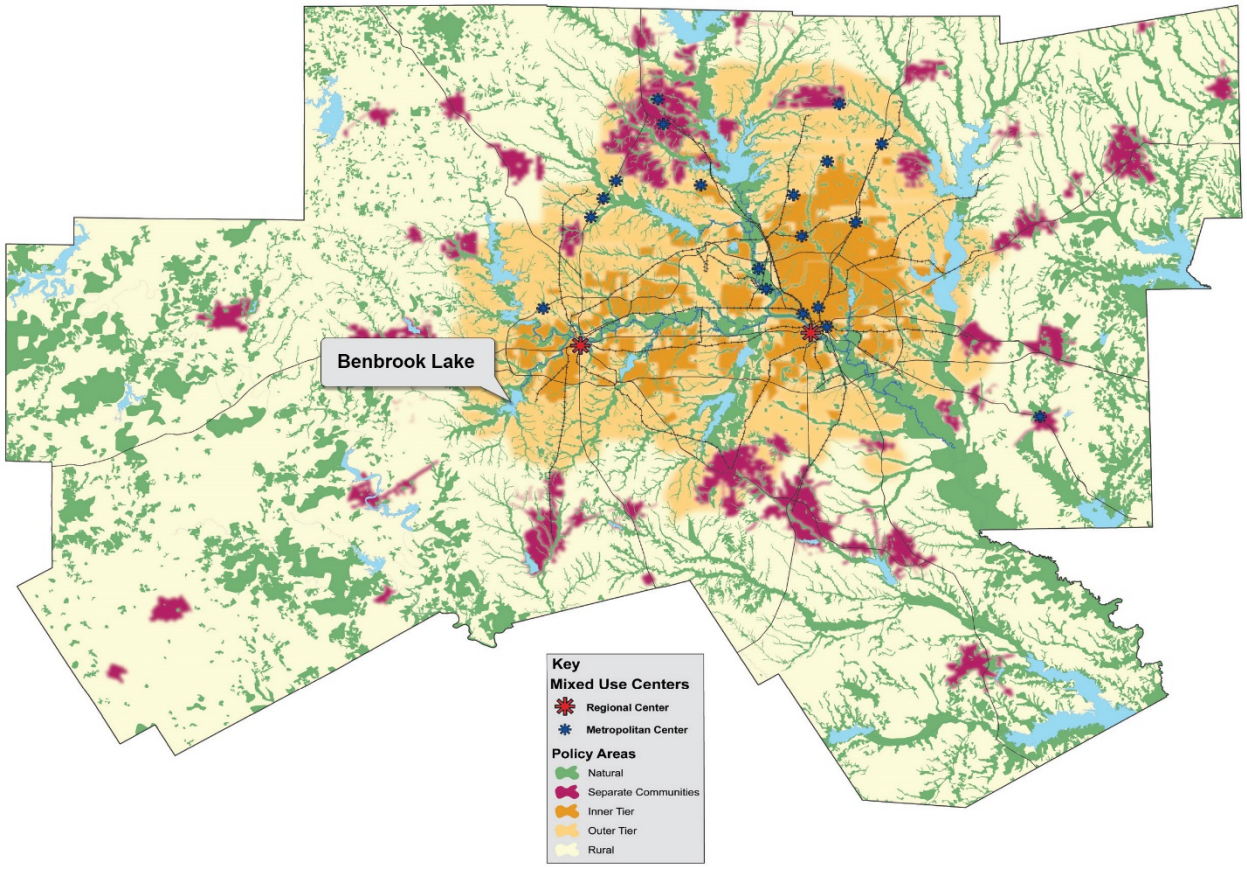
EXECUTIVE SUMMARY

DRAFT Benbrook Lake Master Plan
U.S. Army Corps of Engineers
Prepared by the Southwestern Division
Regional Planning and Environmental Center (RPEC)
March 2021

ES.1 PURPOSE

The revision of the 1972 *Benbrook Lake Master Plan* (hereafter Plan or Master Plan) is a framework built collaboratively to guide appropriate stewardship of U.S. Army Corps of Engineers (USACE) administered resources at Benbrook Lake over the next 25 years. The 1972 Master Plan for Benbrook Lake was a revision to the 1966 Master Plan. The 1972 Plan has served well past its intended 25-year planning horizon and does not reflect the growing population around the lake and regional recreation needs. When originally constructed, the dam and lake's purposes were primarily flood risk management and navigation. Today, the lake and dam provide a multi-purpose reservoir for the original purposes of flood mitigation, water supply, fish and wildlife management, and recreation; whereas the navigation purpose were deauthorized. In addition to these primary missions, USACE has an inherent mission for environmental stewardship of project lands, working closely with the cities of Fort Worth and Benbrook to provide regionally important outdoor recreation opportunities. Benbrook Lake exists in a highly populated region within the 16-county North Central Texas Council of Governments (NCTCOG). Refer to Figure ES.1 for a general location showing Benbrook Lake in the "Outer Tier" of the core population zone as defined by NCTCOG.

Figure ES.1 Preferred Physical Development Pattern for the Sixteen County NCTCOG for Year 2050



Source: NCTCOG: Vision North Texas

The Master Plan is primarily a land use and outdoor recreation strategic plan that does not address the specific authorized purposes of flood risk management or water supply. Although water management is addressed in the 2018 USACE Water Control Manual for Benbrook Lake, the Master Plan acknowledges that fluctuating water level for flood risk management and water supply can have a dramatic effect on outdoor recreation, especially at boat ramps, swim beaches, and the marina.

The 1972 Master Plan included a total of 4,665 acres of USACE land and 3,770 acres of surface water at the normal or conservation pool elevation of 694.0 feet National Geodetic Vertical Datum of 1929 (feet NGVD29). The acres figure was derived using land measurement technology dating from the 1950s and has been used since 1972 to describe the size of the pool at the normal elevation. The mapping used for this Master Plan revision uses modern satellite imagery and Geographic Information System (GIS) mapping, resulting in different acreage calculations than that of the 1972 Master Plan. Benbrook Lake has a water surface of 3,635 acres at the conservation pool of 694.0 feet NGVD29. Approximately 4,375 acres of federal land lie above the conservation pool with a shoreline of approximately 46 miles at the top of the conservation pool. Benbrook Dam and Lake Project (Benbrook Lake hereafter), is part of an integral flood mitigation and water conservation project in the Trinity River Basin

consisting of eight major projects. This Plan and supporting documentation provide an inventory and analysis, goals, objectives, and recommendations for USACE lands and waters at Benbrook Lake, Texas, with input from the public, stakeholders, and subject matter experts.

ES.2 PUBLIC INPUT

To ensure a balance between operational, environmental, and recreational outcomes, USACE obtained both public and agency input toward the Master Plan. An Environmental Assessment (EA) was completed in conjunction with the Master Plan to evaluate the impacts of alternatives and can be found in Appendix B.

Approximately 125 individuals, not including USACE personnel, attended the public scoping meeting held at the onset of the process on 21 August 2019 for the Benbrook Lake Master Plan Revision. During the initial 30-day comment period, a total of 242 separate written comments were received from 124 individual stakeholders and the public at large. Meetings were also held with the City of Benbrook, Texas Parks and Wildlife Department (TPWD), and the Natural Resources Conservation Service (NRCS). The comments resulting from the public and these additional meetings were invaluable in preparing the draft revision of the Plan.

Additional information will be included after the Draft Master Plan is presented at the public outreach presentation and after the conclusion of the comment period.

ES.3 RECOMMENDATIONS

The following land and water classification changes (detailed in Chapter 8) were a result of the inventory, analysis, and synthesis of data, documents, and public and agency input. In general, all USACE land at Benbrook Lake was reclassified either by a change in nomenclature required by regulation or changes needed to identify actual and projected use. With the exception of Project Operations and Wildlife Management acreage, it is not possible to make a direct comparison of the new land classification with the prior 1972 classifications. The 1972 Plan classified a majority of the acres within designated parks as Recreational Areas, even though just a portion of those parks were used for recreation. The changes to the land classification are due to delineating where intensive recreation is occurring or is projected to occur in High Density Recreation areas and setting aside land for Environmentally Sensitive Areas and Multiple Resource Management. In addition to the proposed acreage changes, USACE has proposed 12 utility corridors at Benbrook Lake which are described in detail in Section 6.2 and included in the maps in Appendix A.

Table ES.1 Change from Prior Land Classification to New Land Classification

Prior Land Classifications (1972 Plan)	Acres		New Land Classifications (2021)	Acres
Operations and Maintenance	176		Project Operations	234
Recreational Areas	2,896		High Density Recreation	1,761
Special Use Areas	146		--	
--	--		Environmentally Sensitive Areas	1,122
Aesthetics Area and Multiple Use Recreation Areas	1,254		Multiple Resource Management – Vegetative Management	1,129
Wildlife Area	193		Multiple Resource Management – Wildlife Management	128
Total Land Acres	4,665		Total Land Acres	4,375

Total Acreage differences from the 1972 total to the 2021 totals are due to improvements in measurement technology, deposition/siltation, and erosion. As real estate boundaries are researched, acreages may change slightly to reflect more precise boundary mapping. The fee simple and easement acreage identified in this master plan was obtained from the Real Estate Management Information System and is subject to change as the acquisition documents are audited.

Table ES.2 Change from Prior Water Surface Classification to New Water Surface Classification

Prior Water Surface Classifications (1972 Plan)	Acres		New Water Surface Classifications (2021)	Acres
Flowage Easement	2,823		Flowage Easement*	3,200
Permanent Pool	3,770		Permanent Pool	3,635
--	--		– Restricted	9
--	--		– Designated No Wake	115
--	--		– Open Recreation	3,511

Total Acreage differences from the 1972 total to the 2021 totals are due to improvements in measurement technology, deposition/siltation, and erosion. * Flowage easement acres are approximate, and buildings for habitation will not be constructed on flowage easement land.

The acreages of the conservation pool and USACE land lying above the conservation pool was measured using satellite imagery and GIS software which allows for more finely tuned measurements and, thus, stated acres may vary from official land acquisition records and acreage figures published in the 1972 Master Plan. Some changes may also be due to erosion and siltation. A more detailed summary of changes and rationale can be found in Chapter 8.

ES.4 PLAN ORGANIZATION

Chapter 1 of the Master Plan presents an overall introduction to Benbrook Lake. Chapter 2 consists of an inventory and analysis of Benbrook Lake and associated land resources. Chapters 3 and 4 lay out management goals, resource objectives, and land classifications. Chapter 5 is the resource management plan that identifies how project lands will be managed for each land use classification. This includes current and projected overall park facility needs, an analysis of existing and anticipated resource use, and anticipated influences on overall project operation and management. Chapter 6 details special topics that are unique to Benbrook Lake. Chapter 7 identifies the public involvement efforts and stakeholder input gathered for the development of the Master Plan, and Chapter 8 gives a summary of the changes in land classification from the previous master plan to the present one. Finally, the appendices include information and supporting documents for this Master Plan revision, including Land Classification and Park Plate Maps (Appendix A).

An Environmental Assessment was developed with the master plan, which analyzed alternative management scenarios for Benbrook Lake, in accordance federal regulations including the National Environmental Policy Act of 1969, as amended (NEPA); regulations of the Council on Environmental Quality; and USACE regulations, including Engineer Regulation 200-2-2: Procedures for Implementing NEPA. The EA is a separate document that informs this Master Plan and can be found in its entirety in Appendix B.

The EA evaluated two alternatives as follows: 1) No Action Alternative, which would continue the use of the 1972 master plan, and 2) Proposed Action. The EA analyzed the potential impact these alternatives would have on the natural, cultural, and human environments. The Master Plan is conceptual and broad in nature, and any action proposed in the plan that would result in significant disturbance to natural resources or result in significant public interest would require additional NEPA documentation at the time the action takes place.

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CHAPTER 1 – INTRODUCTION

1.1. GENERAL OVERVIEW

Benbrook Dam and Lake (hereafter Benbrook Lake) is located at river mile (RM) 15 on the Clear Fork of the Trinity River, a tributary of the West Fork of the Trinity River. The damsite is located in Tarrant County, about 10 miles southwest of downtown Fort Worth and two miles south of the city of Benbrook (Figure 1.1). The lake is partially within the city limits of both Benbrook and Fort Worth as well as unincorporated Tarrant County. The construction of Benbrook Dam began in May 1947 and was completed in December 1950. Deliberate impoundment began 29 September 1952, and the conservation pool was filled 12 May 1957.

Figure 1.1 Vicinity Map of Benbrook Lake and Dam

Benbrook Lake is an integral part of the U.S. Army Corps of Engineers (USACE) plan for flood risk management and water conservation in the Trinity River Basin. The plan presently consists of eight major flood risk management projects, known as Benbrook Dam, Bardwell Dam, Grapevine Dam, Joe Pool Dam, Lavon Dam, Lewisville Dam, Navarro Mills Dam, and Ray Roberts Dam. The eight flood mitigation projects in the Trinity River system control approximately 1,591,300 acre-feet (ac-ft) of flood control area. Benbrook mitigates 429 square miles of drainage area within the Trinity River Basin. USACE operates and maintains the dam and associated facilities and administers the Federal lands and flowage easements comprising the project through a combination of direct management and leases for park and recreation purposes.

The Master Plan is intended to serve as a comprehensive land and recreation management guide with an effective life of approximately 25 years. The focus of the Plan is to guide the stewardship of natural and cultural resources and make provision for outdoor recreation facilities and opportunities on federal land associated with Benbrook Lake. The Master Plan identifies conceptual types and levels of activities, but does not include designs, project sites, or estimated costs. All actions carried out by USACE, other agencies, and individuals granted leases to USACE lands must be consistent with the Master Plan. The Plan does not address the flood risk management or water supply purposes of Benbrook Lake (see the 2018 USACE Water Control Manual for Benbrook Lake for a description of these project purposes). The Benbrook Lake Master Plan was last revised in 1972, which is well past the intended planning horizon of 25 years.

National USACE missions associated with water resource development projects may include flood risk management, water conservation, navigation, recreation, fish and wildlife conservation, and hydroelectric power generation. Most of these missions serve to protect the built environment and natural resources of a region from the climate extremes of drought and floods. This helps to create a more resilient and sustainable region for the health, welfare, and energy security of its citizens. Mitigation, while not a formal mission at USACE lakes, may be implemented to achieve the fish and wildlife and recreation missions. Maintaining a healthy vegetative cover and including a native prairie or tree cover where ecologically appropriate on Federal lands within the constraints imposed by primary project purposes helps reduce stormwater runoff and soil erosion, mitigates air pollution, and moderates temperatures. To this end, USACE has developed the following statements.

The USACE Sustainability Policy and Strategic Plan states that:

> *"The U.S. Army Corps of Engineers strives to protect, sustain, and improve the natural and man-made environment of our Nation, and is committed to compliance with applicable environmental and energy statutes, regulations, and Executive Orders. Sustainability is not only a natural part of the Corps' decision processes, it is part of the culture.*

Sustainability is an umbrella concept that encompasses energy, climate change and the environment to ensure today's actions do not negatively impact tomorrow. The Corps of Engineers is a steward for some of the Nation's most valuable natural resources and must ensure customers receive products and services that provide sustainable solutions that address short and long-term environmental, social, and economic considerations."

The USACE mission for the Responses to Climate Change Program is:

"To develop, implement, and assess adjustments or changes in operations and decision environments to enhance resilience or reduce vulnerability of USACE projects, systems, and programs to observed or expected changes in climate."

1.2. PROJECT AUTHORIZATION

Benbrook Lake was authorized 2 March 1945 with the primary missions of flood risk management and navigation as contained in the River and Harbor Act of 1945 (Public Law [PL] 14, 79th Congress, 1st Session), in accordance with the total plan of improvements for the Trinity River basin outlined in House Document Number 403 (77th Congress, 1st Session). Recreational development was authorized by the Flood Control Act of 1944 (PL 534, 78th Congress, 2nd Session). The dam and lake are named for the City of Benbrook, whose border abuts the lake. Construction of Benbrook Dam began 27 May 1947 and was completed in December 1950. Deliberate impoundment began 29 September 1952, and the conservation pool was reached 12 May 1957.

1.3. PROJECT PURPOSE

When originally built, Benbrook Dam and Lake's purposes were primarily flood control and navigation, but the navigation purpose has since been deauthorized, as indicated in the Corps' Federal Register notices of project deauthorizations of June 26, 2003 (68 FR 38022) and March 25, 2016 (81 FR 16147). Today it is a multi-purpose water resource operated by USACE for the purposes of flood control, water supply, recreation, and fish and wildlife management within the Trinity River Basin. USACE administers the surrounding federal lands and water surface to provide a variety of public, outdoor recreation opportunities. Environmental stewardship of Federal lands is carried out to recognize and protect important fish and wildlife habitats and species.

1.4. MASTER PLAN PURPOSE AND SCOPE

The Benbrook Lake Master Plan is the living, flexible, long-term strategic land-use management document that guides the comprehensive management and development of all the project's recreational, natural, and cultural resources. Under the guidance published in Engineering Regulation (ER) 1130-2-550 Change 7, and the accompanying Engineer Pamphlet (EP) 1130-2-550 Change 5, the Master Plan guides the efficient and cost-effective development, management, and use of project lands. It is

a dynamic tool that provides for the responsible stewardship and sustainability of the project's resources for the benefit of present and future generations. The Master Plan works in tandem with the Operational Management Plan (OMP), which is the task-oriented implementation tool for the resource objectives and development needs identified in the Master Plan. The Master Plan guides and articulates the USACE responsibilities pursuant to federal laws. The USACE vision for the future management of the natural resources and recreation program at Benbrook Lake is set forth as follows:

> *"The land, water and, recreational resources of Benbrook Lake will be managed to protect, conserve, and sustain natural and cultural resources, especially environmentally sensitive resources, and provide outdoor recreation opportunities that complement overall project purposes for the benefit of present and future generations."*

It is important to note what the Master Plan does not address. Details of design, management and administration, and implementation are not addressed here; but are covered in the Benbrook Lake OMP. In addition, the Master Plan does not address the specifics of regional water quality, shoreline management (a term used to describe primarily vegetation modification or permits by neighboring landowners), or water level management, nor does it address the operation and maintenance of prime project operations facilities such as the dam embankment, gate control outlet, and spillway. Additionally, the Plan does not address the flood risk management or water conservation purposes of Benbrook Lake with respect to management of the water level in the lake (see the USACE Water Control Manual for Benbrook Lake for a description of these project purposes).

The master planning process encompasses the examination and analysis of past, present, and future environmental, recreational, and socioeconomic conditions and trends. Within a generalized conceptual framework, the process focuses on the following four primary components:

- Regional and ecosystem needs
- Project resource capabilities and suitabilities
- Expressed public interests that are compatible with Benbrook Lake's authorized purposes
- Environmental sustainability elements

The Benbrook Lake Master Plan was originally written as a Draft in 1953, then updated October 1961, updated again in February 1966, and revised in March 1972. The original Plan was given limited approval for building some public use facilities, and the later updates authorized comprehensive land use and resource management. Although the previous revision was sufficient for prior land use planning and management, many changes are affecting the region. Outdoor recreation trends,

regional land use, rapidly growing population, current legislative requirements, and USACE management policy have evolved. Increased urbanization, fragmentation of wildlife habitat, impacts of climate change, and the growing demand for recreational access and natural resource management have affected the region and Benbrook Lake. In response to these escalating pressures, a full revision of the 1972 Master Plan is required. The Master Plan revision will update land classifications, include new resource management objectives, and describe future plans proposed by key partners and stakeholders. The Plan will also inform the management of vegetation, wildlife, and other natural resources for the next 25 years.

1.5. BRIEF WATERSHED AND PROJECT DESCRIPTION

Benbrook Lake is located in the Clear Fork Trinity River watershed in the Upper Trinity River Basin. The headwaters of Clear Fork Trinity River begin in the northern part of Parker County in north central Texas and flow southeast until reaching Benbrook Lake, then turns northeasterly towards the West Fork of the Trinity River where it meets the West Fork at river mile 556.8. The watershed is southwest of Fort Worth, Texas and comprises portions of Parker, Hood, Johnson, and Tarrant Counties. It is relatively narrow in the headwater area, but several small tributary streams entering the Clear Fork give the lower portion a definite fan shape. The watershed is roughly 55 miles long, with a maximum width of about 11 miles, and contains a total area of 522 square miles, of which 429 square miles drain into Benbrook Lake.

The principal tributaries contributing to the Clear Fork upstream of Benbrook Dam are the South Fork, Bear Creek, Mustang Creek, Rocky Creek, East and West Dutch Branch Creeks, and Squaw Creek. The South Fork is formed by the joining of Town Creek and Willow Creeks. Squaw Creek is the only major left-bank tributary above the dam. The only major downstream tributary is Mary's Creek, which has a drainage area of about 55 square miles. Mary's Creek enters the Clear Fork from the left-bank approximately 4.5 miles below the dam.

The only sizable impoundment upstream of Benbrook Dam is Lake Weatherford, a water supply reservoir, not having any flood mitigation storage. The Soil Conservation Service (now Natural Resource Conservation Service (NRCS)) of the U.S. Department of Agriculture has constructed at least 35 retention structures in the Clear Fork Watershed. The 35 retention structures affect 81 square miles of the Benbrook Lake drainage area and do not possess enough storage capacity to have a significant effect on the operation of Benbrook Dam. The impoundments are responsible for trapping some sediment and controlling local erosion. During low to moderate flow periods, Lake Weatherford and other retention structures retain most of the runoff.

Benbrook Dam consists of a compacted earthfill embankment, an uncontrolled ogee weir spillway, and a gated outlet works. The total length of the dam is 9,130 feet. The outlet works consist of an approach channel, reinforced concrete intake and control structure, concrete conduit, service bridge, stilling basin, and a discharge channel. The intake tower is located in the lake upstream from the dam embankment station.

A total of 8,746 fee simple acres and approximately 3,200 flood flowage easement acres were acquired for the construction of Benbrook Lake. The real estate acquisition was based a normal conservation pool elevation of 694.0 feet NGVD29 and a flood pool elevation of 724.0 feet NGVD29. Flowage easements were obtained in the upper reaches of the lake up to a contour elevation of 741.0 feet NGVD29, 17 feet above the top of the flood pool. Lands not needed for project purposes or recreational development were offered for reconveyance to former owners. There is now a total of 4,375 acres of fee-owned land above 694.0 NGVD and approximately 3,200 acres of flowage easements.

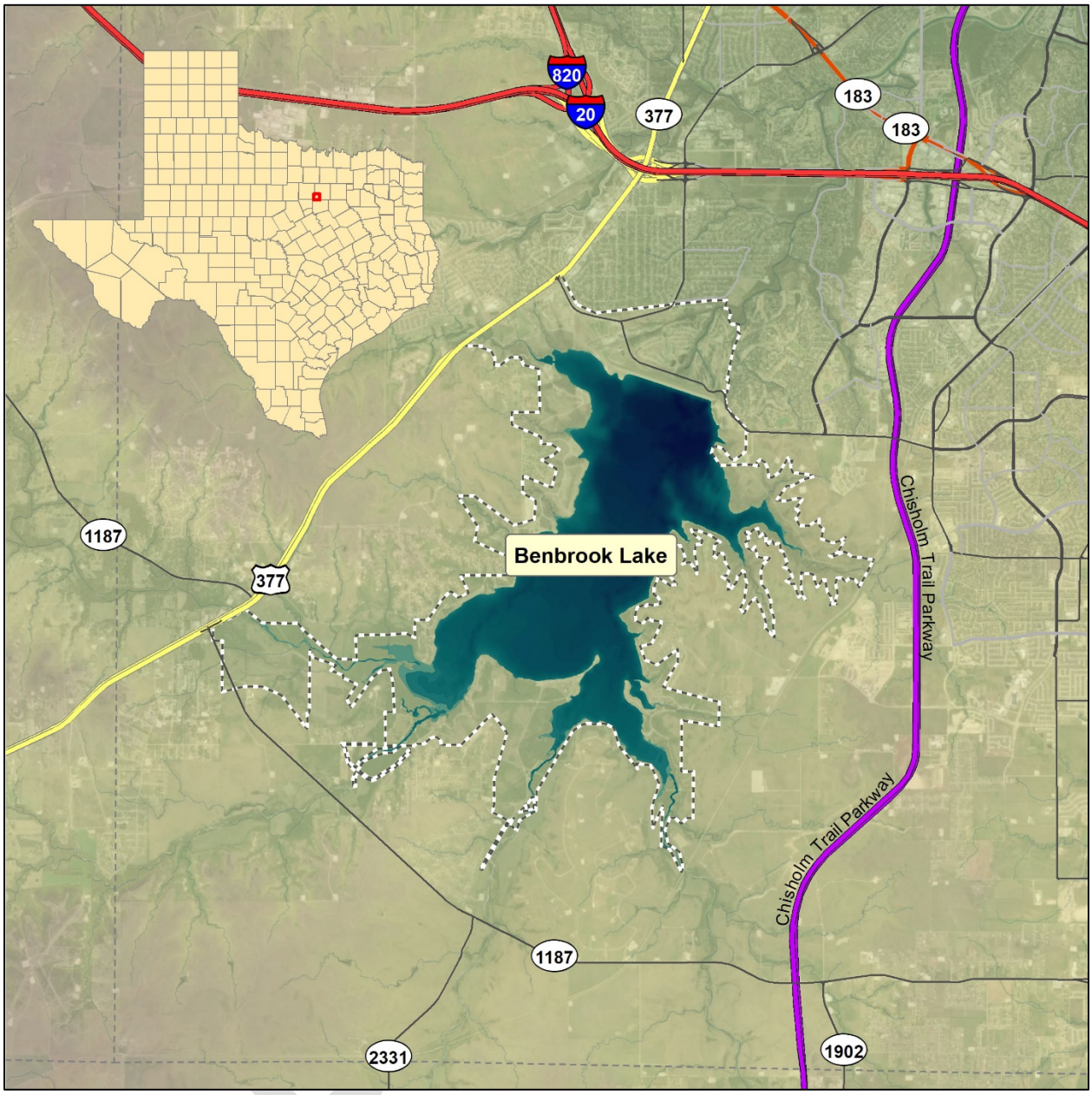
1.6. DESCRIPTION OF RESERVOIR

Benbrook Lake is small by comparison to many USACE lakes, with a conservation (normal) pool of 3,635 surface acres at elevation 694.0 feet NGVD29. The depth of the lake near the outlet works is approximately 60 feet, but depths decrease further south of the dam. The top of the flood pool is elevation 724.0 feet NGVD29 and the uncontrolled spillway crest is at elevation 724.0 feet NGVD29. The lake was originally designed to allow the accumulation of 15,750 acre-feet of sediment, but it was later revised to 14,000 acre-feet, based on 50-year duration. Sedimentation surveys would typically be conducted every twenty years. However, sedimentation surveys are currently done periodically depending on need and funding availability. Three sedimentation surveys have been completed at Benbrook Lake, the last of which was in 1998 by the Texas Water Development Board (TWDB) Hydrographic Survey Program.

1.7. PROJECT ACCESS

Benbrook Lake is easily accessed by several primary, secondary, and tertiary roads. The three main east-west access roads include Interstate Highway (IH) 20 located 2.5 miles north of the dam; Farm to Market Road (FM) 1187 that crosses Rocky Creek, Mustang Creek, and Bear Creek as well as flowage easement south of the lake; and just north of the dam is Lakeside Drive. The two main north-south access highways are U.S. Highway (US) 377, also known as Benbrook Boulevard, to the west of the lake and Chisolm Trail Parkway, a toll road east of the lake. Both highways connect to all three major east-west access roads. Refer to Figure 1.2 for a map of the major access roads around Benbrook Lake.

Figure 1.2 Major Access Roads around Benbrook Lake



The North Central Texas Council of Governments (NCTCOG) coordinates with cities, counties, and transportation partners to plan road, transit, bicycle, and pedestrian transportation improvements for 16 counties comprising the NCTCOG and serves as the Metropolitan Planning Organization for the Dallas-Fort Worth Area. NCTCOG's Mobility 2045 plan was used as a reference document for this Master Plan. Items recommended for implementation in the Mobility 2045 plan that are of significance to the area surrounding Benbrook Lake include the following:

- Widening Chisolm Trail Parkway toll road from 2 to 4 lanes by 2028
- Widening IH 20 from 6 to 8 lanes by 2028

- Reconstruct FM 1187 by 2045

The City of Benbrook's 2018 Capital Improvement Program, which is part of the Comprehensive Plan, proposes the following projects that will affect major roads and Benbrook Lake access:

- Improve pedestrian safety crossing along US 377 at Overcrest Drive (Dutch Branch Park Pedestrian/Bicycle Access)

- Dutch Branch Park Low Water Crossing and Drainage Improvements by 2024

National USACE policy set forth in ER 1130-2-550, Appendix H, states that USACE lands will, in most cases, only be made available for roads that are regional arterials or freeways (as defined in ER 1130-2-550). All other types of proposed roads, including driveways and alleys, are generally not permitted on USACE lands. The proposed expansion or widening of existing roadways on USACE lands will be considered on a case-by-case basis.

1.8. PRIOR DESIGN MEMORANDA

Design Memorandums were prepared from 1968 thru 1985 setting forth design criteria for all aspects of the project including the prime flood risk management facilities, real estate acquisition, road and utility relocations, reservoir clearing, and the master plan for recreation development and land management. A few supplements and project related reports and manuals were added after 1985. Table 1.1 lists the Design Memoranda as well as other manuals and reports for Benbrook Lake.

Table 1.1 Design Memoranda, Manuals, and Reports – Benbrook Lake

	Title	Date
1.	Definite Project Report	March 1946
2.	Clear Fork – Trinity River Basin Benbrook Dam and Reservoir Analysis of Design for Second Contract for Completion of Embankment and Construction of Appurtenant Structure	June 1947
3.	Benbrook Lake - Design Memorandum No. 1C – Master Plan (Draft) Benbrook Lake Master Plan Updated Benbrook Lake Master Plan Updated Benbrook Lake Master Plan Revised	May 1953 October 1961 February 1966 March 1972
4.	A Water Quality Survey of Benbrook Lake, Texas	August 1973
5.	Operation and Maintenance Manual, Benbrook Project	September 1974
6.	Benbrook Lake – Report on Water Quality Updated Report on Water Quality	December 1980 July 1997
7.	National Dam Safety Assurance Study Benbrook Lake Hydrology	December 1982
8.	Benbrook Lake – Operation and Maintenance Manual	November 1991

	Updated Operations and Maintenance Manual	April 1999
9.	Volumetric Survey of Benbrook Lake	March 1998
10.	Periodic Inspection Report #10	April 2016

Source: USACE

1.9. PERTINENT PROJECT INFORMATION

The following table provides pertinent information regarding key reservoir elevations and storage capacity at Benbrook Lake.

Table 1.2 Elevations and Water Storage Capacity

Feature	Elevation (Feet NGVD)	Lake Area (Acres)	Storage (Acre-Feet)	Runoff (inches)
Top of Dam	747.0	–	–	–
Maximum Design Water Surface Elevation (1982 Study)	741.0	11,387	410,013	18.48
Spillway Crest and Top of Flood Pool (2003 Study)	724.0	7,426	258,630	11.66
Weir Notch Crest (1946 Study)	710.0	5.024	164,776	7.43
Top of the Conservation Pool (2011 Survey)	694.0	3,635	85,648	3.98
Sediment Reserve	–	–	14,000	–
Streambed (1998 Survey)	617.0	–	0	–

Source: USACE 2018 Benbrook Lake Water Control Manual

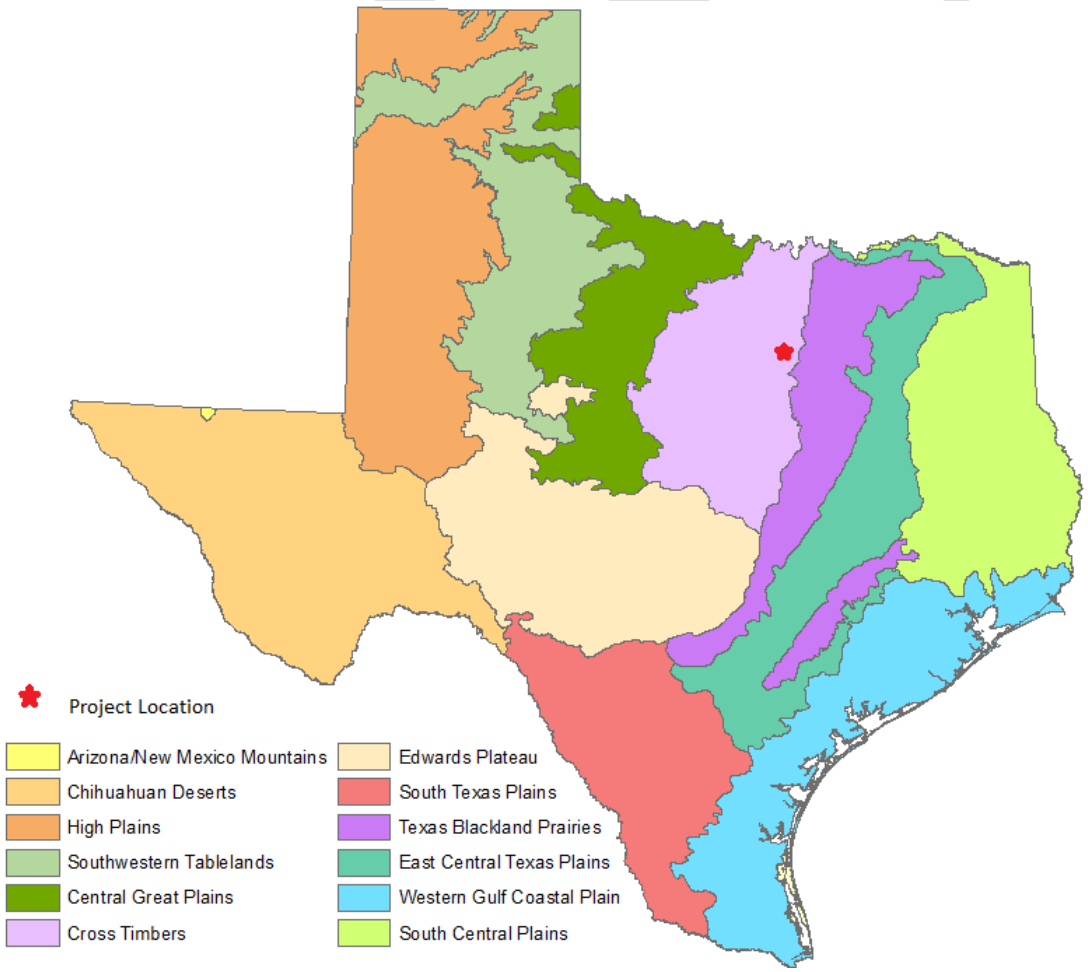
CHAPTER 2 – PROJECT SETTING AND FACTORS INFLUENCING MANAGEMENT AND DEVELOPMENT

2.1. PHYSIOGRAPHIC SETTING

2.1.1. Ecoregion Overview

Ecoregions denote areas of general similarity in ecosystems and in the type, quality, and quantity of environmental resources. The Environmental Protection Agency (EPA) has developed a series of maps that categorizes these regions across the United States. Levels I and II divide the North American continent into 15 and 52 regions, respectively, while Level III ecoregions represent a subdivision of those into 104 unique regions and Level IV a finer sub-classification of those. Benbrook Lake and its watershed is located in the Level III Cross Timbers ecoregion as seen in Figure 2.1, and specifically in the Grand Prairie and Western Cross Timbers Level IV subdivision of the Cross Timbers ecoregion.

Figure 2.1 Benbrook Lake within Texas and Level III Ecoregions



Source: TPWD (2019)

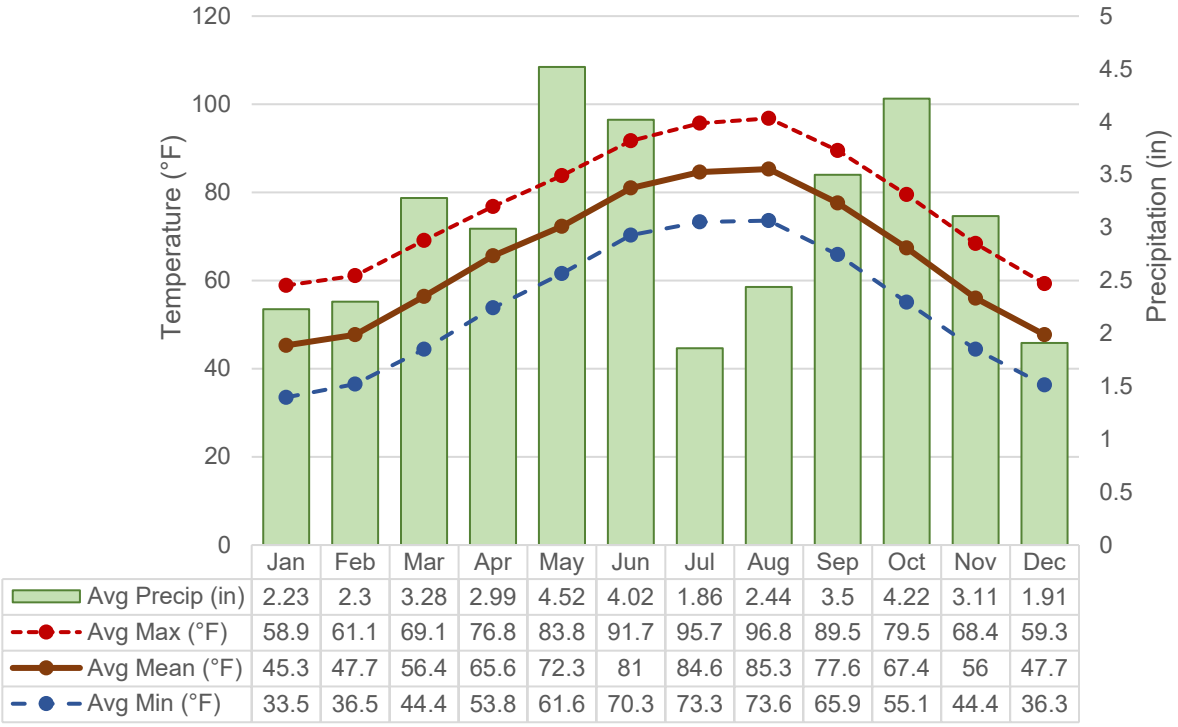
The Cross Timbers ecoregion is characterized by a diverse mix of soils including those with a surface humus layer; both alkaline and acidic soils, although more often alkaline; fine-textured, clayey soils; and both limestone and sandstone rock formations. Benbrook Lake is in a transitional zone between the moister climate of east Texas and the drier climate of the Great Plains. The Cross Timbers ecoregion stretches nearly 600 miles from southern Kansas in the north, across Oklahoma, and into Central Texas and covers 9,829 square miles. Prairie vegetation includes various grasses and forbs; bottomland forests are predominantly oak, pecan, and other hardwood trees, while transitional savannah are often a mix of prairie, forest, and shrubland. Elevation within the ecoregion ranges from 1,845 feet NGVD29 to 450 feet NGVD29, while the Clear Fork sub-watershed ranges from approximately 1,300 feet NGVD29 near its source to 505 feet NGVD29 at its confluence with the West Fork, with Benbrook Lake conservation pool at 694.0 feet NGVD29.

Before Anglo settlement, the region was habitat for bison (*Bison bison*), pronghorn antelope (*Antilocapra americana*), mountain lion (*Puma concolor*), bobcat (*Lynx rufus*), ocelot (*Leopardus pardalis*), black bear (*Ursus americanus*), collared peccary (*Pecari tajacu*), white tailed deer (*Odocoileus virginianus*), red wolf (*Canis lupus rufus*), coyote (*Canis latrans*), red fox (*Vulpes vulpes*), gray fox (*Urocyon cinereoargenteus*), badger (*Taxidea taxus*), river otter (*Lontra canadensis*), and many species of birds. Much of the original prairie and forest has been converted to cropland and pasture or cleared for urbanization, leading to a loss of habitat for native species.

2.1.2. Climate

Benbrook Lake lies in the north central part of the state of Texas. The region has a warm, temperate, continental climate with cool winters and hot, humid summers. Tropical maritime air masses from the Gulf of Mexico play a dominant role in the climate from late spring through early fall, while polar air masses determine the winter climate. The mean annual temperature over the lake is about 68.7 degrees Fahrenheit (°F) (NOAA, 2020B). January, the coldest month, has an average temperature of 45.3°F and average minimum daily temperature of about 33.5°F. August, the warmest month, has an average daily temperature of 85.3°F and average maximum daily temperature of 96.8°F. The average length of the growing season is 251 days (NOAA 2020A). Benbrook Lake lies within the USDA Plant Hardiness Zone 8A, which is determined by the winter extreme low temperatures, with 8A having normal winter lows between 10°F and 15°F. Average monthly temperature and precipitation is provided in Figure 2.2.

Figure 2.2 Average Monthly Climate Benbrook Lake, 2000 – 2019



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Avg Precip (in)	2.23	2.3	3.28	2.99	4.52	4.02	1.86	2.44	3.5	4.22	3.11	1.91
Avg Max (°F)	58.9	61.1	69.1	76.8	83.8	91.7	95.7	96.8	89.5	79.5	68.4	59.3
Avg Mean (°F)	45.3	47.7	56.4	65.6	72.3	81	84.6	85.3	77.6	67.4	56	47.7
Avg Min (°F)	33.5	36.5	44.4	53.8	61.6	70.3	73.3	73.6	65.9	55.1	44.4	36.3

Source: NOAA, 2020B.

The normal annual precipitation is 37.4 inches with greater precipitation during spring and fall, and less precipitation during summer and winter. Because of the preponderance of tropical maritime air, heavy showers of short duration may occur at any time during the year (NOAA/Weather.gov).

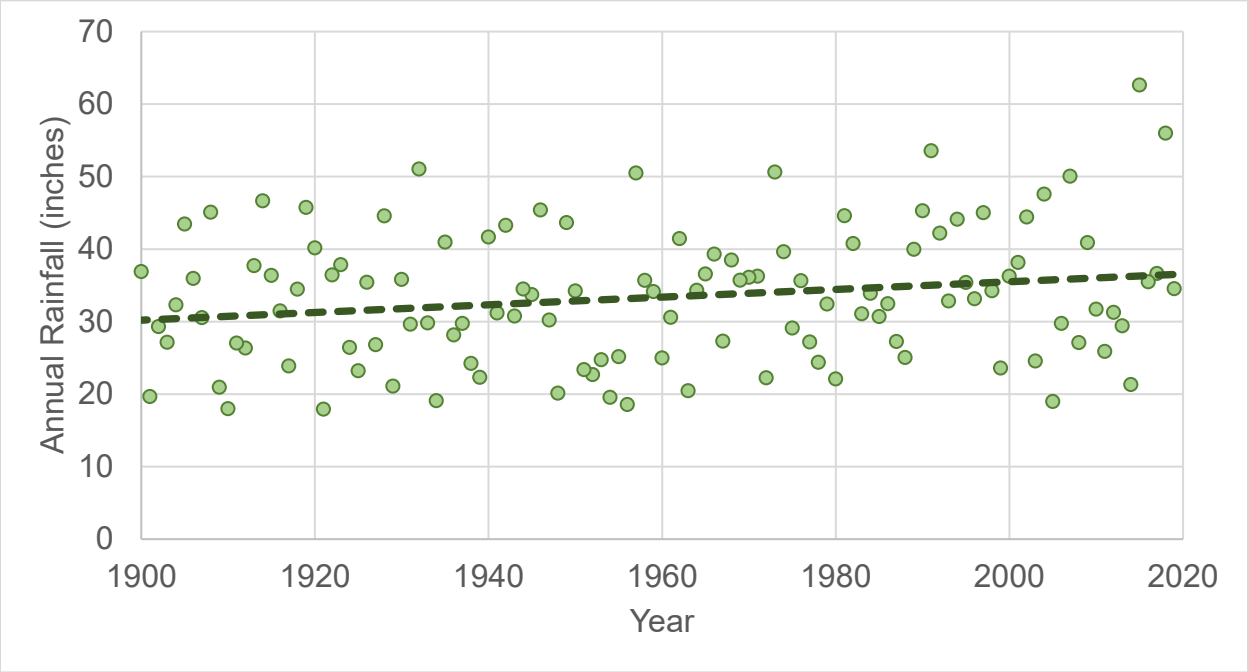
The relative humidity typically ranges from 0% to 76% over the course of a year. The air is driest around the end of November-February timeframe and is most humid between June-July (USACE, 2018). The average annual evaporation rate at Benbrook Lake, as calculated using the measured pan evaporation multiplied by the monthly pan coefficient, is about 57 inches with the lowest evaporations rates occurring during the winter and greatest evaporation occurring during the summer (USACE, 2018).

2.1.3. Climate Change and Greenhouse Gasses (GHG)

The U.S. Global Change Research Program (USGCRP) researched potential impacts of climate change globally, nationally, regionally, and by resource (e.g., water resources, ecosystems, human health). Benbrook Lake lies within the Southern Great Plains region of analysis. Growing population in the region has already increased the demand for water and energy, while evidence of climate change in the form of rising temperatures has led to increasing demand for water and energy and has impacted local agricultural practices. Over the last few decades, the Southern Great Plains region and specifically the DFW Metropolitan Area has seen fewer cold days (below 32°F), more hot days (over 100°F), as well as an overall increase in total annual precipitation, as seen in Figures 2.3, 2.4, and 2.5. The decrease in the cold days has resulted in an

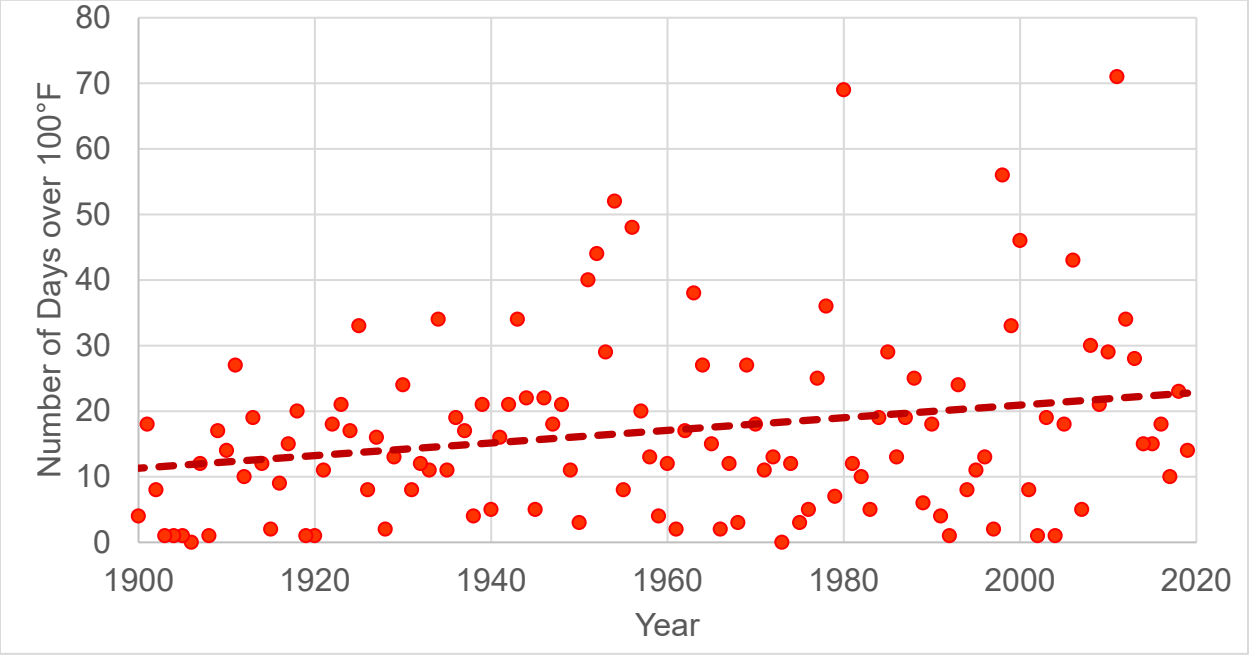
overall lengthening of the frost-free season by one to two weeks, depending on local microclimates.

Figure 2.3 Annual Rainfall in the DFW Metro Area 1900 – 2019



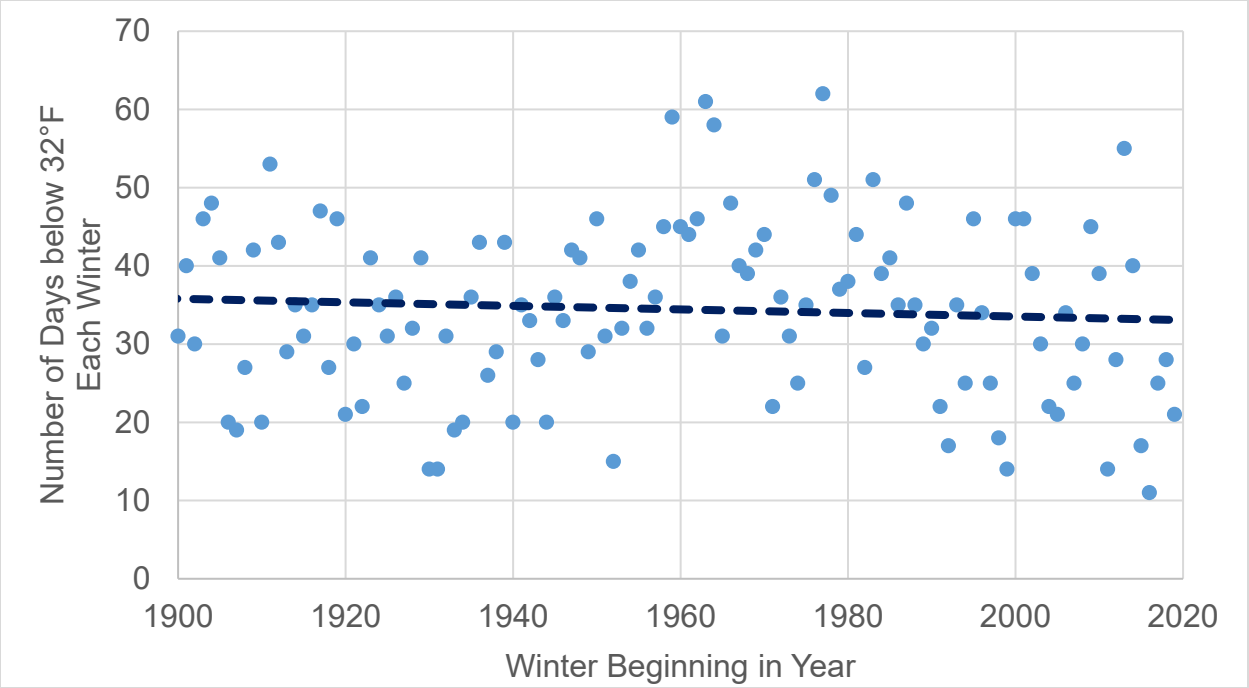
Source: NOAA, 2020B.

Figure 2.4 Number of Days over 100°F in the DFW Metro Area 1900 – 2019



Source: NOAA, 2020B.

Figure 2.5 Number of Days below 32°F in the DFW Metro Area 1900 – 2019



Source: NOAA, 2020B.

Within the entire Southern Great Plains Region, there has been an increase in average temperatures by 1.5°F from a 1960–1970 baseline to the year 2000 (USGCRP 2014). The increased heat wave severity and frequency in the U.S. has been connected to human activity, with a detectable human influence in recent heat waves in the Southern Great Plains (USGCRP, 2014). In 2011, the State of Texas experienced a heat wave and drought that lasted through the winter of 2014 and ended with record breaking floods in 2015. The growing season and summer of 2011 was the hottest and among the driest on record. Frequent extreme heat events throughout Texas have increased substantially over the past 20 years.

This trend of rising temperatures and more frequent extreme events such as heat waves, drought, and heavy rainfall is predicted to continue (USGCRP 2014). The USGCRP projected two potential future conditions as part of its predictive modeling process. Under conditions of lower greenhouse gas (GHG) emissions, the average temperature in the Southern Great Plains region may increase as much as 6°F by 2050 and 8°F by 2090 from averages observed in 2000. Under conditions of higher continuous GHG emissions, the potential increase is greater in the long-term, and may be as much as 13.5°F by 2090.

2.1.4. Air Quality

The U.S. Environmental Protection Agency (EPA) established nationwide air quality standards to protect public health and welfare in 1971. The State of Texas has adopted the National Ambient Air Quality Standards (NAAQS) as the state's air quality criteria. NAAQS standards specify maximum permissible short- and long-term concentrations of various air contaminants including primary and secondary standards

for six criteria pollutants: Ozone (O_3), Carbon Monoxide (CO), Sulfur Dioxide (SO_2), Nitrogen Oxide (NO_x), particulate matter (PM10 and PM2.5), and Lead (Pb). If the concentrations of one or more criteria pollutants in a geographic area is found to exceed the regulated "threshold" level for one or more of the NAAQS, the area may be classified as a non-attainment area. Areas with concentrations that are below the established NAAQS levels are considered either attainment or unclassifiable areas.

Benbrook Lake is located within the Metropolitan Dallas-Fort Worth Air Quality Control Region (AQCR). The DFW AQCR is in attainment for all criteria air pollutants, except for O_3 (TCEQ, 2015). The DFW non-attainment area includes 9 counties (Collin, Dallas, Denton, Ellis, Johnson, Kaufman, Parker, Tarrant, and Wise counties). Current attainment status is classified as marginal under the 2015 eight-hour ozone NAAQS. The attainment deadline for the DFW marginal non-attainment area is August 3, 2021.

Emissions in the DFW non-attainment area come from a variety of stationary and mobile sources. Approximately 70% of the region's air pollution comes from mobile sources such as cars, trucks, airplanes, construction equipment, and lawn equipment. The majority of pollutants emitted from motor vehicles include volatile organic compounds (VOC), NO_x, CO, PM10, and PM2.5. The largest regional sources of VOC and NO_x emissions, those that contribute most to ozone levels, are non-road vehicles (construction equipment, airplanes, and locomotive) and on-road vehicles (cars and trucks) (TCEQ 2011).

2.1.5. Topography, Geology, and Soils

Topography

Benbrook Lake and its watershed are located in the Gulf Coastal Plain physiographic province. The area is generally characterized by mature and well-developed dendritic drainage system. The topography near the dam is rolling hills and becomes more rugged near the headwaters. Local relief along the major stream valleys ranges from a minimum of 50 feet in the lower reaches to about 200 feet near the headwaters. The stream channel in the lower reaches varies from 70 to 200 feet in width, and averages about 100 feet wide. The banks are 11 to 23 feet high, with an average height of 17 feet. Most of the stream channel near the dam consists of limestone bedrock. Stream channels in the upper reaches average 50 feet wide with banks about 8 feet high. The streambeds in the upper reaches are characterized by alternate bars of coarse sand and gravel and ponded pools.

Geology

The Clear Fork of the Trinity River is located in the north central section of the Great Plains province generally designated as the Grand Prairie region. Benbrook Lake is situated in one of the subdivisions of the Grand Prairie, the Fort Worth Prairie, which is underlain by alternating limestone and shale strata. The area is underlain, from oldest to youngest, by strata of the Paluxy, Walnut, Goodland, Kiamichi, and Duck Creek formations of Lower Cretaceous age. The Lower Cretaceous rocks in the lake strike

northeast to southwest and dip southeasterly at a rate of approximately 17 feet per mile steeping to about 35 feet per mile in the vicinity of the dam. The strike of the beds is northeast to southeast. Major structural features such as faulting and folding are not evident in the lake area. Many Cretaceous age marine fossils are found among limestone deposits at Benbrook Lake.

Soils

The main soil series within Benbrook Lake Project Lands is the Bolar-Aledo complex, 3 to 20 percent slopes. It makes up 17.9 percent of soils found within Benbrook Lake project lands, and it is not a prime farmland soil. The complex is made of two different kinds of soils but because of their small overall size were grouped together for readability on the soil map (Table 2.1). The Bolar portion of the complex is well drained, occurs in 20 to 40-inch-thick surface layers, normally found on structural benches on ridges, contains loamy alluvium derived from limestone, and makes up 45 percent of the complex. The Aledo portion is well drained, occurs in 9 to 20-inch-thick surface layers, normally found on ridges, contains loamy alluvium derived from limestone, and makes up 40 percent of the complex.

The Western Cross Timbers and Grand Prairie are the two major soil groups found in the watershed. The Western Cross Timbers group covers the upper quarter of the watershed. This group is composed of sandy soils underlain by clay subsoils, both of which are highly erodible. The Grand Prairie group is characterized by shallow clay soils with native grass cover. The overburden alluvial soils of the floodplain above Benbrook Dam consist mainly of sandy and silty clay. Total 8 to 10 feet thick sand deposits and overlay the foundation rocks near the dam.

The NRCS Web Soil Survey (2018) reports 29 soil types occurring within Benbrook Lake project lands. Table 2.1 shows the acreage and farmland status associated with each soil & surface type in the detention area.

Table 2.1 Acres of Surface Soil Types within Benbrook Lake Project Lands

Map Unit Symbol	Soil Type	Number of Acres	Farmland Status
1	Aledo gravelly clay loam, 1 to 8 percent slopes	351.3	None
2	Bolar-Aledo complex, 3 to 20 percent slopes	726.5	None
3	Aledo-Bolar-Urban land complex, 3 to 20 percent slopes	29.7	None
4	Aledo-Urban land complex, 1 to 8 percent slopes	38.2	None
7	Arents, frequently flooded	132.7	None
9	Bastsil fine sandy loam, 0 to 3 percent slopes	8.3	Prime
14	Bolar clay loam, 1 to 3 percent slopes	23.6	Statewide

Map Unit Symbol	Soil Type	Number of Acres	Farmland Status
15	Bolar clay loam, 3 to 5 percent slopes	55.0	Statewide
16	Bolar-Urban land complex, 1 to 5 percent slopes	4.5	None
17	Brackett clay loam, 3 to 8 percent slopes	20.2	None
20	Chatt silty clay, 1 to 3 percent slopes	25.1	Prime
26	Frio silty clay, 0 to 1 percent slopes, occasionally flooded	410.0	Prime
27	Frio silty clay, frequently flooded	548.0	None
40	Lindale-Urban land complex, 1 to 3 percent slopes	0.8	None
43	Luckenbach clay loam, moist, 1 to 3 percent slopes	366.6	Prime
44	Luckenbach-Urban land complex, 1 to 3 percent slopes	10.4	None
46	Maloterre, Aledo, and Brackett soils, 3 to 20 percent sl opes	228.2	None
56	Pits, quarries, 0 to 45 percent slopes	45.7	None
61	Purves clay, 1 to 3 percent slopes	50.1	None
62	Purves-Urban land complex, 0 to 5 percent slopes	5.5	None
65	Sanger clay, 1 to 3 percent slopes	331.2	Prime
66	Sanger clay, 3 to 5 percent slopes	205.9	Prime
67	Sanger-Urban land complex, 1 to 5 percent slopes	39.9	None
70	Silawa fine sandy loam, 3 to 8 percent slopes	7.2	None
74	Slidell clay, 1 to 3 percent slopes	243.2	Prime
77	Sunev clay loam, cool, 1 to 3 percent slopes	53.9	Statewide
78	Sunev clay loam, 3 to 8 percent slopes	378.7	None
80	Trinity clay, 0 to 1 percent slopes, frequently flooded	47.7	None
84	Wilson clay loam, 0 to 2 percent slopes	12.0	Statewide
Total		**4,440.1**	

Source: USGS.gov

A soil survey by the Natural Resource Conservation Service (NRCS) shows there are eight possible general classifications (Classes I through Class VIII) occurring in the reservoir area. The erosion hazards and limitations for use increase as the class number increases. Class I has few limitations, whereas Class VIII has many. The soil class data for project lands is provided in Table 2.2 This data is compiled by the NRCS and is a

standard component of natural resources inventories on USACE lands. This, and other inventory data, is recorded in the USACE Natural Resource Management System (NRMS).

Table 2.2 Soil Classes

Soil Class	Acreage
Class I	0
Class II	700
Class III	600
Class IV	700
Class V	1,700
Class VI	750
Class VII	0
Class VIII	8

Source: NRM Assessment Tool – ES Module

A general description of the soils and the land capability classes are described below:

- *Class I* soils have slight limitations that restrict their use.
- *Class II* soils have moderate limitations that reduce the choice of plants or require moderate conservation practices.
- *Class III* soils have severe limitations that reduce the choice of plants or require special conservation practices, or both.
- *Class IV* soils have very severe limitations that restrict the choice of plants or require very careful management, or both.
- *Class V* soils have little or no hazard of erosion but have other limitations, impractical to remove, that limit their use mainly to pasture, range, forestland, or wildlife food and cover.
- *Class VI* soils have severe limitations that make them generally unsuited to cultivation and that limit their use mainly to pasture, range, forestland, or wildlife food and cover.
- *Class VII* soils have very severe limitations that make them unsuited to cultivation and that restrict their use mainly to grazing, forestland, or wildlife.
- *Class VIII* soils and miscellaneous areas have limitations that preclude their use for commercial plant production and limit their use to recreation, wildlife, or water supply or for aesthetic purposes.

Prime Farmland

As required by Section 1541(b) of the Farmland Protection Policy Act (FPPA) of 1980 and 1995, 7 U.S.C. 4202(b), federal and state agencies, as well as projects funded with federal funds, are required to (a) use the criteria to identify and take into account the adverse effects of their programs on the preservation of farmland, (b) consider alternative actions, as appropriate, that could lessen adverse effects, and (c) ensure that their programs, to the extent practicable, are compatible with state and units of local government and private programs and policies to protect farmland.

There are several soil types in the study area that are considered prime farmland soils or soils associated with farmlands of state importance. However, the lands represented by these soil types have not been used for farming since the lands were acquired prior to the initiation of construction of Benbrook Reservoir in May 1947.

2.1.6. Water Resources

Surface Water

The Clear Fork of the Trinity River originates in the extreme northwestern corner of Parker County in north central Texas and is approximately 65 miles long. It flows in a generally southeasterly direction through Parker County and thence northeasterly to its junction with the West Fork of the Trinity River at Fort Worth, Texas. The Lower Clear Fork watershed lies between north latitudes 32°30′ and 33°00′ and west longitudes 97°20′ and 97°55′. The watershed comprises parts of Johnson, Parker, Hood, and Tarrant Counties. The watershed area upstream of Benbrook Dam is approximately 55 miles long and eleven miles wide. The watershed is relatively narrow in the headwater area but several small tributary streams entering the Clear Fork give the lower portion a definite fan shape. The watershed of the Clear Fork of the Trinity River has total drainage area of 522 square miles of which 429 square miles (or 82 percent of the entire Clear Fork drainage area) is controlled by Benbrook Dam.

Benbrook Dam is located on the Clear Fork of the Trinity River at river mile 15.0. The Clear Fork begins at an elevation of about 1,300 feet at its source near Poolville, Texas. It drops from 617.0 feet at the Benbrook Dam site to 505.0 feet at its confluence with the West Fork. The streambed has a total fall of about 745 feet with an average slope of 11.5 feet per mile.

The principal tributaries contributing to the Clear Fork upstream of Benbrook Dam are the South Fork, Bear Creek, Mustang Creek, Rocky Creek and Squaw Creek. The South Fork is formed by the joining of Town Creek and Willow Creeks. Squaw Creek is the only major left-bank tributary above the dam. The only major downstream tributary is Mary's Creek, which has a drainage area of about 55 square miles. Mary's Creek enters the Clear Fork from the left-bank approximately 4.5 miles below the dam.

Municipal Water Supply

A water supply storage contract with the city of Fort Worth was approved 12 August 1969 for 10.0 percent (7,250 acre feet (ac-ft)) of the storage between elevations 694.0 and 665.0 feet NGVD29. Water supply storage contracts with the Benbrook Water and Sewer Authority (BWSA) were approved on 14 February 1972 and 16 August 1979 for interim use of 22.7 percent (16,458 ac-ft) of the storage between the same elevations. A water supply contract with Tarrant County Water Control and Improvement District No. 1 (now TRWD) was approved for interim use of 48,792 ac-ft below elevation 694.0 feet NGVD29. Since navigation storage was deauthorized, a new water supply contract is being completed with TRWD.

In addition to storage, TRWD constructed a system of pumps and pipelines connecting Benbrook Lake to the Rolling Hills Treatment Plant in south Fort Worth. Rolling Hills Treatment Plant receives water pumped from Cedar Creek Reservoir and Richland-Chambers Reservoir. The 90-inch pipeline between Benbrook Lake and the Rolling Hills Treatment Plant allows water to be delivered to or withdrawn from Benbrook Lake, increasing the annual yield. TRWD constructed a pump station in 1999 near the outlet works. Water can be pumped out of Benbrook Lake at a maximum rate of 200 million gallons per day (MGD) when using all four 1,500 horsepower pumps. The water that flows into Benbrook Lake from the Rolling Hills Treatment Plant is gravity fed. The maximum inflow into Benbrook Lake is 100 MGD. The pumping and drawdown of water has affected recreation at Benbrook Lake, which is discussed as a special topic in Chapter 6.

Wetlands

Waters of the United States are defined within the Clean Water Act (CWA), and jurisdiction is addressed by the USACE and EPA. Wetlands are a subset of the waters of the United States that may be subject to regulation under Section 404 of the CWA (40 CFR 230.3). Wetlands are those areas inundated or saturated by surface or groundwater at a frequency and duration sufficient to support a prevalence of vegetation typically adapted for life in saturated soil conditions, and under normal circumstances these wetlands do support this vegetation type.

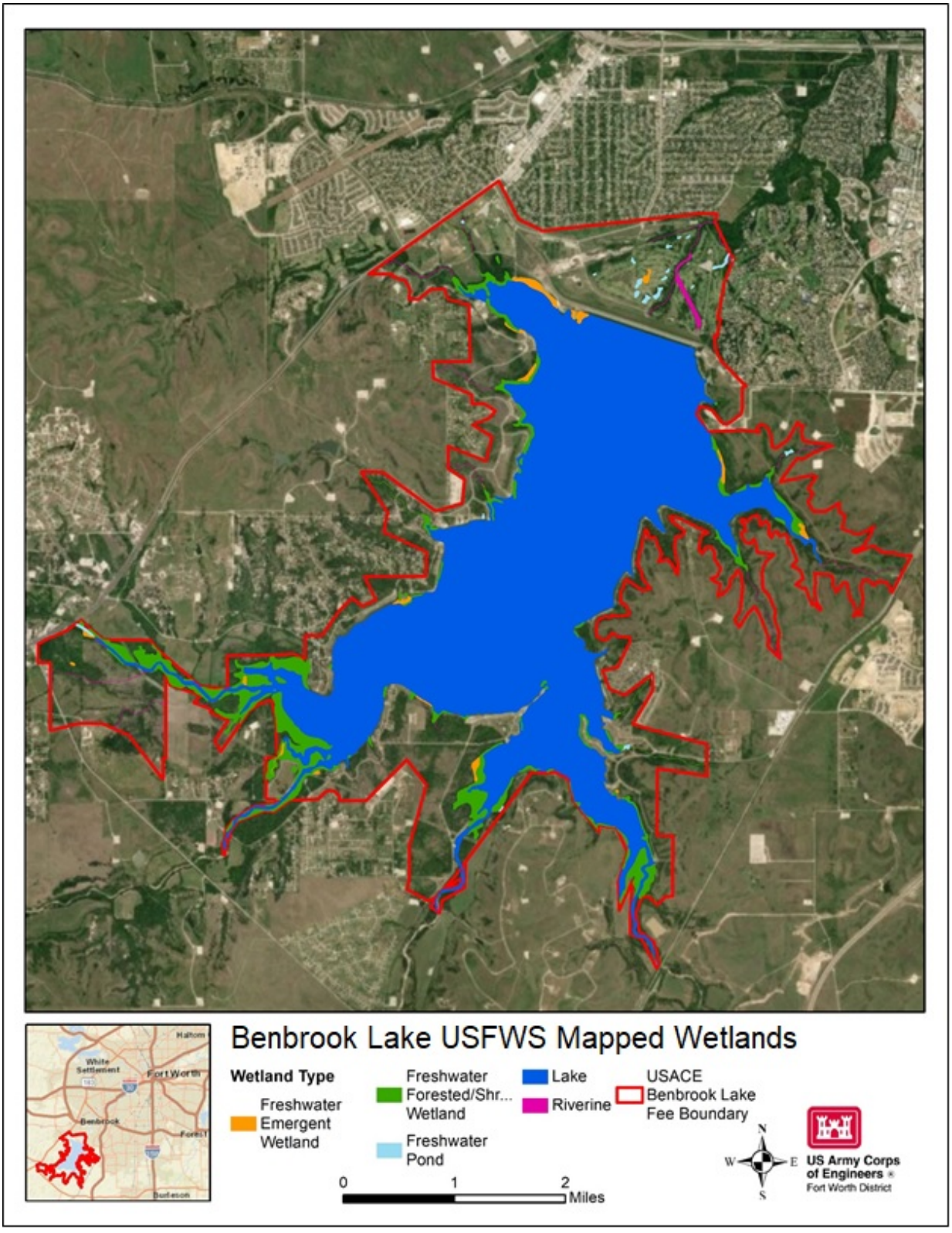
Wetland classifications presented are derived from the National Wetlands Inventory, which was established by U.S. Fish and Wildlife Service (USFWS) to aid in conservation efforts by collecting nationwide wetland distribution and type information (USFWS 2019). Within the Benbrook Lake project lands, wetlands generally occur near the rivers and flatter areas in the southern end of the lake. Table 2.3 lists the acreages of various types of wetlands present at Benbrook Lake from the USFWS and is mapped in Figure 2.6.

Table 2.3 Total Acres of Wetland and Open Water at Benbrook Lake

Wetland Type	Acres
Freshwater Emergent Wetland	41
Freshwater Forested/Shrub Wetland	532
Freshwater Pond	22
Lake	3,638
Riverine	12
TOTAL ACRES of Water Resources	**4,245**

Source: USFWS 2019.

Figure 2.6 Wetland Types Found at Benbrook Lake



Groundwater

Deep below Benbrook Lake lies the Trinity aquifers. The Trinity Aquifer extends across much of the central and northeastern portion of Texas. This major aquifer is composed of several smaller aquifers contained within the Trinity Group including: Antlers, Glen Rose, Paluxy, Twin Mountains, Travis Peak, Hensell, and Hosston.

The Trinity Aquifer is one of the most extensive and highly used groundwater resources in Texas. Although its primary use is for municipalities, it is also used for irrigation, livestock, and other domestic purposes. Some of the state's largest water level declines, ranging from 350 to more than 1,000 feet, have occurred in counties along the Interstate 35 corridor from McLennan County to Grayson County. These declines are primarily attributed to municipal pumping, but they have slowed over the past decade as a result of increasing reliance on surface water.

In general, groundwater quality in the Trinity Aquifer is fresh but very hard in the outcrop. Total dissolved solids (TDS) increase from less than 1,000 milligrams per liter in the east and southeast to between 1,000 and 5,000 milligrams per liter, or slightly to moderately saline, as the depth of the aquifer increases. Sulfate and chloride concentrations also tend to increase with depth.

Most of the recreation areas on Benbrook Lake continue to rely on treated groundwater from wells located in the parks.

Hydrology

The Lower Clear Fork watershed is subject to three general types of flood-producing rainfall events: thunderstorms, frontal rainfall, and tropical cyclones. The topography, soils, and typical rainfall patterns of the watershed lead to rapid and sharp crested flood hydrographs. Floods occur frequently and can occur at any time of year. Generally, the highest 24-hour and monthly precipitation periods have occurred during major thunderstorm events. However, there are some instances where heavy precipitation results from localized thunderstorms or rain events.

Benbrook Dam and Lake are an integral part of the USACE plan for flood risk management and water conservation in the Trinity River Basin. The plan presently consists of eight major USACE flood mitigation projects – Benbrook Dam, Bardwell Dam, Grapevine Dam, Joe Pool Dam, Lavon Dam, Lewisville Dam, Navarro Mills Dam, and Ray Roberts Dam. The eight USACE dam projects in the Trinity River system work in concert to control approximately 1,591,300 acre-feet (ac-ft) of flood mitigation area. Specifically, Benbrook Lake has a conservation pool capable of storing 3,635 surface acres at elevation 694.0 feet NGVD29. Once the water elevation reaches 724.0 feet NGVD29 and fills an additional 3,860 surface acres of storage space, water overtops the spillway and is uncontrollably released downstream. The pool of record occurred on May 3, 1990 with an elevation of 717.5 feet NGVD29.

Water Quality

Texas Commission on Environmental Quality (TCEQ) sets and implements standards for surface water quality to improve and maintain the quality of water in the state, based on various beneficial use categories for the water body. The Texas Integrated Report of Surface Water Quality, which is a requirement of the Federal Clean Water Act Sections 305(b) and 303(d), evaluates the quality of surface waters in Texas and identifies those that do not meet uses and criteria defined in the Texas Surface Water Quality Standards (TSWQS). The Texas Integrated Report describes the status of Texas' natural waters based on historical data and assigns waterways to various categories depending on the extent to which they attain the TSWQS.

Existing water quality within Benbrook Lake is affected by rainfall and associated stormwater flows originating from residential, commercial, and industrial point and nonpoint sources from properties upstream of the dam and reservoir. These stormwater flows have increased over time as a result of increased urbanization and development.

The 2020 Texas Integrated Report - Texas 303(d) List (TCEQ, 2020) does not identify any segment within Benbrook Lake as exceeding TSWQS. However, below Benbrook Dam and within USACE fee own boundary the Clear Fork of the Trinity River is impaired for PCB and Dioxin in edible fish tissue (TCEQ, 2020).

The Texas Department of State Health Services (DSHS) Seafood and Aquatic Life Group purpose is to address and prevent/reduce any disease-causing agent from occurring that can be transferred from aquatic life to humans within the State of Texas. As of October 2020, no fish consumption advisories have been issued for Benbrook Lake. However, DSHS does support TCEQ finding of the Clear Fork of the Trinity River within the Benbrook Lake Federal fee boundary below the dam as being impaired with PCB and Dioxin in edible tissue (DSHS, 2020). DSHS further advises that children under 12 and adult women avoid eating all fish within that body of water.

2.1.7. Hazardous Materials and Solid Waste

There are no hazardous or solid waste advisories for Benbrook Lake or the Clear Fork of the Trinity River above Benbrook Dam. However, DSHS has issued chemical contaminant advisories for the West Fork of the Trinity River and recommends that persons should not consume any species of fish below Benbrook Dam, due to the possibility of contaminated fish navigating up the Clear Fork to the dam. The most recent DSHS seafood advisories affecting the Trinity River are Advisory 25 from 2015 and Advisory 43 from 2010. The chemical contaminants of concern are Polychlorinated Biphenyls (PCBs) and polychlorinated dibenzofurans and polychlorinated dibenzopdioxins (PCDFs/PCDDs or "dioxins"). Generally, fish caught above the dam and within Benbrook Lake are considered safe to consume.

2.1.8. Health and Safety

Benbrook Lake's authorized purposes include flood risk management, water conservation, fish and wildlife, and recreation. Compatible uses incorporated in project operation management plans include conservation and fish and wildlife habitat management components. The USACE, with some assistance from the TPWD and USFWS, has established public outreach programs to educate the public on water safety and conservation of natural resources. In addition to the water safety outreach programs, the project has established recreation management practices to protect the public. These include safe boating and swimming regulations, and speed limit and pedestrian signs for park roads. Benbrook Lake also has solid waste management plans in place for camping and day use areas that are maintained by the respective partners that hold the lease.

2.2. ECOREGION AND NATURAL RESOURCE ANALYSIS

2.2.1. Natural Resources

Operational civil works projects administered by USACE are required, with few exceptions, to prepare an inventory of natural resources. The basic inventory required is referred to within USACE regulations (ER and EP 1130-2-540) as a Level One Inventory. This inventory includes the following: vegetation in accordance with the National Vegetation Classification System through the sub-class level; assessment of the potential presence of special status species including but not limited to Federal and state listed endangered and threatened species, migratory species, and birds of conservation concern listed by the USFWS; land (soils) capability classes in accordance with NRCS soil surveys; and wetlands, which are previously discussed in Section 3.2. In addition to the data from the Level One Inventories, two different studies were conducted – a Wildlife Habitat Appraisal Procedure (WHAP) and a prairie assessment.

TPWD's Wildlife Habitat Appraisal Procedure (WHAP) was used to assist in the preparation of the 2021 MP. The assessment was conducted on 8–11 April 2019 at Benbrook Lake by an interagency team of TPWD and USACE biologists, foresters, and park rangers. A total of 118 data collection sites were selected haphazardly and using aerial photography and knowledge of the Benbrook Lake staff. The purpose of the survey was to quickly assess wildlife habitat quality within the USACE Benbrook Lake fee-owned property. The four major habitat types that were selected and assessed were marsh, riparian/bottomland hardwood forests (BHF), upland forests, and grasslands. The highest score a site can receive is 1.00 while the lowest is 0.03, while a score of 0 represents a site skipped and not incorporated into the report calculations. The scores are not species dependent but rather diversity dependent. The data gather from this survey helped to quantifiably describe the general habitat characteristics and identify unique/high quality areas found with USACE Benbrook Fee Boundary. Which then helped with revising the land classification based on what areas needed the most protection. The WHAP assessment report can be found in Appendix C of this Plan.

The WHAP assessment revealed that the two most abundant habitat types surveyed were grassland and riparian/bottomland hardwood forest. However, the two habitat types that scored the highest on average were grassland and upland forest habitats. Overall, 60% of surveyed grassland points scored medium to high values. Two areas were identified as having a concentration of high scoring habitats, one along the East Dutch Branch Creek and the other along North Holiday Park Day Use Area. It was also determined that the areas within Pecan Valley Park have the greatest potential for improvement.

To better describe prairie quality within the USACE Benbrook Lake fee-owned property, a separate prairie assessment study was conducted by USACE from 7–11 October 2019. The method used in this study was a modification of the United States Department of Agriculture (USDA) Line-point intercept alternative (LIA) (Herrick et al. 2005) resulting in a diversity index score ranging from 0.03 (low quality with lack of diversity) to 1.0 (high quality and very diverse), while a score of 0 represents sites that were skipped and not incorporated into the report calculations. The data gather from this survey helped to quantifiably describe the general habitat characteristics and identify unique/high quality areas found with USACE Benbrook Fee Boundary. Which then helped with revising the land classification based on what areas needed the most protection. Prairie survey point locations were selected based on data obtained in a previous wildlife survey and in consultation with representatives from the Natural Resources Conservation Service (NRCS) that best represent the prairies that may be in the greatest conservation need.

The points chosen for the prairie assessment were the prairie sites with the highest WHAP scores. The scoring index is diversity-based and creates an index species list by compiling the common species found at most of the sites, and each site was scored based upon how many of those index species they contained. The prairie assessment scores showed a range of diversity across many of the prairie sites, with some being much more diverse than others, but no correlation between the similarity index and other recorded data was discovered.

The sites in the prairie assessment had an average score of 0.83, with leaf litter the prominent cover for the base layer. The prairies at Benbrook Lake typically have at least three to four layers of vegetation but can have as many as eight layers. The average height of the vegetation is 24.5 inches of which forbs constitute the greatest number of species. The prairie assessment report is included as Appendix C of this Plan.

2.2.2. Vegetation

Benbrook Lake is located within the Cross Timbers ecological region. The Cross Timbers ecoregion encompasses approximately 26,000 square miles in north and central Texas and is the primary ecoregion of north central Texas. It can be further divided into four vegetative subregions: Eastern Cross Timbers, Grand Prairie, Limestone Cut Plain, and Western Cross Timbers. Benbrook Lake is located in the

Grand Prairie subregion of the Cross Timbers ecoregion, while a portion of the Clear Fork Trinity River entering the lake is within the Western Cross Timbers subregion.

The region, like many other ecological regions in Texas, has undergone significant changes in the past 150 years. Although habitat for wildlife is present throughout the entire ecological region, populations vary considerably within sub-regions. The diversity and configuration of the plant communities on the landscape influence wildlife populations. Other factors include fragmentation of once continuous habitat into smaller, isolated land holdings; competition for food and cover with livestock; conversion of woodland habitat to improved pastures or urban and rural developments; and lack of proper wildlife and habitat management.

The common grass species include little bluestem (*Schizachyrium scoparium*), big bluestem (*Andropogon gerardi*), buffalograss (*Bouteloua dactyloides*), big muhly (*Muhlenbergia lindheimeri*), eastern gamagrass (*Tripsacum dactyloides*), sideoats grama (*Bouteloua curtipendula*), and Indiangrass (*Sorghastrum nutans*). Slopes and upland forests support honey mesquites (*Prosopis glandulosa*) and several cedars and junipers (*Juniperus* spp.), both of which have become more prevalent due to the absence of regular fires and grazing. Upland wooded areas that are not dominated by honey mesquites and junipers contain Shumard oak, Buckley's oak, post oak, live oak, western soapberry, Mexican plum, cedar elm, and others. Bottomland forests are incredibly dense in number and diverse with pecan, black walnut, sycamore, eastern cottonwood, red mulberry, plateau liveoak, bur oak, American elm, boxelder, ash, Texas persimmon, little walnut, honey mesquite, lance-leaf sumac, redbud, Mexican plum, and others.

Two of the most populous metropolitan areas of Texas are within the Cross Timbers ecoregion – Dallas and Fort Worth. The proximity to urban and suburban landscapes has led to many plants escaping into natural areas, some of which have dramatically altered the ecosystems where they have spread. These non-native plants are considered invasive if they cause harm within the ecosystem (TPWD 2012). Invasive species are covered in more detail in Section 2.2.5.

2.2.3. Fisheries and Wildlife Resources

Benbrook Lake provides habitat for an abundance of fish and wildlife species. Predominant fish species in the lake are largemouth bass (*Micropterus salmoides*), channel catfish (*Ictalurus punctatus*), white crappie (*Pomoxis annularis*), and white bass (*Morone chrysops*). Other less prominent species include yellow and striped bass; carp; blue and hybrid catfish; gar; sunfish; and trout. Several species have been stocked periodically since 1981 with bass and catfish being the most popular.

Many of the undeveloped open spaces provide habitat for wildlife including mountain lions (*Puma concolor*), coyotes (*Canis latrans*), bobcats (*Lynx rufus*), eastern cottontail rabbit (*Sylvilagus floridanus*), fox squirrel (*Sciurus niger*), nine-banded armadillo (*Dasypus novemcinctus*), striped skunks (*Mephitis mephitis*), and raccoons (*Procyon lotor*). The area also provides habitat for a diverse range of birds and acts as a

stopover for migratory birds. Parts of USACE land holding at Benbrook Lake are located within the corporate city limits of Fort Worth, and Benbrook.

2.2.4. Threatened and Endangered Species

The Endangered Species Act was enacted to provide a program for the preservation of endangered and threatened species and to provide protection for the ecosystems upon which these species depend for their survival. USFWS is the primary agency responsible for implementing the Endangered Species Act and is responsible for birds and other terrestrial and freshwater species. USFWS responsibilities under the Endangered Species Act include (1) the identification of threatened and endangered species; (2) the identification of critical habitats for listed species; (3) implementation of research and recovery efforts for these species; and (4) consultation with other Federal agencies concerning measures to avoid harm to listed species.

An endangered species is a species officially recognized by USFWS as being in danger of extinction throughout all or a significant portion of its range. A threatened species is a species likely to become endangered within the foreseeable future throughout all or a significant portion of its range. Proposed species are those that have been formally submitted to Congress for official listing as threatened or endangered. Species may be considered eligible for listing as endangered or threatened when any of the five following criteria occur: (1) current/imminent destruction, modification, or curtailment of their habitat or range; (2) overuse of the species for commercial, recreational, scientific, or educational purposes; (3) disease or predation; (4) inadequacy of existing regulatory mechanisms; and (5) other natural or human-induced factors affecting their continued existence.

In addition, USFWS has identified species that are candidates for listing as a result of identified threats to their continued existence. The candidate designation includes those species for which USFWS has sufficient information to support proposals to list as endangered or threatened under the Endangered Species Act; however, proposed rules have not yet been issued because such actions are precluded at present by other listing activity. Although not afforded protection by the Endangered Species Act, candidate species may be protected under other federal or state laws.

The USFWS's Information for Planning and Consultation (IPaC) database (2019A) lists the threatened and endangered species and trust resources that may occur within the Benbrook Lake Federal Fee Boundary (see USFWS Species List and the IPaC Report in Appendix C of the 2021 MP). Based on the IPaC report, there are four federally listed species found at within Benbrook Lake, and two listed species considered for this Master Plan: least tern and whooping crane (USFWS 2020). A list of these species is presented in Table 2.4. Although the red knot and piping plover are on the threatened and endangered species list, they were intentionally left out when addressing impacts of the Master Plan since the Master Plan does not entail any wind energy projects. The species identified as Threatened, Endangered or Candidate Species by TPWD that are not federally listed are included in Appendix C of the 2021 Master Plan as well as a list of Species of Greatest Conservation Need (SGCN) for the

Cross Timbers Ecoregion. No Critical Habitat has been designated within or near Benbrook Lake.

Table 2.4 Federally Listed Threatened & Endangered Species with Potential to Occur at Benbrook Lake

Common Name	Scientific Name	Federal Status	State Status
Whooping Crane	*Grus americana*	Endangered	Endangered

Although the red knot and piping plover are federally listed species, they only require consideration for projects entailing wind energy projects.

The whooping crane habitat consists of marshes, shallow lakes, lagoons, salt flats, grain and stubble fields, and barrier islands (AOU 1983, Matthews and Moseley 1990) and (NatureServe 2016). Pockets of habitat for this species are present on Benbrook Lake project land but these areas are used as a stopover during their annual migrations. When the species is migrating, sighting for the species is uncommon at the lake and therefore they are considered a rare occurrence at Benbrook Lake.

Texas Parks and Wildlife Department's (TPWD 2020) Annotated County Lists of Rare Species database records the threatened and endangered species that may occur on Benbrook project lands (see Appendix C of the 2021 MP for the full report).

Texas Natural Diversity Database

The Texas Natural Diversity Database (TXNDD 2020), administered by TPWD, manages and disseminates information on occurrence of rare species, native plant communities, and animal aggregations in Texas to help guide project planning efforts. TXNDD provided information for the following U.S. Geological Survey (USGS) quadrangles that encompass Benbrook project lands: Benbrook, Primrose, and Cresson. This information is summarized in the following paragraphs:

1) Within the Benbrook Lake project lands, several locations were identified by the TXNDD to contain unique communities and species. Among these communities were those that contain earleaf false foxglove (*Agalinis auriculata*), Texas garter snake (*Thamnophis sirtalis annectens*), and a mixed herbaceous vegetation community can be found.

2) There is a formal recording of earleaf false foxglove (*Agalinis auriculata*) being detected from a location on the project lands at Benbrook Lake but with no date recorded, and no other recordings being listed. The ideal soil type for this species is mesic to dry, and can be found in Blackland and tallgrass prairies, as well as thickets, openings, glades that are prairie like in nature (*NatureServe* 2019A). Because of this information and lack of recent sightings, the occurrence of this species on Benbrook Lake project lands is considered rare. The last recorded siting of a Texas garter snake within the project lands of Benbrook Lake was in 1954. The ideal habitat for this species is flooded or wet fields near streams, rivers, and lakes (*NatureServe* 2019B). Because of this information and lack of

recent sightings, the occurrence of this species on Benbrook Lake project lands is considered rare.

3) The TXNDD reports and the data collected from the survey confirms that pockets of a mixed herbaceous plant that primarily consist of Little Bluestem (*Schizachyrium scoparium*), Sideoats Grama (*Bouteloua curtipendula*), and Texas Wintergrass (*Nassella leucotricha*) community can be found on the project lands at Benbrook Lake; thus, the occurrence of this community on project lands is considered common.

2.2.5. Invasive Species

An invasive species is defined as a plant or animal that is non-native (or native nuisance) to an ecosystem and whose introduction causes, or is likely to cause, economic and/or environmental harm, or harm to human health. Invasive species can thrive in areas beyond their normal range of dispersal. These species are characteristically adaptable, aggressive, and have high reproductive capacity. Their vigor, along with a lack of natural enemies or controls, often leads to outbreak populations with some level of negative effects on native plants, animals, and ecosystem functions and are often associated with disturbed ecosystems and human activities.

Table 2.5 lists many of the invasive and noxious native species found at Benbrook Lake. Other species are currently being researched for their invasive characteristics.

Table 2.5 Invasive and Noxious Native Species Found at Benbrook Lake

Common Name	Scientific Name	Native/Non-native
Birds		
Cattle egret	*Bubulcus ibis*	Non-native
Cowbirds	*Molothrus ater*	Native
Eurasian collared dove	*Streptopelia decaocto*	Non-native
European starling	*Sturnus vulgaris*	Non-native
House sparrow	*Passer domesticus*	Non-native
Mammals		
None		
Fish		
European carp	*Cyprinus carpio*	Non-native
Insects		
Red imported fire ant	*Solenopsis invicta*	Non-native
Plants		
Annual bastard cabbage	*Rapistrum rugosum*	Non-native
Ashe juniper	*Juniperus ashei*	Native aggressive

Common Name	Scientific Name	Native/Non-native
Bermudagrass	*Cynodon dactylon*	Non-native
Cheatgrass	*Bromus tectorum*	Non-native
Chinaberry	*Melia azedarach*	Non-native
Chinese privet	*Ligustrum sinense*	Non-native
Chinese tallow	*Tridica sebirefa*	Non-native
Eastern red cedar	*Juniperus virginiana*	Native aggressive
Glossy privet	*Ligustrum lucidum*	Non-native
Heavenly bamboo	*Nandina domestica*	Non-native
Honey mesquite	*Prosopis glandulosa*	Native aggressive
Japanese honeysuckle	*Lonicera japonica*	Non-native
Johnson grass	*Sorghum halepense*	Non-native
King Ranch (yellow) bluestem	*Bothriochloa ischaemum var. songarica*	Non-native
Lilac chaste tree	*Vitex agnus-castus*	Non-native
Multiflora rose	*Rosa multiflora*	Non-native
Mollusks		
Asian clam	*Corbicula fluminea*	Non-native
Decollate snail	*Rumina decollate*	Non-native

Because of the large expanse of metropolitan areas located in the Texas Cross Timbers ecoregion, it has led to a greater number of invasive species than most other regions of the state. Free-ranging pets (cats and dogs, in particular) have made a significant impact on populations of small mammals, reptiles, and birds.

Other invasive animals include several species of introduced fish (including released baitfish and “aquarium dumping”). While currently not present in Benbrook Lake, invasive mollusks including zebra mussels (*Dreissena polymorpha*) are an ongoing threat to native aquatic species and infrastructure due to their ability to infest and expand rapidly, and the close proximity to other infested lakes increases the risk at Benbrook Lake. Asian clams (*Corbicula fluminea*) and decollate snails (*Rumina decollate*) are common in waterways throughout Texas and often out-compete native mollusks.

Although native, cowbirds (*Molothrus ater*) have become problematic due to their expanding range associated with agriculture and human development and are considered a nuisance. Honey mesquites (*Prosopis glandulosa*) and junipers/cedars are also native but are spreading aggressively in native prairies where their aggressive growth was historically kept in check by periodic wildfires and grazing. The close proximity to urban landscaping has led to many common landscape plants becoming aggressive colonizers and are now invasive at Benbrook Lake.

2.2.6. Aesthetic Resources

Benbrook Lake includes many acres of scenic shorelines, lake views, and wildlife viewing areas providing high visual and scenic qualities. Some areas are admired for their scenic attractiveness (intrinsic scenic beauty that evokes a positive response), scenic integrity (wholeness of landscape character), and landscape visibility (how many people view the landscape and for what reasons and how long). Because Benbrook Lake is located near several large cities, people come from local urban communities to enjoy the scenic and naturalistic views offered at the lake. Some areas have been designated as Wildlife and Vegetative Management, or Environmentally Sensitive Areas to preserve specific animal, plant, or environmental features that also add to the scenic qualities at the lake. Nearby parks have been designed to access the lake, allow access to hiking trails, and take advantage of scenic qualities at the lake and surrounding areas.

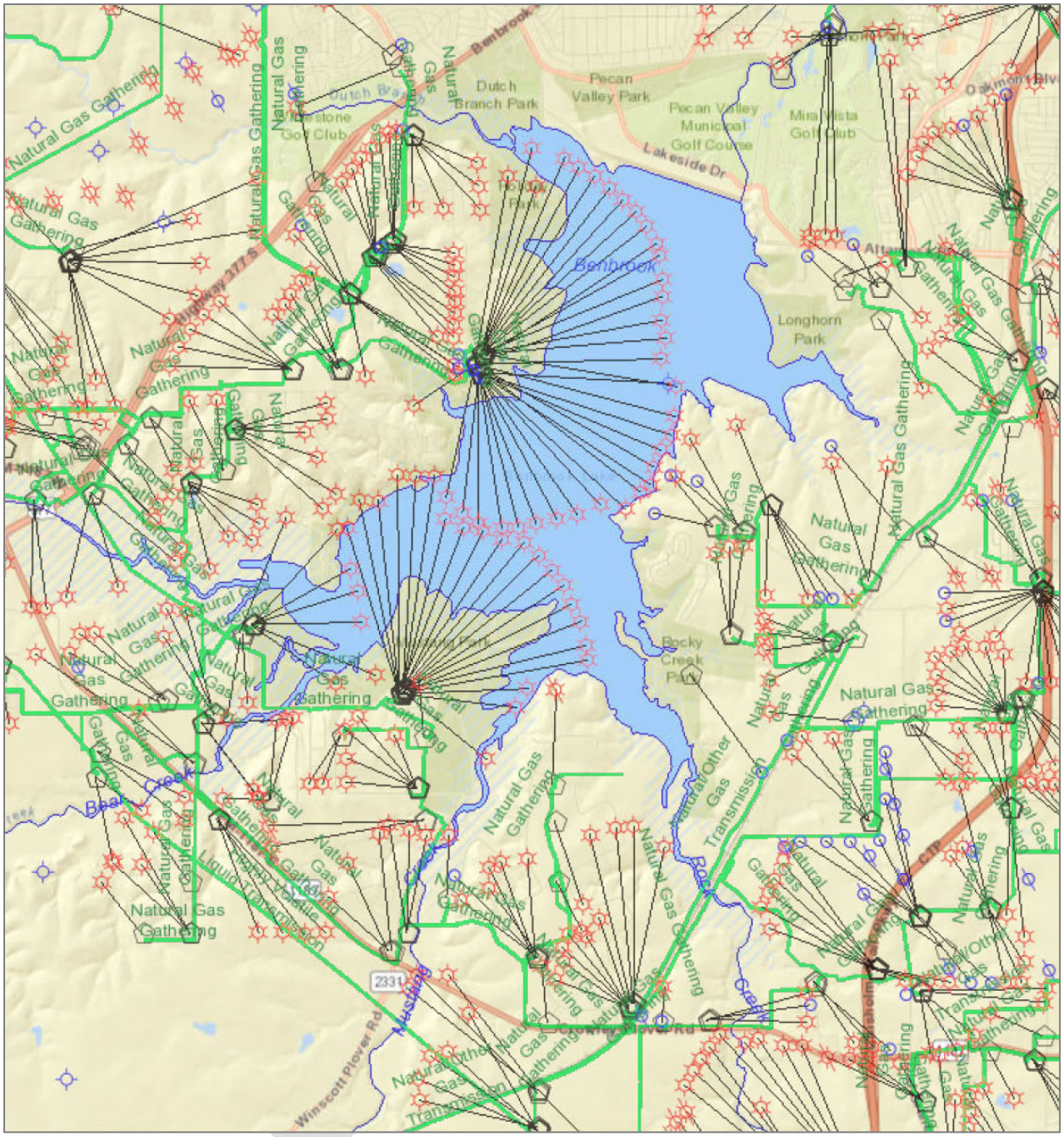
Adjacent landowners are informed that removing trees to obtain a view of the lake not only destroys wildlife habitat but also lowers the scenic quality of the shoreline when viewed by the general public from the water surface. Unauthorized removal of trees and other vegetation could result in a fine. Additionally, reasonable measures must be taken to ensure that damage to the natural landscape from invasive species and catastrophic wildfire are minimized. Vegetative management, mowing permits, debris removal, and other shoreline issues are addressed in the shoreline policy.

2.2.7. Mineral and Timber Resources

Minerals

The principal mineral resource known to exist near Benbrook Lake is natural gas. Benbrook Lake is located on the eastern edge of the Barnett Shale formation, one of the largest producible onshore natural gas fields in the United States. Within the Barnett Shale formation, natural gas is normally extracted through horizontal drilling and/or hydraulic fracturing. Currently, there are no well surface locations on USACE property. There are, however, many horizontal well bores that extend under USACE property, including under the water surface. During acquisition of lands for Benbrook Lake, only relatively small areas of minerals were acquired, primarily those under and adjacent to the dam which were acquired to protect the structural integrity of the dam and associated facilities. USACE has implemented a “no hydraulic fracturing” exclusion zone around each dam operated and maintained by USACE. This zone is 3,000 horizontal feet from the toe of the dam at Benbrook Lake. Underground gas pipelines also cross USACE property along Clear Fork Trinity River, Bear Creek, and Rocky Creek. See Figure 2.7 for a map of existing natural gas activity near Benbrook Lake.

Figure 2.7 Natural Gas Wells and Pipelines near Benbrook Lake



Source: Texas Railroad Commission GIS Map Viewer

Timber

Benbrook Lake is not located in a region having viable commercial timber resources. The woodlands that exist on USACE lands have value primarily as wildlife habitat and as an aesthetic resource but have no commercial timber value.

2.3. CULTURAL RESOURCES

2.3.1. Prehistoric

The earliest well-documented evidence of human occupation in North Central Texas dates to about 12,000 years before present (B.P.). Prehistory is divided generally into three broad time periods: Paleo-Indian (12,000-8,500 B.P.), Archaic (8,500-1.250 B.P.), and Late Prehistoric (1,250-300 B.P.).

Evidence for Paleo-Indian period occupation is relatively rare in the Tarrant County area and is known primarily from distinctive projectile point styles dating to this time period found in surface collections or in mixed multi-component sites. It is likely that intact Paleo-Indian camp sites may be buried deeply beneath Holocene floodplain alluvium, as was the case with the Aubrey Clovis site on the Elm Fork Trinity River in Denton County. Evidence suggests that the region was occupied by small groups of highly mobile hunter-gatherers that traveled over very large territories. Traditionally thought of as big-game hunters of mammoth and bison, more recent evidence indicates Paleo-Indians exploited a much broader range of animal and plant resources.

The Archaic period is divided into Early (8,500-6,000 B.P.), Middle (6,000-3,500 B.P.), and Late (3,500-1,250 B.P.) sub-periods. During this long time period, a generalized hunting and gathering subsistence strategy is indicated. Trends through time suggest increasing population density and decreasing group mobility within smaller territories. Sites with Late Archaic components are well represented in the Tarrant County area and in North Central Texas generally.

The Late Prehistoric Period (1,250-300 B.P.) is marked by the presence of the bow and arrow and pottery. During the early portion of this time span, subsistence strategies remained similar to those of the preceding Late Archaic. By around 800 B.P., there is evidence for maize horticulture and house structures indicating a more sedentary occupation at the Cobb-Pool Site (41DL148) at nearby Joe Pool Lake. Pottery from Cobb-Pool includes plain and decorated grog-tempered specimens in the Caddo ceramic tradition. It is unclear whether this pottery was made locally or represents trade with East Texas Caddo groups. Plain, shell-tempered pottery is also found at Tarrant County sites and is thought to show connections with southern plains groups to the north and west. This shell-tempered pottery is generally thought to date to the late portion of the Late Prehistoric period (after ca. 600 B.P.) when bison hunting became more important.

2.3.2. Historic

Members of several Native American Nations occupied North Central Texas prior to the arrival of the first white settlers in the early 1840s. Bird’s Fort was established in 1841 on the West Fork of the Trinity River in what is now eastern Tarrant County. Among the Native Americans signing the Bird’s Fort Treaty in 1843 were Caddo, Waco, Tawakoni, Delaware, Cherokee, and Chickasaw. The majority of the early white settlers were farmers operating small family farms growing mainly wheat and corn.

Following the annexation of Texas by the United States in 1845, Fort Worth was established by the U.S. Army in 1849. Also in 1849, Tarrant County was created out of Navarro County. The population grew steadily between the 1840s and 1870s. After the Civil War, cotton farming became an important agricultural activity in the region and tenant farming was a major social institution. The arrival of the railroads in the early 1870s allowed farmers access to markets and led to a major increase in the number of farms. Many of the historic resources at Benbrook Lake are the archeological remains of house sites and farmsteads dating from the late 19th century through the mid-20th century.

2.3.3. Previous Investigations at Benbrook Lake

The initial archeological investigation at Benbrook Lake was a survey conducted by the River Basins Survey in 1948. No cultural resource sites were found by that survey, and no further investigations were recommended. More recently, several linear surveys were conducted where proposed water pipelines crossed USACE fee property in the 1990s and in 2004. The 2004 survey recorded site 41TR205, and data recovery excavations were conducted in a portion of the site located within the pipeline right-of-way in 2006. Stratified components of Late Archaic and Late Prehistoric age were recovered. The majority of 41TR205 is located outside the pipeline right-of-way and remains intact.

2.3.4. Recorded Cultural Resources

Currently, only three archeological sites have been recorded on USACE fee property at Benbrook Lake. One of these sites (41TR205) has been determined eligible for the National Register of Historic Places (NRHP). The other two sites (41TR147 and 41TR248) have not yet been evaluated for NRHP eligibility.

2.3.5. Long-term Objectives for Cultural Resources

As funding allows, a Cultural Resources Management Plan (CRMP) shall be developed and incorporated into the Operational Management Plan (OMP) in accordance with EP 1130-2-540. The purpose of the CRMP is to provide a comprehensive program to direct the historic preservation activities and objectives at Benbrook Lake. Completion of a full inventory of cultural resources at Benbrook Lake is a long-term objective that is needed for compliance with Section 110 of the National Historic Preservation Act (NHPA). All currently known sites with unknown eligibility and newly recorded sites must be evaluated to determine their eligibility for the NRHP. In accordance with Section 106 of the NHPA, any proposed ground-disturbing activities or projects, such as those described in this master plan or as may be proposed in the future by others for right-of-way easements, will require cultural resource surveys to locate and evaluate historic and prehistoric resources. Resources determined eligible for the NRHP must be protected from proposed project impacts, or the impacts must be mitigated. All future cultural resource investigations at Benbrook Lake must be coordinated with the State Historic Preservation Officer and federally recognized Tribes to ensure compliance with the National Historic Preservation Act, the Archaeological

Resources Protection Act, and the Native American Graves Protection and Repatriation Act.

2.4. DEMOGRAPHIC AND ECONOMIC ANLALYSIS

2.4.1. Region Served

The zone of interest for Benbrook Lake is defined as Tarrant County, Texas and the adjacent counties to the southwest: Hood, Johnson, and Parker Counties.

2.4.2. Population

The population for the zone of interest and the constituent counties is shown in Table 2.6. The current population estimate for the zone of interest is approximately 2.4 million people, 85 percent of which resides in Tarrant County. This represents about 8 percent of the total state population of 28 million people. Between 2010 and 2018, the zone of interest's population increased by 56 percent, and is projected to increase from 2018 to 2050 at an annualized growth rate of 1.4 percent, to 3.7 million people. By comparison, Texas is projected to increase at an annualized growth rate of 1.6 percent over the same period.

Table 2.6 Population Estimates and Projections

Geographical Area	2010	2018	2050
Texas	25,145,561	27,885,195	**47,342,105**
Tarrant County	1,809,034	2,019,977	**3,196,603**
Hood County	51,182	56,901	**82,296**
Johnson County	150,934	163,475	**238,332**
Parker County	116,927	129,802	**195,261**
Zone of Interest	2,128,077	2,370,155	**3,712,492**

Sources: 2010 Population, 2010 Decennial Census, US Census Bureau; 2018 Population, American Community Survey 5 Year Estimate, US. Census Bureau; 2050 Projection, Texas State Demographer

The population distribution by gender is shown in Table 2.7. In the zone of interest, the distribution is approximately 49 percent male and 51 percent female. This distribution is similar to the constituent counties as well as the State, which are approximately 50 percent male and 50 percent female.

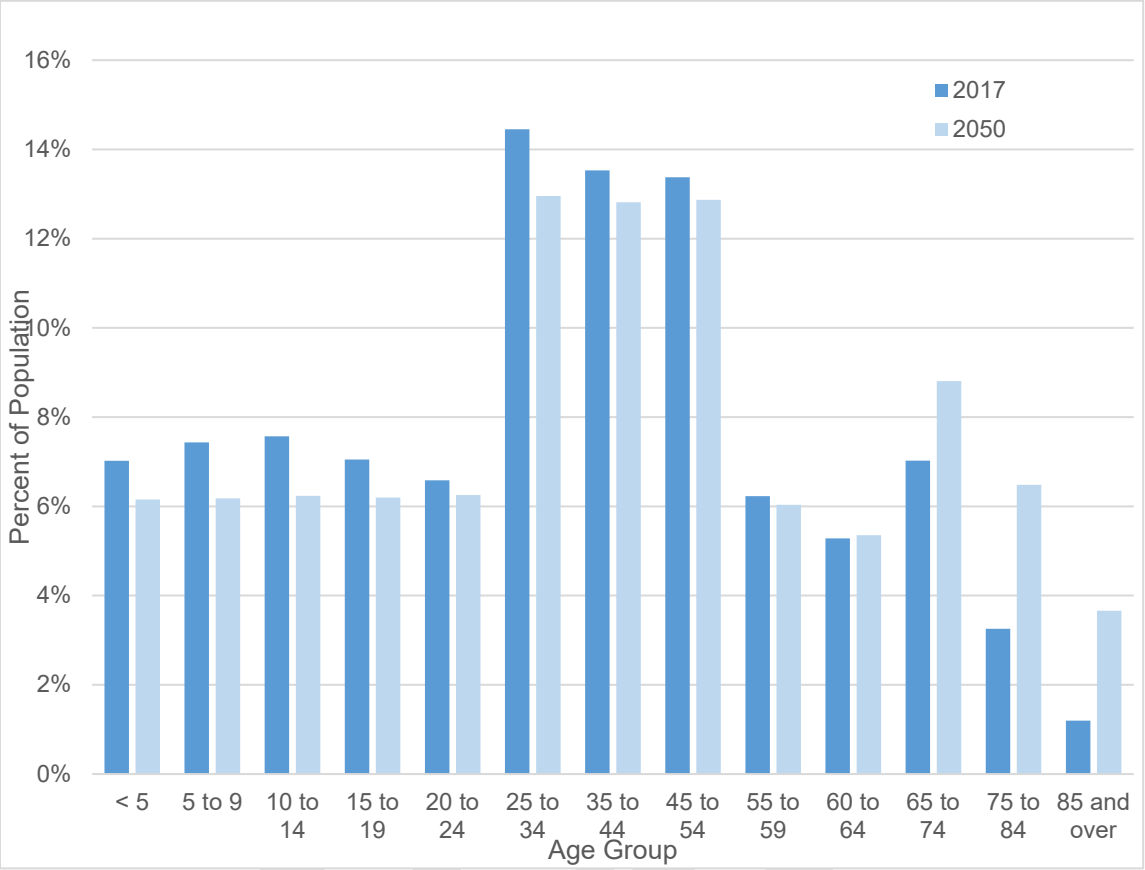
Table 2.7 2018 Population by Gender

Geographical Area	Male	Female
Texas	13,849,775	14,035,420
Tarrant County	988,765	1,031,212
Hood County	28,004	28,897
Johnson County	81,568	81,907
Parker County	64,448	65,354
Zone of Interest	1,162,785	1,207,370

Source: American Community Survey 5 Year Estimate, US. Census Bureau

The population by age group for the zone of interest is displayed in Figure 2.5. Approximately 41 percent of the 2018 population is between 25 and 54. Thirty-six percent of the 2018 population was under 25 years of age, and 23 percent was 55 years or older. Comparing the age distribution between 2018 and 2050, it can be seen the project population would still be dominated by the 25 to 54 years age group. However, there is a trend of the population aging, given the percent of population under 25 years shows to decline and the percent of population 55 years and older shows to generally increase, albeit by less than 2 percent for any particular age group. For reference, the population by age group for Texas and the constituent counties of the zone of interest is presented in Figure 2.8 and Table 2.8.

Figure 2.8 Area of Interest Population by Age Group: 2018 and 2050



Source: American Community Survey 5 Year Estimate, US. Census Bureau

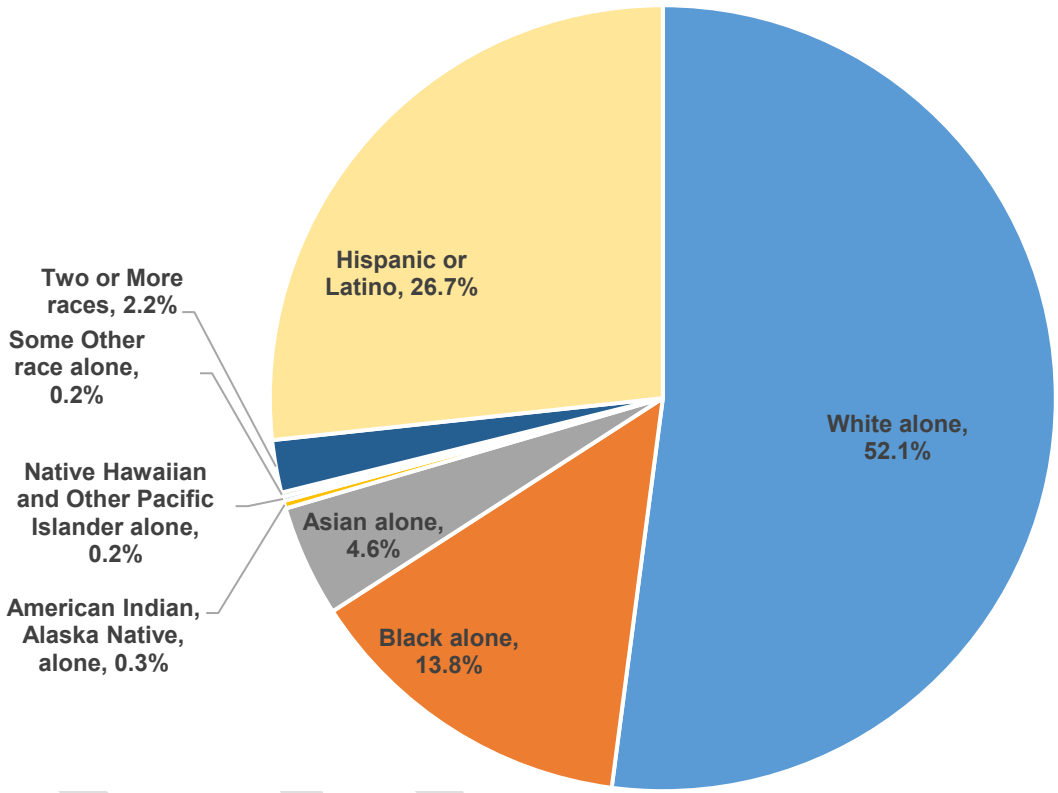
Table 2.8 2018 Population by Age Group

Age Group	Texas	Tarrant	Hood	Johnson	Parker	Zone of Interest
< 5	1,998,869	144,494	3,109	10,772	7,993	166,368
5 to 9	2,028,151	151,834	3,220	12,070	9,003	176,127
10 to 14	2,057,414	154,147	3,506	12,313	9,467	179,433
15 to 19	1,987,192	143,146	3,474	11,668	8,811	167,099
20 to 24	1,998,210	135,990	2,578	10,001	7,444	156,013
25 to 34	4,094,297	300,991	5,914	20,689	14,842	342,436
35 to 44	3,767,582	277,505	5,641	21,405	16,093	320,644
45 to 54	3,511,040	269,412	6,942	21,985	18,625	316,964
55 to 59	1,658,878	121,880	4,449	11,444	9,861	147,634
60 to 64	1,445,748	103,987	4,261	8,798	8,124	125,170
65 to 74	2,000,715	132,708	7,883	13,666	12,182	166,439
75 to 84	971,168	60,433	4,531	6,700	5,508	77,172
85 and over	365,931	23,450	1,393	1,694	1,849	28,386

Source: American Community Survey 5 Year Estimate, US. Census Bureau

The population of the zone of interest is predominantly White, with approximately 52 percent of the population, as shown in Figure 2.9. About 27 percent of the population is Hispanic or Latino, and 14 percent are Black. Asians make up about 5 percent and just over 2 percent identify as two or more races. The remaining categories each make up less than 1 percent of the total population. The state, by comparison, is 42 percent White; 39 percent Hispanic or Latino, 12 percent Black, 5 percent Asian, 2 percent two or more races, and the remaining races each less than 1 percent. Table 2.9 presents the population by race for Texas and the constituent counties.

Figure 2.9 2018 Zone of Interest Population by Race/Hispanic Origin



Source: American Community Survey 5 Year Estimate, US. Census Bureau

Table 2.9 2018 Population by Race/Hispanic Origin

Geographical Area	White alone	Black alone	Asian alone	American Indian, Alaska Native, alone	Native Hawaiian and Other Pacific Islander alone	Some Other race alone	Two or More races	Hispanic or Latino
Texas	11,807,263	3,269,253	1,292,813	68,452	20,381	42,354	463,123	10,921,556
Tarrant County	958,302	319,829	106,427	5,797	3,474	3,976	45,930	576,242
Hood County	48,047	466	433	469	0	0	460	7,026

Geographical Area	White alone	Black alone	Asian alone	American Indian, Alaska Native, alone	Native Hawaiian and Other Pacific Islander alone	Some Other race alone	Two or More races	Hispanic or Latino
Johnson County	119,128	4,982	1,400	644	607	79	2,587	34,048
Parker County	108,865	1,762	644	523	61	147	2,238	15,562
Zone of Interest	1,234,342	327,039	108,904	7,433	4,142	4,202	51,215	632,878

Source: American Community Survey 5 Year Estimate, US. Census Bureau

2.4.3. Education and Employment

Approximately 86 percent of the population 25 years and older in the zone of interest have attained a high school diploma or greater education, demonstrating a well educated population. Approximately 37 percent of the population has earned an associate's degree or higher. About 20 percent have earned a bachelor's degree. The distribution for the state is almost identical, with less than 1 percent difference in any of the categories, except for less than 12th grade level of attainment, where the state has a slightly higher percentage of 15 percent. The populations by educational attainment and geographic area are shown in Table 2.10.

Table 2.10 Educational Attainment of the 2018 Population 25 Years and Older

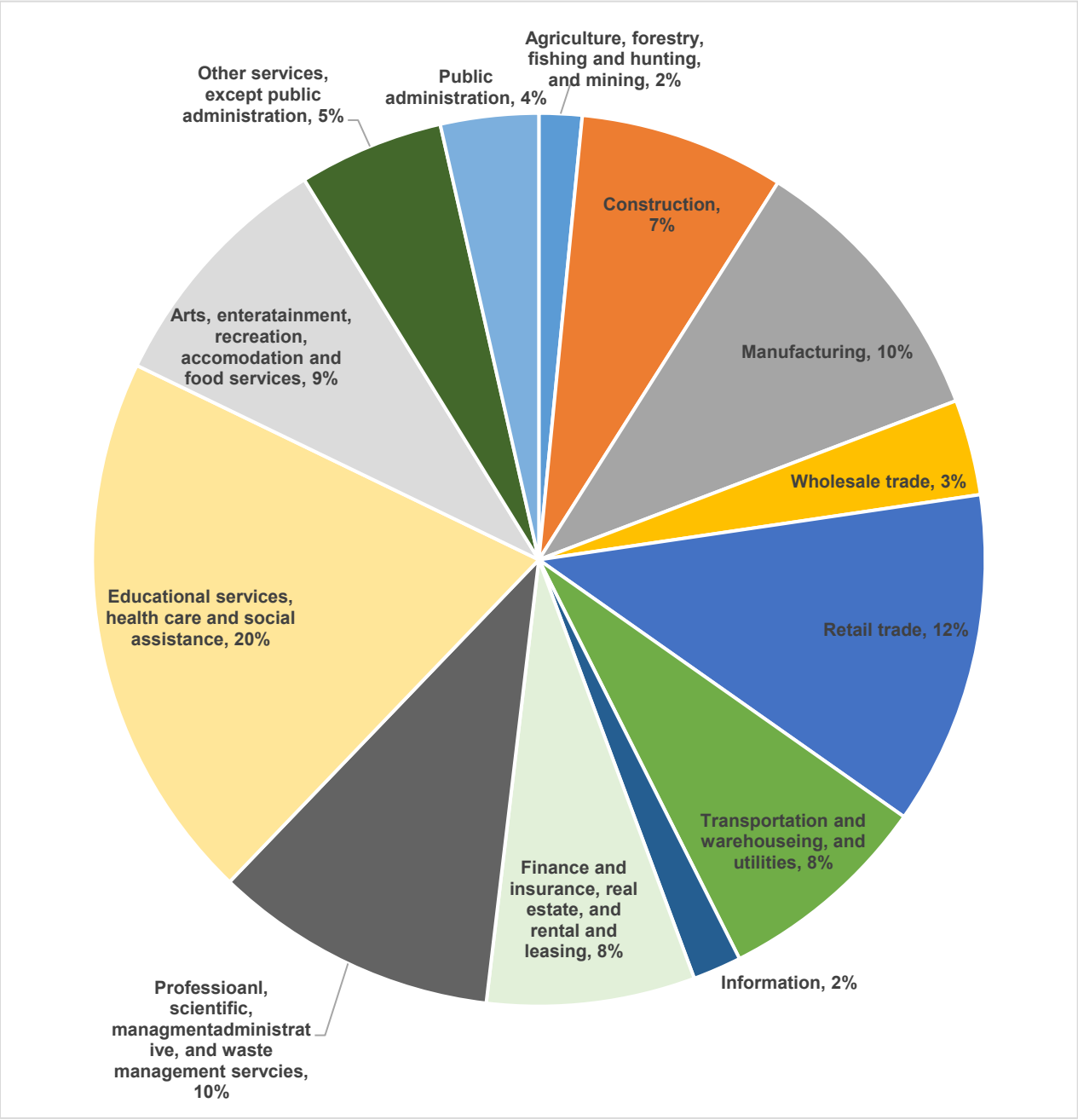
Geographical Area	Total Population 25 Years and Older	Less than 12th Grade	12th Grade, no diploma	12th Grade, with diploma or equivalent	Some College, no degree	Associates Degree	Bachelor's Degree	Graduate or Professional Degree
Texas	17,815,359	2,689,164	304,268	4,448,881	3,892,527	1,261,050	3,409,836	1,809,633
Tarrant County	1,290,366	163,369	22,227	309,229	291,433	98,132	271,552	134,424
Hood County	41,014	3,826	531	12,296	11,032	2,631	7,135	3,563
Johnson County	106,651	14,489	1,734	36,008	27,131	7,744	13,928	5,617
Parker County	87,084	8,095	1,440	25,111	21,585	7,551	16,074	7,228
Zone of Interest	1,525,115	189,779	25,932	382,644	351,181	116,058	308,689	150,832

Source: American Community Survey 5 Year Estimate, US. Census Bureau

There were approximately 1.2 million persons, 16 years of age and older, employed in the zone of interest in 2018. The largest share of the employment occurs in the educational, health care, and social services sector, with 20 percent of total employment. Approximately 12 percent of the population are employed in the retail sector, and 10 percent each in manufacturing and professional/scientific/management

services sector. For the construction; transportation and warehousing; finance and insurance; and arts, entertainment, and food services sectors each account for 7 to 9 percent of employment, and the remaining sectors account for 5 percent or less of total employment. The zone of interest generally mirrors the state distribution of employment by sector with a 1 percent or less difference in each sector. Figure 2.10 shows the employment by sector for each of the geographic areas.

Figure 2.10 2018 Employment by Sector for the Area of Interest



Source: American Community Survey 5 Year Estimate, US. Census Bureau

Table 2.11 2018 Employment by sector for the population 16 years of age and over

Sector	Texas	Tarrant County	Hood County	Johnson County	Parker County	Zone of Interest
Total	12,985,624	997,459	23,937	74,845	60,252	1,156,493
Agriculture, forestry, fishing and hunting, and mining	407,019	11,564	1,029	2,207	3,176	17,976
Construction	1,088,705	72,089	2,316	5,887	5,738	86,030
Manufacturing	1,116,997	101,989	1,447	7,943	6,727	118,106
Wholesale trade	380,277	35,307	638	2,636	1,461	40,042
Retail trade	1,483,375	115,977	3,858	13,244	6,759	139,838
Transportation and warehousing, and utilities	741,256	79,725	1,823	4,778	4,131	90,457
Information	229,841	18,027	508	850	973	20,358
Finance and insurance, real estate, and rental and leasing	862,041	78,826	1,336	3,572	3,467	87,201
Professional, scientific, management, administrative, and waste management services	1,480,493	106,320	2,278	5,577	4,894	119,069
Educational services, health care and social assistance	2,805,186	197,470	5,023	16,088	12,570	231,151
Arts, entertainment, recreation, accommodation and food services	1,192,224	94,062	1,446	4,628	4,317	104,453
Other services, except public administration	673,193	51,960	1,146	4,394	3,286	60,786
Public administration	525,017	34,143	1,089	3,041	2,753	41,026

Source: American Community Survey 5 Year Estimate, US. Census Bureau

There are approximately 1,216,293 persons in the civilian labor force in the zone of interest, with 1,156,493 of those employed in 2018, as shown in Table 2.12. Approximately 4.9 percent of the civilian labor force is unemployed. For the state of Texas, the unemployment rate is 5.4 percent, suggesting a slightly more robust economy within the zone of interest.

Table 2.12 2018 Civilian Labor Force, Number Employed, Unemployed, and Unemployment Rate

Geographic Area	Total Civilian Labor Force	Employed	Unemployed	Unemployment Rate
Texas	13,728,630	12,985,624	743,006	5.4%
Tarrant County	1,050,005	997,459	52,546	5.0%
Hood County	24,655	23,937	718	2.9%
Johnson County	78,205	74,845	3,360	4.3%
Parker County	63,428	60,252	3,176	5.0%
Zone of Interest	1,216,293	1,156,493	59,800	4.9%

Source: American Community Survey 5 Year Estimate, US. Census Bureau

2.4.4. Households, Income and Poverty

There were approximately 822 thousand households in the zone of interest in 2018, representing about 9 percent of the total households in the state. About 85 percent of the households were in Tarrant County. The average household size is approximately 2.9 in the zone of interest, the state, and all of the constituent counties other than Hood County, which is about 2.6. This information is presented in Table 2.13.

Table 2.13 2018 Number of Households and Average Household Size

Geographic Area	Total Households	Average Household Size
Texas	9,553,046	2.92
Tarrant County	698,995	2.89
Hood County	21,969	2.59
Johnson County	56,433	2.90
Parker County	44,255	2.93
Zone of Interest	821,652	2.88

Source: American Community Survey 5 Year Estimate, US. Census Bureau

The 2018 median household income and per capita income for the geographic areas is presented in Table 2.14. The median household income for the zone of interest is not available, but for the constituent counties it ranges from approximately $59 thousand to $75 thousand, therefore the zone of interest median household income would fall within that range. This would show that the median household income for the zone of interest would be greater than the $60 thousand for the state overall. Per capita income tells the similar story that the zone of interest has higher incomes than the state overall. For the zone of interest, the per capita income is approximately $32 thousand, compared to the state with $30 thousand.

Table 2.14 2018 Median Household Income and Per Capita Income

Geographic Area	Median Household Income ($)	Per Capita Income ($)
Texas	59,570	30,143
Tarrant County	64,874	32,092
Hood County	59,049	32,727
Johnson County	62,066	27,667
Parker County	74,625	34,705
Zone of Interest	N/A	31,945

Source: American Community Survey 5 Year Estimate, US. Census Bureau

Table 2.15 shows the number of families in the geographic areas along with the percent of families below the poverty level. There were approximately 572 thousand families in the zone of interest. This represents about 9 percent of the number of families in the state. Approximately 10 percent of the families in the zone of interest have incomes below the poverty level, which is slightly lower than the state's rate of 12 percent. The percent of families with incomes below the poverty level in the constituent counties ranges from 7 percent to 10 percent.

Table 2.15 2018 Number of Families and Percent of Families with Incomes below the Poverty Level

Geographic Area	Total Number of Families	Percent of Families
Texas	6,560,303	12%
Tarrant County	481,588	10%
Hood County	14,935	9%
Johnson County	42,181	8%
Parker County	33,503	7%
Zone of Interest	572,207	10%

Source: American Community Survey 5 Year Estimate, US. Census Bureau

2.5. RECREATION FACILITIES, ACTIVITIES, AND NEEDS

The initial development of outdoor recreation facilities at Benbrook Lake was addressed in the 1966 Master Plan, Design Memorandum (DM) No. 1C. This document laid out a robust plan for the comprehensive management of the lake's lands and water surface including plans for a significant investment in outdoor recreation facilities.

USACE's role in outdoor recreation at Benbrook Lake consists of managing roads and trails, fishing along waterways and adjacent to the stilling basin area below the dam, management of the water surface as it relates to boating activity, and managing general access to lands that are not leased to the City of Benbrook and City of Fort Worth. Benbrook Lake provides a popular public hunting program through a lottery system. See chapter 6 for more details about Benbrook Lake's hunting program.

The following factors contribute to the importance of Benbrook Lake as a recreational area:

- Easily accessed by nearby highways. Benbrook Lake Dam is located 12 miles from downtown Fort Worth and just 2 miles from downtown Benbrook along major highways.
- Full-service campgrounds and day-use areas
- Benbrook Community Center with YMCA
- Eighteen-hole and nine-hole/par-three golf courses as well as a driving range
- Benbrook Marina

2.5.1. Zone of Influence

The zone of influence for Benbrook Lake as it relates to this Master Plan includes Tarrant County, Texas as well as the adjacent counties of Hood, Johnson, and Parker Counties.

2.5.2. Visitation Profile

Most visitors to Benbrook Lake come from within the zone of influence. The most recent visitor data from Recreation.gov includes zip codes for visitors who made reservations at Holiday, Bear Creek, Mustang, Longhorn, and Rocky Creek Parks. The most recent data available includes zip codes from visitors during 2017-2018. An examination of approximately 15,000 visits revealed that 10.3 percent of visitors were from out-of-state zip codes or no zip code listed; 76.4 percent were from within the zone of influence of Hood, Johnson, Parker, and Tarrant Counties; while 55.7 percent were from Tarrant County. Table 2.16 provides percentages for each county within the zone of influence as well as zip codes that share a boundary with federal property at Benbrook Lake. The highest number of visitors comes from the 76126 zip code, which is from the city of Benbrook and neighboring portions of Fort Worth and unincorporated Tarrant County.

Table 2.16 Point of Origin for Benbrook Lake Reservations

ZIP CODE	PERCENT OF CAMPERS
Hood County	4.0%
Johnson County	11.0%
Parker County	5.7%
Tarrant County	55.7%
Total Zone of Influence	76.4%
Zip Code 76063	0.5%
Zip Code 76126	6.0%
Zip Code 76132	1.5%

Source: Recreation.gov

2.5.3. Recreation Areas and Facilities

The primary outdoor recreation facilities at Benbrook are operated by USACE, City of Benbrook, City of Fort Worth, and various private parties. USACE provides recreational opportunities by managing pedestrian traffic on the road across the top of Benbrook Dam, fishing access to the stilling basin area, as well as all the campgrounds and day use areas around the lake. Table 2.17 provides a brief summary of the primary recreation facilities operated by these various entities.

Table 2.17 Facilities Provided by USACE, City of Benbrook, City of Fort Worth, and various Private Parties.

Facilities	USACE	City of Benbrook	City of Fort Worth	Private Party Leases
Campsites: electric and water	108	0	0	0
Campsites: electric, water and sewer	6	0	0	0
Enclosed screen shelters, with 20/30/50 amp electric and water hookups	5	0	0	0
Campsites with no hookups	26	0	0	0
Picnic Sites	Yes – Varies with lake level	yes	yes	yes
Group shelters	2	0	0	1
Picnic Shelter	2	2	0	0
Hike/equestrian trails	24 miles	0	0	0
Boat Ramp	8	0	0	1
Swimming Beach	2	1	0	0
Interpretive Site	No	0	0	0

Source: USACE

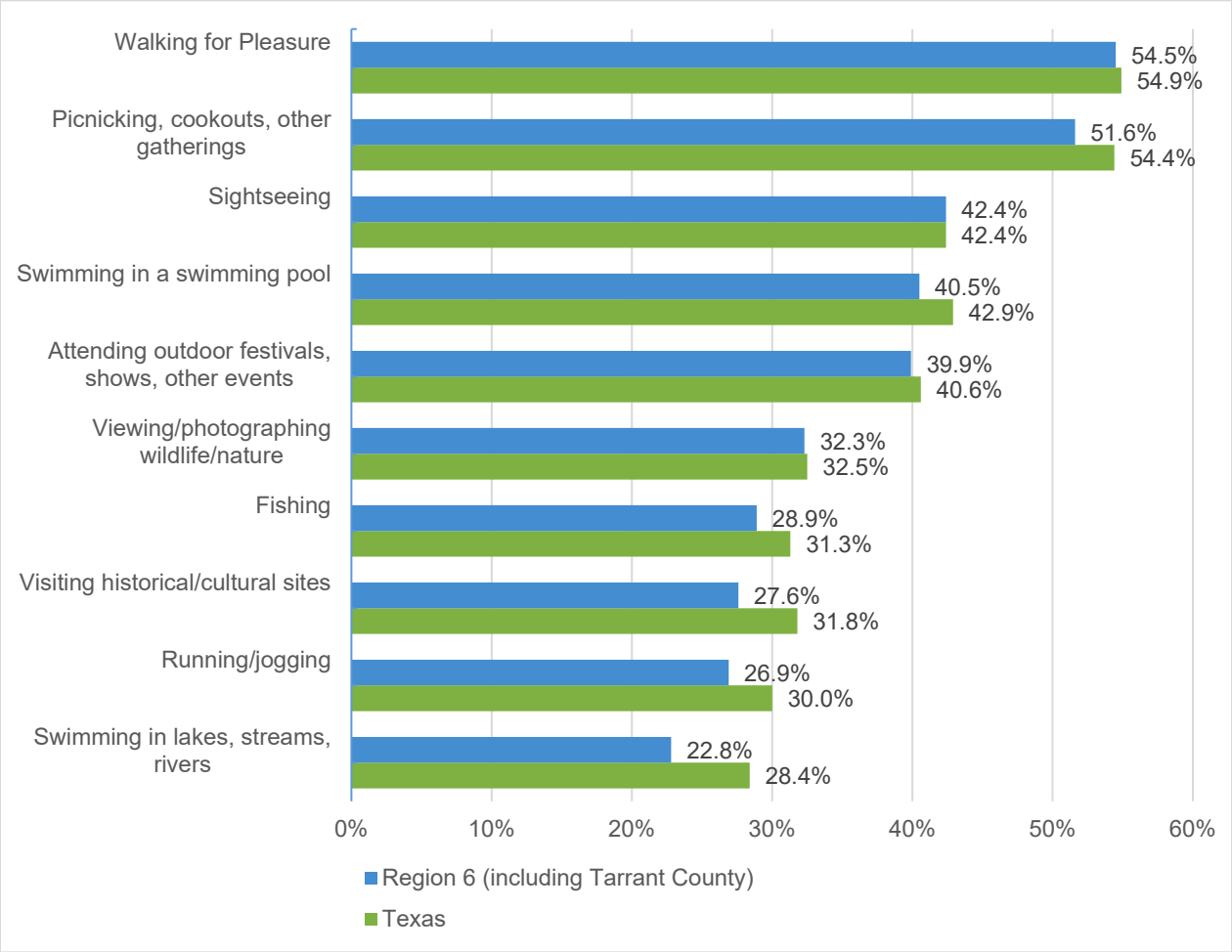
2.5.4. Recreational Analysis - Trends

The 2018 Texas Outdoor Recreation Plan (TORP) published by TPWD is a comprehensive recreational demand study that evaluates recreation trends and needs across Texas and in subdivided regions. Some of the information in the TORP was extracted from the National Survey on Recreation and the Environment (NSRE) and reports generated by the USFWS. Much of the data in the TORP was from a survey conducted in 2017 titled “Texas Residents’ Participation in and Attitudes Toward Outdoor Recreation by Responsive Management (Survey) on behalf of TPWD.

Benbrook Lake provides many recreation opportunities that help to meet the recreation needs identified in the TORP.

The TORP indicated the rates of participation for various outdoor activities in Texas, with Tarrant County and Benbrook Lake located in TORP Region 6. Across the entire state and in Region 6, walking for pleasure is the most popular outdoor activity, while the next most popular being picnicking, cookouts, and other gatherings. The top ten areas of participation for outdoor recreation are indicated in Figure 2.11.

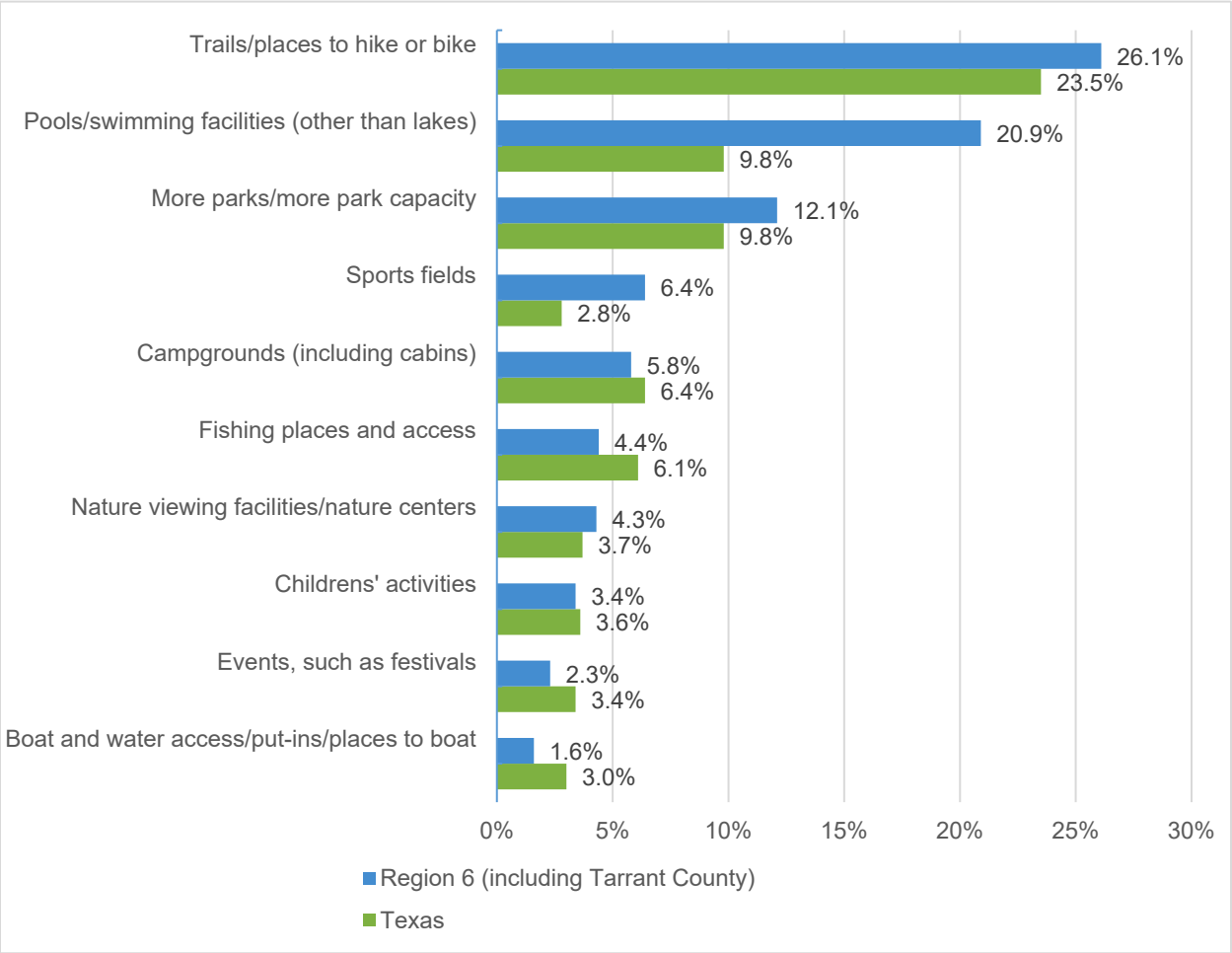
Figure 2.11 Top 10 Areas of Participation for Outdoor Recreation Activities



Source: TPWD TORP 2018

Asked "which outdoor recreation opportunities does your community currently lack or would like to see more of in your community," the top answer across the state and region was trails/places to hike/bike, and the next highest response was pools/swimming facilities (other than lakes). The top ten responses are indicated in Figure 2.12.

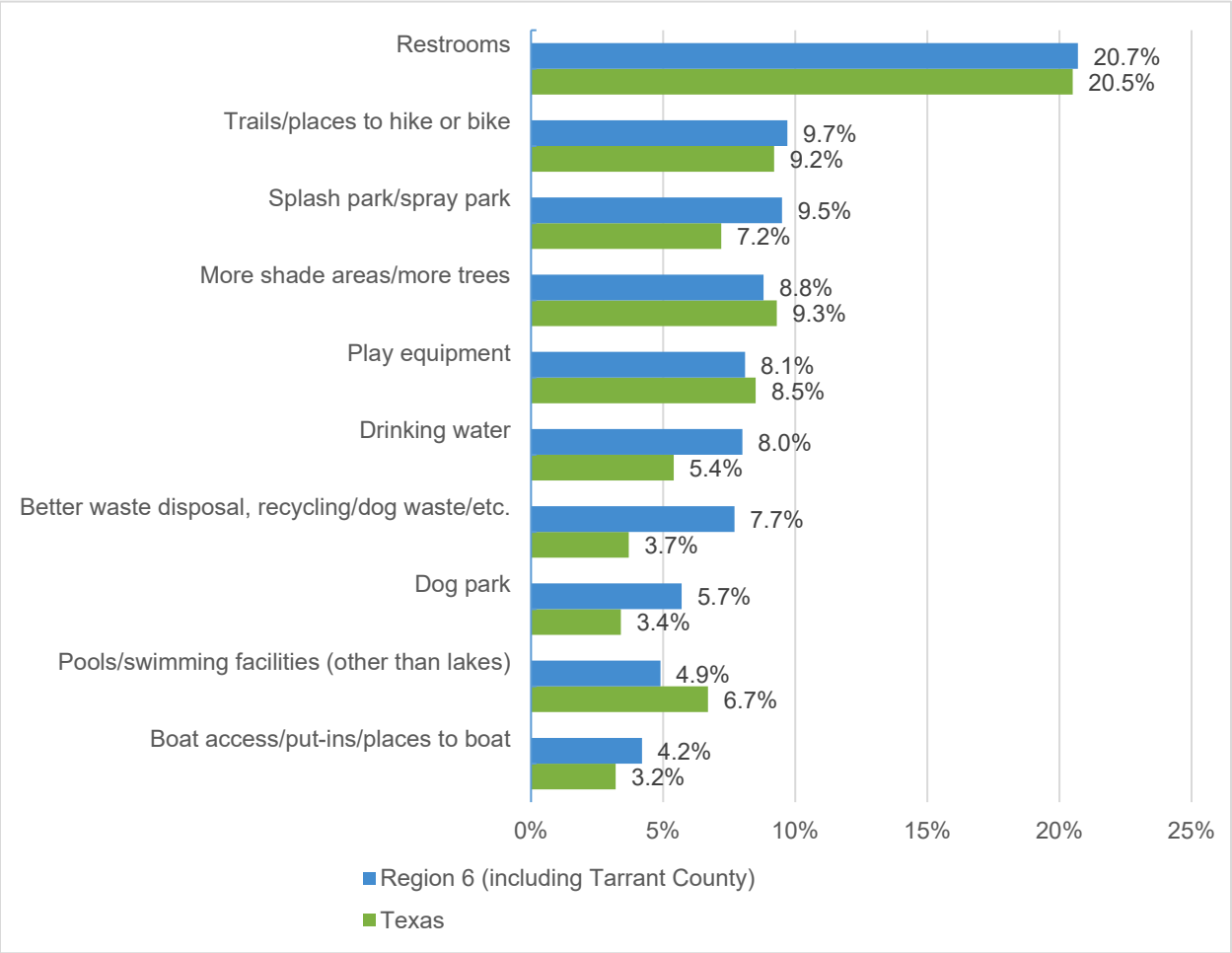
Figure 2.12 "Which outdoor recreation opportunities does your community currently lack or would like to see more of in your community?"



Source: TPWD TORP 2018

Additional findings from the Survey found that 34 percent of Texas residents and 27 percent of Region 6 residents have visited a state park during the past 12 months. Furthermore, 58 percent of Texas residents and 53 percent of Region 6 residents have visited a local park in the past 6 months (local park was defined as 30 minutes from respondents' home and not a state or national park). Within Region 6, 50 percent of survey respondents have visited a local park at least 5 times in the last 12 months, while 98 percent have visited a local park at least once in the past 12 months. Asked "which features or facilities do your local parks currently lack, or would you like to see more of at your local parks," the overwhelming response was more restroom facilities at 20.7 percent across Region 6 and 20.5 percent across Texas. The top ten responses to that survey question are indicated in Figure 2.13.

Figure 2.13 "Which features or facilities do your local parks currently lack, or would you like to see more of at your local parks?"



Source: TPWD TORP 2018

In accordance with historical visitation rates and recent outdoor recreation trends documented in the 2012 and 2018 TORP, camping in developed and primitive settings has declined significantly since 2000. In contrast, the TORP documented an increase in demand for day trip activities including hiking/walking for pleasure; picnicking, cookouts, or other gatherings; sightseeing; swimming in pools; attending outdoor festivals, shows, or events; and viewing/photographing wildlife/nature. The recreation activity most people say their community lacks is hiking/biking trails, swimming pool facilities, more park capacity, and more sports fields; with the demand for swimming pool facilities and more sports fields being much higher in the Region 6 than the entire state. In response to trends documented in the TORP, USACE will endeavor to improve access to some swim beaches and to develop trails in or adjacent to park areas as funding permits. USACE encourages partnerships with agencies who lease and manage parks to respond to increasing demands and build on the current quality of USACE parks for present and future visitors. Comments from the public mirrored the demand published in the TORP, as there were many comments from the public showing interest in additional trails at Benbrook lake.

The TORP documented a dramatic increase in the demand for motor homes and travel trailers, but it did not make the top-ten areas of participation or top-ten lacking recreation opportunities. Public comments also showed interest in new motor home and travel trailer facilities, as well as upgrades and improvements for larger vehicles and improvements to hookups including electrical, water, and internet/Wi-Fi connectivity. USACE intends to continue to operate campgrounds and day use areas by maintaining and improving existing facilities but has no long-range plans to add additional campsites or add new motor home or recreational vehicle facilities at Benbrook Lake. In response to comments and the increased trend documented in the TORP, USACE will continue to monitor demand for motor home and travel trailer facilities as well as other amenities. USACE will make needed upgrades based on changes in demand as funding permits.

2.6. REAL ESTATE

In May 1947, under the authorization of The River & Harbors Act of 1945, construction of Benbrook Lake began for the purposes of both flood risk management and navigation. This generally required fee simple acquisition of the area that closely followed and encompassed the 741.0 feet NGVD29 contour. In lieu of fee simple acquisition, flowage easements were acquired in the upper reaches of most tributaries where the configuration of required lands was relatively narrow. The boundary at Benbrook Lake is typically fenced.

Considering the reconveyance of approximately 3,683 acres of land, the current fee simple owned lands total approximately 8,746 acres. In addition to the fee land acquisition, approximately 3,200 acres of flowage easement were acquired up to elevation 741.0 feet NGVD29. A flowage easement, in general, grants to the government the perpetual right to temporarily flood/inundate private land during flood risk management operations and to prohibit activities on the flowage easement that would interfere with flood risk management operations such as placement of fill material or construction of habitable structures on flowage lands.

Benbrook Lake is part of a series of lakes, along with an extensive floodway system of levees, which are operated in a coordinated manner to minimize flooding along the Trinity River floodplain corridor in the Fort Worth and Dallas metroplex.

Table 2.18 Real Estate Fee and Flowage Acreage

Land	Acres
Fee Acres	8,746
Approximate Flowage Easement Acres	3,200
Total Acres	**11,946**

The fee simple and easement acreage identified in this master plan was obtained from the Real Estate Management Information System and is subject to change as the acquisition documents are audited.

Table 2.19 Outgrants at Benbrook Lake

Outgrant Type	Number
Leases	**3**
Park and Recreation Lease	2
Model Airplane Field	1
Easements	**47**
Sewer/water/storm drain	16
Gas pipeline	7
Road	8
Electric	15
Hike and Bike Trail	1
Licenses	**3**
Consents/Other	**62**
Driveway	3
Electric/Sewer Line	5
Oil/Gas Pipeline/Well	23
Earthworks/Pond/Pool	7
Structures	18
Other	6
Bureau of Land Management Leases	**7**
Total Outgrants	**122**

2.6.1. Guidelines for Property Adjacent to Public Land

It is the policy of the USACE to manage the natural, cultural and developed resources of Benbrook Lake to provide the public with safe and healthful recreational opportunities, while protecting and enhancing those resources. While private exclusive use of public land is not permitted, property owners adjacent to public lands do have all the same rights and privileges as any other citizen. Therefore, the information contained in these guidelines is designed to acquaint the adjoining landowner and other interested persons with the types of property involved in the management of Benbrook Lake. Adjoining landowners interested in more information should review section 6.3 on the Shoreline Management Policy or request additional information from the USACE office at Benbrook Lake.

2.6.2. Trespass and Encroachment

Government property is monitored by USACE personnel to identify and correct instances of unauthorized use, including trespasses and encroachments. The term “trespass” includes unauthorized transient use and occupancy, such as mowing, tree cutting and removal, livestock grazing, cultivation and harvesting crops, and any other alteration to Government property done without USACE approval. Unauthorized trespasses may result in a Title 36 citation to appear in Federal Magistrate Court, which

could subject the violator to fines or imprisonment (See Title 36 Code of Federal Regulations (CFR) Part 327 Rules and Regulations Governing Public Use of Water Resources Development Projects Administered by the Chief of Engineers). More serious trespasses will be referred to the USACE Office of Counsel for enforcement under state and federal law, which may require restoration of the premises and collection of monetary damages.

The term “encroachment” pertains to an unauthorized structure or improvement on Government property. When encroachments are discovered, lake personnel will attempt to resolve the issue at the project level. Where no resolution is reached, or where the encroachment is a permanent structure, the method of resolution will be determined by USACE Real Estate Division, with recommendations from Operations Division and Office of Counsel. USACE’s general policy is to require removal of encroachments, restoration of the premises, and collection of appropriate administrative costs and fair market value for the term of the unauthorized use.

2.7. PERTINENT PUBLIC LAWS

- Numerous public laws apply directly or indirectly to the management of Federal land at Benbrook Lake. Listed below are several key public laws that are most frequently referenced in planning and operational documents. Refer to Appendix D for a more comprehensive listing.

- Public Law 78-534, Flood Control Act of 1944. - Section 4 of the act as last amended in 1962 by Section 207 of Public Law 87-874 authorizes USACE to construct, maintain, and operate public parks and recreational facilities in reservoir areas and to grant leases and licenses for lands, including facilities, preferably to Federal, State or local governmental agencies.

- Public Law 85-624, Fish and Wildlife Coordination Act 1958. - This act as amended in 1965 sets down the general policy that fish and wildlife conservation shall receive equal consideration with other project purposes and be coordinated with other features of water resource development programs. Opportunities for improving fish and wildlife resources and adverse effects on these resources shall be examined along with other purposes which might be served by water resources development.

- Public Law 86-717, Forest Conservation. - This act provides for the protection of forest and other vegetative cover for reservoir areas under the jurisdiction of the Secretary of the Army and the Chief of Engineers.

- Public Law 89-72, Federal Water Project Recreation Act of 1965. - This act requires that not less than one-half of the separable costs of developing recreational facilities and all operation and maintenance costs at Federal reservoir projects shall be borne by a non-Federal public body. A Headquarters USACE (HQUSACE)/OMB implementation policy made these provisions applicable to projects completed prior to 1965.

- Public Law 91-190, National Environmental Policy Act of 1969 (NEPA). – NEPA declared it a national policy to encourage productive and enjoyable harmony between man and his environment, and for other purposes. Specifically, it declared a “continuing policy of the Federal Government... to use all practicable means and measures...to foster and promote the general welfare, to create conditions under which man and nature can exist in productive harmony, and fulfill the social, economic, and other requirements of present and future generations of Americans.” Section 102 authorized and directed that, to the fullest extent possible, the policies, regulations, and public law of the United States shall be interpreted and administered in accordance with the policies of the Act. It is Section 102 that requires consideration of environmental impacts associated with Federal actions. Section 101 of NEPA requires the federal government to use all practicable means to create and maintain conditions under which man and nature can exist in productive harmony.

  Specifically, Section 101 of the National Environmental Policy Act declares:

  - Fulfill the responsibilities of each generation as trustee of the environment for succeeding generations;

  - Assure for all Americans safe, healthful, productive, and aesthetically and culturally pleasing surroundings;

  - Attain the widest range of beneficial uses of the environment without degradation risk to health or safety or other undesirable and unintended consequences;

  - Preserve important historic, cultural, and natural aspects of our national heritage and maintain wherever possible an environment which supports diversity and variety of individual choice;

  - Achieve a balance between population and resource use which will permit high standards of living and a wide sharing of life's amenities: and

  - Enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources.

- PL 89-665, Historic Preservation Act of 1966. - This act provides for: (1) an expanded National Register of significant sites and objects; (2) matching grants to states undertaking historic and archeological resource inventories; and (3) a program of grants in aid to the National Trust for Historic Preservation; and (4) the establishment of an Advisory Council on Historic Preservation. Section 106 requires that the President’s Advisory Council on Historic Preservation have an opportunity to comment on any undertaking which adversely affects properties listed, nominated, or considered important enough to be included on the National Register of Historic Places.

- PL 101-601, Native American Graves Protection and Repatriation Act (16 November 1990), requires Federal agencies to return Native American human remains and cultural items, including funerary objects and sacred objects, to their respective peoples.

CHAPTER 3 – RESOURCE GOALS AND OBJECTIVES

3.1. INTRODUCTION

This chapter sets forth goals and objectives necessary to achieve the USACE vision for the future of Benbrook Lake. The terms “goal” and “objective” are often defined as synonymous, but in the context of this Master Plan goals express the overall desired end state of the Master Plan whereas resource objectives are specific task-oriented actions necessary to achieve the overall Master Plan goals.

3.2. RESOURCE GOALS

The following statements, paraphrased from *EP 1130-2-550*, Chapter 3, express the goals for the Benbrook Lake Master Plan (see section 3.3 for Resource Goals applicability to Resource Objectives):

GOAL A. Provide the best management practices to respond to regional needs, resource capabilities and capacities, and expressed public interests consistent with authorized project purposes.

GOAL B. Protect and manage the project’s natural and cultural resources through sustainable environmental stewardship programs.

GOAL C. Provide public outdoor recreation opportunities that support project purposes and public interests while sustaining the project’s natural resources.

GOAL D. Recognize the project’s unique qualities, characteristics, and potentials.

GOAL E. Provide consistency and compatibility with national objectives and other State and regional goals and programs.

In addition to the above goals, USACE management activities are guided by USACE-wide Environmental Operating Principles as follows:

- Strive to achieve environmental sustainability. An environment maintained in a healthy, diverse, and sustainable condition is necessary to support life.
- Recognize the interdependence of life and the physical environment. Proactively consider environmental consequences of USACE programs and act accordingly in all appropriate circumstances.
- Seek balance and synergy among human development activities and natural systems by designing economic and environmental solutions that support and reinforce one another.

- Continue to accept corporate responsibility and accountability under the law for activities and decisions under our control that impact human health and welfare and the continued viability of natural systems.

- Seek ways and means to assess and mitigate cumulative impacts to the environment; bringing systems approaches to the full life cycle of our processes and work.

- Build and share an integrated scientific, economic, and social knowledge base that supports a greater understanding of the environment and impacts of our work.

- Respect the views of individuals and groups interested in USACE activities; listen to them actively and learn from their perspective in the search to find innovative win-win solutions to the nation's problems that also protect and enhance the environment.

3.3. RESOURCE OBJECTIVES

Resource objectives are clearly written statements that respond to identified issues and that specify measurable and attainable activities for resource development and/or management of the lands and waters under the jurisdiction of the Fort Worth District, Benbrook Lake Project Office. The objectives stated in this Master Plan support the goals of the Master Plan, USACE Environmental Operating Principles (EOPs), and applicable national performance measures. They are consistent with authorized project purposes, Federal laws and directives, regional needs, resource capabilities, and they consider public input. Recreational and natural resources carrying capacities are also accounted for during development of the objectives found in this Master Plan. Regional and State planning documents including TPWD's 2012 Texas Conservation Action Plan (TCAP) and TORP are monitored for applicability to Benbrook Lake. Finally, these objectives are consistent with the management objectives of the cities of Benbrook and Fort Worth at the distinct parcels of USACE land they manage under lease agreements with USACE.

The objectives in this master plan provide project benefits, meet public needs, and foster environmental sustainability for Benbrook Lake to the greatest extent possible as funding permits. They include recreational objectives, natural resource management objectives, visitor information, education and outreach objectives, general management objectives, and cultural resource management objectives.

Table 3.1 Recreational Objectives

Recreational Objectives	Goals				
	A	B	C	D	E
In cooperation with the cities of Benbrook and Fort Worth as well as TPWD, evaluate the demand for improved recreation facilities and increased public access on USACE-administered public lands and water for recreational activities (i.e. camping,	*		*		

Recreational Objectives	Goals				
	A	B	C	D	E
walking, hiking, biking, boating, fishing, wildlife viewing, etc.) and facilities (i.e. campsites, picnic facilities, overlooks, all types of trails, boat ramps, courtesy docks, interpretive signs/exhibits, and parking lots).					
Monitor the condition and quality of day use and campground facilities within USACE managed and leased areas including but not limited to roads, sewer hook ups, potable water systems, electrical service, concrete or asphalt recreational vehicle pads, tent pads, restrooms, trails, pavilions, and park entrances.	*		*		
Monitor public use levels (with a special focus on boating congestion and marina capacity) and evaluate potential impacts from overuse and crowding. Take action to prevent/remediate overuse, conflict, and public safety concerns.	*		*		
Evaluate water surface classification and regulations with emphasis on designated no-wake areas, natural resource protection, quality recreational opportunities, and public safety concerns.	*				
Follow the Environmental Operating Principles associated with recreational use of waterways for all water-based management activities and plans.		*	*		*
Encourage an increase of universally accessible facilities on Benbrook Lake.	*		*		*
Consider flood/conservation pool elevations to address potential impact to recreational facilities (i.e. campsites, boat ramps, courtesy docks, etc.).	*	*	*	*	
Ensure consistency with USACE Recreation Strategic Plan.					*
Monitor the TCAP, the TORP, and adjacent municipality plans to insure that USACE is responsive to outdoor recreation trends, public needs, and resource protection within a regional framework. All plans by others will be evaluated considering USACE policy and operational aspects of Benbrook Lake.					*

1721 *Denotes that the objective helps to meet the specified goal.

1722 **Table 3.2 Natural Resource Management Objectives**

Natural Resource Management Objectives	GOALS:				
	A	B	C	D	E
Consider flood/conservation pool levels to ensure that natural resources are managed in ways that are compatible with primary project purposes of flood risk management and water supply.	*	*		*	
Ensure project lands are managed with preservation and conservation of natural habitat and open space as a primary objective in order to maintain availability of public open space.	*			*	

Natural Resource Management Objectives	GOALS:				
	A	B	C	D	E
Actively manage and conserve fish and wildlife resources, especially migratory and other special status species, by implementing ecosystem management principles. Key among these principles is the use of native species adapted to the ecological region in restoration and mitigation plans.	*	*		*	*
Consider watershed approach during decision-making process.					*
Optimize resources, labor, funds, and partnerships for protection and restoration of fish and wildlife habitats.		*			*
Minimize activities that disturb the scenic beauty and aesthetics of the lake.	*	*	*	*	
Continually evaluate erosion control and sedimentation issues at Benbrook Lake and develop alternatives to resolve the issues.	*	*			*
Address unauthorized uses of public lands such as off-road vehicle use, trash dumping, unauthorized fires, fireworks, poaching, clearing of vegetation, unauthorized trails and paths, and placement of advertising signs that create negative environmental impacts.	*	*	*	*	*
Monitor lands and waters for invasive, non-native, and aggressively spreading native species and take action to prevent and/or reduce the spread of these species as funding permits. and to promote the vigor of native prairie grasses and forbs.	*	*		*	*
Protect and/or restore important native habitats such as riparian zones, wetlands, and native prairie where they occur, or historically occurred on project lands. Special emphasis should be taken to protect and/or restore special or rare plant communities, to include actions that promote butterfly and/or pollinator habitat, migratory bird habitat, and habitat for birds listed by USFWS as Birds of Conservation Concerns.	*	*	*	*	*
Administer shoreline management to balance private shoreline uses (such as mowing or vegetation removal requests along the Federal property boundary, or paths to the shoreline) with wildlife habitat protection and impacts to public use.	*		*		

1723 *Denotes that the objective helps to meet the specified goal.

1724 **Table 3.3 Visitor Information, Education, and Outreach Objectives**

Visitor Information, Education and Outreach Objectives	Goal				
	A	B	C	D	E
Provide more opportunities for communication with lessees, agencies, special interest groups, and the general public (i.e. comment cards, updates to City Managers, web page).	*			*	*

Visitor Information, Education and Outreach Objectives	Goal				
	A	B	C	D	E
Implement more educational, interpretive, and outreach programs at the lake office and around the lake. Topics to include the lake history, lake operations (flood risk management and water supply), water safety, recreation, nature, cultural resources, ecology, and USACE missions.	*	*	*	*	*
Enhance network among local, state, and federal agencies in order to exchange lake-related information for public education and management purposes.	*			*	*
Increase public awareness of special use permits or other authorizations required for special activities, organized special events, and commercial activities on public lands and waters of the lake.	*	*	*		
Capture trends concerning boating accidents and other incidents on public lands and waters and coordinate data collection with other public safety officials.	*		*	*	*
Promote USACE Water Safety message.	*		*	*	*
Educate adjacent landowners on shoreline management policies and permit processes in order to reduce encroachment actions.	*	*	*	*	*

*Denotes that the objective helps to meet the specified goal.

Table 3.4 General Management Objectives

General Management Objectives	Goal				
	A	B	C	D	E
Maintain the USACE boundary line to ensure it is clearly marked and recognizable in all areas to reduce habitat degradation and encroachment actions.	*	*		*	
Secure sustainable funding for the shoreline management program.	*	*	*	*	*
Ensure consistency with USACE Campaign Plan (national level), IPlan (regional level), and OPlan (District level).					*
Ensure green design, construction, and operation practices, such as the Leadership in Energy and Environmental Design (LEED) criteria for government facilities, are considered as well as applicable Executive Orders.					*
Carefully manage non-recreation outgrants such as utility and road easements in accordance with national guidance set forth in ER-1130-2-550 and applicable chapters in ER 405-1-12.	*	*			*
Manage project lands and recreational programs to advance broad national climate change mitigation goals, including but not limited to climate change resilience and carbon sequestration, as set forth in Executive Order 13834 and related USACE policy.					*

*Denotes that the objective helps to meet the specified goal.

Table 3.5 Cultural Resources Management Objectives

Cultural Resources Management Objectives	Goal				
	A	B	C	D	E
Monitor and coordinate lake development and the protection of cultural resources with lessees and appropriate entities.	*	*		*	*
Complete an inventory of cultural resources.	*	*		*	*
Increase public awareness and education of regional history.		*		*	*
Ensure any future historical preservation is fully integrated into the Benbrook Lake Master Plan and planning decision making process (Section 106 and 110 of the National Historic Preservation Act; the Archeological Resources Protection Act; and the Native American Graves Protection and Repatriation Act) on public lands surrounding the lake.		*		*	*
Develop partnerships that promote and protect cultural resources at Benbrook Lake.		*	*	*	*
Stop unauthorized use of public lands as it pertains to the illegal excavation and removal of cultural resources.		*		*	*

*Denotes that the objective helps to meet the specified goal.

CHAPTER 4 – LAND ALLOCATION, LAND CLASSIFICATION, WATER SURFACE, AND PROJECT EASEMENT LANDS

4.1. LAND ALLOCATION

All lands at USACE water resource development projects are allocated by USACE into one of four categories in accordance with the congressionally authorized purpose for which the project lands were acquired: Operations, Recreation, Fish and Wildlife, and Mitigation. At Benbrook Lake, the only land allocation category that applies is Operations, which is defined as those lands that are required to operate the project for the primary authorized purposes of flood risk management, hydroelectric power, and water conservation. The remaining allocations of Recreation, Fish and Wildlife, and Mitigation would apply only if lands had been acquired specifically for these purposes. The entire fee simple federal estate at Benbrook Lake is 8,260 acres of which 3,635 acres is inundated at conservation pool.

4.2. LAND CLASSIFICATION

The previous version of the Benbrook Lake Master Plan included some land classification criteria that were similar to the current criteria. These prior land classifications were based on predicted projected need rather than actual experience, which resulted in some areas being classified for a type of use that has not or is not likely to occur. Additionally, in the 48 years since the previous Master Plan was published, wildlife habitat values, surrounding land use, and regional recreation trends have changed giving rise to the need for revised classifications. Refer to Table 8.1 in Chapter 8 for a summary of land classification changes from the prior classifications to the current classifications.

4.2.1. Current Land and Water Surface Classifications

USACE regulations require project lands and waters to be classified in accordance with the primary use for which project lands are managed. At Benbrook Lake, there are five land classification and three subclassifications identified in USACE regulations, as well as four water designations including:

- Project Operations
- High Density Recreation
- Mitigation
- Environmentally Sensitive Areas
- Multiple Resource Management Lands
    - Wildlife Management
    - Vegetative Management
    - Future/Inactive Recreation
- Water Surface
    - Restricted Areas

- Designated No Wake Areas
- Fish and Wildlife Sanctuary
- Open Recreation

The revised land and water surface classifications for Benbrook Lake were established after considering public comments, key stakeholder's input including elected officials, city and county governments, lessees operating on USACE land, and USACE expert assessment. Additionally, wildlife habitat values and the trends analysis provided in TPWD's TORP and 2012 TCAP were used in decision making. Maps showing the various land classifications can be found in Appendix A. Each of the land classifications, including the acreage and description of allowable uses, is described in the following paragraphs.

4.2.2. Project Operations

This classification includes the lands managed for operation of the dam, project office, and maintenance yards, all of which must be maintained to carry out the authorized purpose of flood risk management. In addition to the operational activities taking place on these lands, limited recreational use may be allowed for activities such as public access to the road on top of the dam. Regardless of any limited recreation use allowed on these lands, the primary classification of Project Operations will take precedent over other uses. There are 234 acres of Project Operations land specifically managed for this purpose.

4.2.3. High Density Recreation (HDR)

These are lands developed for intensive recreational activities for the visiting public including day use areas, campgrounds, marinas and related concession areas. Recreation development by lessees operating on USACE lands must follow policy guidance contained in USACE regulations at ER 1130-2-550, Chapter 16. That policy includes the following statement:

> *"The primary rationale for any future recreation development must be dependent on the project's natural or other resources. This dependency is typically reflected in facilities that accommodate or support water-based activities, overnight use, and day use such as marinas, campgrounds, picnic areas, trails, swimming beaches, boat launching ramps, and comprehensive resort facilities. Examples that do not rely on the project's natural or other resources include theme parks or ride-type attractions, sports or concert stadiums, and standalone facilities such as restaurants, bars, motels, hotels, non-transient trailers, and golf courses. Normally, the recreation facilities that are dependent on the project's natural or other resources, and accommodate or support water-based activities, overnight use, and day use, are approved first as primary facilities followed by those facilities that support them. Any support facilities (e.g., playgrounds, multipurpose sports fields, overnight facilities, restaurants, camp*

stores, bait shops, comfort stations, and boat repair facilities) must also enhance the recreation experience, be dependent on the resource-based facilities, and be secondary to the original intent of the recreation development…"

Lands classified for High Density Recreation are suitable for the development of comprehensive resorts. The regulation cited above defines Comprehensive Resort as follows:

"Typically, multi-faceted developments with facilities such as marinas, lodging, conference centers, golf courses, tennis courts, restaurants, and other similar facilities."

At Benbrook Lake, prior land classifications included a number of areas under the recreation classification. Several of these areas, including Holiday Park, Longhorn Park, Bear Creek Park, Mustang Park, Rocky Creek Park, and Pecan Valley Park were developed for recreation, hunting, and interim recreation as areas would be developed in the future. Using public, agency, and lessee input, the planning team revised the classification of some of these lands to reflect current and projected outdoor recreation needs and trends. At Benbrook Lake there are 1,761 acres classified as High Density Recreation land. Each of the High Density Recreation areas is described briefly in Chapter 5 of this Plan.

Prior land classifications at Benbrook Lake identified several tracts for future high density recreation development but included them all as recreation. However, much of that land is not suitable for recreation or would be better classified to protect natural resources such as Environmentally Sensitive Areas, Wildlife Management, or Vegetation Management. Several areas of existing parks are less developed but will remain HDR, which will allow for the cities of Benbrook and Fort Worth to further develop them as needed. The City of Benbrook has expressed plans for additional development within Holiday Park and requested that it remain HDR to allow for expanding development. The City of Fort Worth is growing rapidly to the east of Benbrook Lake, and it is likely that USACE or the city of Fort Worth will need to further develop parks on the east side of Benbrook Lake and will need to keep areas as HDR which to meet those recreation needs. This growth is expected during the 25-year planning horizon of this Master Plan, so some areas on the east side should be classified as HDR in anticipation for that growing demand.

4.2.4. Mitigation

This classification is used only for lands set aside for mitigation for the purpose of offsetting losses associated with the development of the project. This is not the same as allocated lands that are purchased for the purpose of mitigation. There are no lands at Benbrook Lake with this classification.

4.2.5. Environmentally Sensitive Areas (ESA)

These are areas where scientific, ecological, cultural, and aesthetic features have been identified. At Benbrook Lake several distinct areas have been classified as Environmentally Sensitive Areas (ESA), primarily for the protection of sensitive habitats or cultural resources. Each of these areas is discussed in Chapter 5 of this Plan and illustrated on the maps in Appendix A. There are 1,122 acres classified as ESA at Benbrook Lake.

4.2.6. Multiple Resource Management Lands (MRML)

This classification is divided into four sub-classifications identified as: Low Density Recreation, Wildlife Management, Vegetative Management, and Future/Inactive Recreation Areas. A given tract of land may be classified using one or more of these sub-classifications, but the primary sub classification should reflect the dominant use of the land. Typically, Multiple Resource Management Lands support only passive, non-intrusive uses with very limited facilities or infrastructure. Where needed, some areas may require basic facilities that include, but are not limited to minimal parking space, a small boat ramp, and/or primitive sanitary facilities. There are 1,257 acres of land under this classification at Benbrook Lake. The following paragraphs list each of the sub-classifications, and the number of acres and primary uses of each.

Wildlife Management (WM)

This land classification applies to lands managed primarily for the conservation of fish and wildlife habitat. These lands generally include comparatively large contiguous parcels. Passive recreation uses such as natural surface trails, fishing, hunting, and wildlife observation are compatible with this classification unless restrictions are necessary to protect sensitive species or to promote public safety. There are 128 acres of land included in this classification at Benbrook Lake.

Vegetative Management (VM)

These are lands designated for stewardship of forest, prairie, and other native vegetative cover. Passive recreation activities previously described may be allowed in these areas. There are 1,129 acres of land included in this classification at Benbrook Lake.

Future or Inactive Recreation

These are lands with site characteristics compatible with High Density Recreation development but have been undeveloped or planned for very long-range recreation needs. There are no areas classified as Future or Inactive Recreation.

4.2.7. Water Surface

USACE regulations specify four possible sub-categories of water surface classification. These classifications are intended to promote public safety, protect

resources, or protect project operational features such as the dam and spillway. These areas are typically marked by USACE or lessees with navigational or informational buoys, signs, or are denoted on public maps and brochures. The Water Surface Classification map can be found in Appendix A of this Plan. The four sub-categories of water surface classification are Restricted, Designated No Wake, Fish and Wildlife Sanctuary, and Open Recreation.

Restricted.

Restricted water surface includes those areas where recreational boating is prohibited or restricted for project operations, safety, and security purposes. The areas include the water surface immediately surrounding the gate control tower upstream of the Benbrook Lake Dam as well as around the water intake towers and three designated swim beaches at Benbrook Lake parks. There are 9 acres of restricted water surface at Benbrook Lake.

Designated No-Wake

Designated No-Wake areas are intended to protect environmentally sensitive shorelines and improve boating safety near key recreational water access areas such as boat ramps. There are twelve boat ramps, one marina at Benbrook Lake, an area of shoreline in Mustang Park, and the site of the former Rocky Creek Marina where no-wake restrictions are in place for reasons of public safety and protection of property. There are 115 acres of designated no-wake water surface at Benbrook Lake.

Fish and Wildlife Sanctuary

This water surface classification applies to areas with annual or seasonal restrictions to protect fish and wildlife species during periods of migration, resting, feeding, nesting, and/or spawning. Benbrook Lake has no water surface areas designated as a Fish and Wildlife Sanctuary.

Open Recreation

Open Recreation includes all water surface areas available for year-round or seasonal water-based recreational use. This classification encompasses the majority of the lake water surface and is open to general recreational boating. Boaters are advised through maps and brochures, or signs at boat ramps and marinas, that navigational hazards may be present at any time and at any location in these areas. Operation of a boat in these areas is at the owner's risk. Specific navigational hazards may or may not be marked with a buoy. There are 3,461 acres of open recreation water surface at Benbrook Lake.

4.2.8. Recreational Seaplane Operations

Seaplane restrictions are part of Title 36 Code of Federal Regulations. At Benbrook Lake and other USACE lakes across the nation, areas where recreational seaplane operations are prohibited were established through public meetings and

environmental assessments circa 1980. The seaplane policy for USACE Fort Worth District is found in the Notice to Seaplane Pilots (see Appendix E), which lays out the general restrictions as well as lake-specific restrictions for seaplane operation. Due to potential hazards from sub-surface tree stumps and fluctuating water levels; seaplane operations at Benbrook Lake are generally prohibited in all areas.

Table 4.1 provides a summary of the new land and water surface classifications and acreage at Benbrook Lake. Acreages were calculated by historical and GIS data. A map representing these areas can be found in Appendix A.

Table 4.1 Land and Water Surface Classification and Acreage

Land Classifications	Acres		Water Surface Classifications	Acres
Project Operations	234		**Restricted**	9
High Density Recreation	1,761		**Designated No Wake**	115
Environmentally Sensitive Areas	1,122		**Open Recreation**	3,511
Multiple Resource Management – Vegetative Management	1,129		**Total Water Surface Classification**	**3,635**
Multiple Resource Management – Wildlife Management	128			

*Total Acreage differences from the 1972 total to the 2021 totals are due to improvements in measurement technology, deposition/siltation, and erosion.

4.3. PROJECT EASEMENT LANDS

Project Easement Lands are primarily lands on which easement interests were acquired. Fee title was not acquired on these lands, but the easement interests convey to the Federal government certain rights to use and/or restrict the use of the land for specific purposes. Easement lands are typically classified as Operations Easement, Flowage Easement, and/or Conservation Easement. Flowage easement lands are the only easements that exist at Benbrook Lake. A flowage easement, in general, grants to the government the perpetual right to temporarily flood/inundate private land during flood risk management operations and to prohibit activities on the flowage easement that would interfere with flood risk management operations such as placement of fill material or construction of habitable structures. There are approximately 3,200 acres of flowage easements lands at Benbrook Lake.

CHAPTER 5 – RESOURCE PLAN

5.1. MANAGEMENT BY CLASSIFICATION

This chapter describes the management plans for each land use classification within the Master Plan. The classifications that exist at Benbrook Lake are Project Operations (PO), High Density Recreation (HDR), Environmentally Sensitive Area (ESA), and Multiple Resource Management Lands (MRML) on which a predominant use is specified including Vegetative Management (VM) and Wildlife Management (WM). The water surface is also classified into sub-classifications of Restricted, Designated No Wake, and Open Recreation. The management plans describe how the project lands and water surface will be managed in broad terms. A more descriptive plan for managing these lands can be found in the Benbrook Lake Operations Management Plan (OMP) parks and recreation plans prepared by the city of Fort Worth and the City of Benbrook in their respective park lease areas. Acreages shown for the various land classifications were calculated using GIS technology and may not agree with lease documents, prior publications, or official land acquisition records.

5.2. PROJECT OPERATIONS

The Project Operations (PO) classification is land associated with the dam, spillway, levees, lake office, maintenance facilities, and other areas managed solely for the operation and fulfillment of the primary mission of the project.

5.3. HIGH DENSITY RECREATION

Benbrook Lake has 1,761 acres classified as High Density Recreation. These lands are developed for intensive recreational activities for the visiting public including day use and campgrounds. National USACE policy set forth in ER 1130-2-550, Chapter 16, limits recreation development on USACE lands to those activities that are dependent on a project's natural resources and typically include water-based activities, overnight use, and day use such as marinas, campgrounds, picnic areas, trails, swimming beaches, boat launching ramps and comprehensive resorts. Examples of activities that are not dependent on a project's natural resources include theme parks or ride-type attractions, sports or concert stadiums, and stand-alone facilities such as restaurants, bars, motels, hotels, and golf courses.

USACE operates and manages numerous areas designated as High Density Recreation. In addition to the USACE managed and operated High Density Recreation areas, recreation facilities on Federal land at Benbrook Lake are currently leased to and operated and maintained by The City of Benbrook at Dutch Branch Park, and the City of Fort Worth at Pecan Valley Park, Golf Course, and Day Use Area. The City of Benbrook also provides the following through subleases: Benbrook Community Center with YMCA, Benbrook Marina, Benbrook Stables, driving range, miniature golf, par-3 golf courses, batting cages, and trailhead access to hiking and equestrian trails. Fort Worth's Pecan Valley Park is home to Fort Worth's most popular municipal golf course,

and subleases provide a large soccer complex and soapbox derby raceway which is currently not in use. USACE operates and manages Holiday Park, Bear Creek Park, Mustang Park, Rocky Creek Park, and Longhorn Park, while also administering the Federal lands and water surface at Benbrook Lake for environmental stewardship purposes. Refer to the maps in Appendix A for an overview of maps showing existing parks and facilities and the lands managed by each managing entity. Following is a brief description of these parks and notes the recreational partners who manage them.

5.3.1. Parks Operated by USACE

The management plan for all the parks listed below is to continue to operate them as day use areas and access points by maintaining and improving existing facilities. Emphasis will be placed on improvements such as upgrading aging water and electrical infrastructure, repairing or replacing outdated restrooms, paving gravel roads in some parks and installing site amenities such as fire rings, lantern posts and cookers, as funds and personnel allow. Adding new or upgrading existing trails within parks will be considered in cooperation with other agency partners for development and operation.

Holiday Park – Located on the west and northwest portion of the lake, Holiday Park is home to a day use area (often called North Holiday Park) and campground area (often called South Holiday Park). The Holiday Park day use area is the largest and most popular day use area and is open year-round. Holiday Park includes the following amenities: nearly three miles of shoreline, four day-use restrooms and three restrooms with showers, five boat ramps, a designated swimming beach, 105 campsites, fishing pier, one campsite specifically for equestrian use, and direct access to over 14 miles of equestrian trails. Holiday Park includes some undeveloped areas designated as High Density Recreation, since future demand is projected to need additional recreational facilities and to protect sensitive habitat when future recreation needs continue to grow.

Longhorn Park – Located on the northeast portion of the lake near the lake office, this day use only area is open year-round. The following are the amenities that the park provides: picnic area, two boat ramps, ball field, horseshoe pits, and sand volleyball court. The shoreline here is not suitable for wading due to steep slopes, so there are no designated swimming areas; however, swimming is popular among boaters.

Westcreek Circle (Mustang Park) – Located on the southwest portion of the lake, this limited-development park contains primitive camping and offers access to Bear Creek and over 14 miles of equestrian and hiking trails. There are no restrooms, water, or electricity in the park.

Mustang Point – Located on the southern portion of the lake, it provides access to swimming and picnicking facilities, and primitive camping, 2 boat ramps, and to a model airplane field. With the exception of the model airplane field, the park is owned and operated by USACE. The model airplane field is leased and operated by Fort Worth Thunderbirds Radio-controlled Model Airplane Club.

Rocky Creek Park – Located on the southeast portion of the lake, this campground provides 11 primitive camp sites and open space for picnicking. The park has three restrooms and at one time was home to a marina and has potential for one in the future if there were adequate demand.

Bear Creek Campground – Located on the south end of Benbrook Lake, Bear Creek Campground provides 40 campsites; three restrooms, two of which provide showers; and two boat ramps. There is also a group camping facility with large group pavilion, 6 individual camp sites, and hookups.

5.3.2. Parks and/or Recreation Areas Operated by Others and through Lease Agreements

Recreational outgrants are issued in the form of permits or leases to recreational partners, referred to as grantees, at the lake. Each grantee is responsible for the operation and maintenance of their leased area, and although USACE does not provide direct maintenance within any of the leased locations, it may occasionally lend support where appropriate. All leases at Benbrook Lake with the exception of the Thunderbirds Radio-Controlled Model Airplane Field are through the Cities of Benbrook and Fort Worth or are managed through a sublease through those cities. The USACE reviews requests and ensures compliance with applicable laws and regulations for proposed activities in all leased and USACE-operated HDR areas. USACE works with partners to ensure that recreation areas are managed and operated in accordance with the objectives prescribed in Chapter 3 of this Plan. The following is a description of each leased park.

Benbrook Stables – The stables are located between Dutch Branch Park, Lake Shore Drive, and Benbrook Boulevard and cover 60 acres. Stable amenities include direct and indirect access to Benbrook Lake's 24 miles of horse trails, stable rentals, and guided trail rides. It is part of the City of Benbrook lease area and subleased by a private party.

Driving range, miniature and par 3 golf courses, batting cages – Located by the Benbrook Community Center and Beach Road, these facilities are part of the City of Benbrook lease area and subleased to a private party.

Dutch Branch Park Day Use Area – Dutch Branch Park is located between Benbrook Stables and Benbrook Community Center. Park amenities include two playgrounds, walking track, two lighted sand volleyball courts, multi-use courts, soccer fields, baseball and softball fields, duck pond, pavilions, picnic areas with grills, and restrooms. Fort Worth Independent School District operates a baseball and softball field, while most of the park is leased and operated by the City of Benbrook. The City of Benbrook has shown interest in further developing Dutch Branch Park, including the possibility of a comprehensive development or resort.

Benbrook Community Center with YMCA – Located on the northwest side of Benbrook Lake and part of Dutch Branch Park, the Community Center serves as

multifunction role of providing meeting spaces for various community activities as well as a health and wellness center. It is leased by the City of Benbrook, while the YMCA operates the Community Center through a sublease to YMCA of Fort Worth.

Pecan Valley Park Day Use Area – Located immediately north of Benbrook Dam, this park is home to one of the City of Fort Worth's municipal golf courses, Pecan Valley Golf Course. Additionally, the city of Fort Worth subleases the operation of a large soccer complex and soapbox derby raceway in this park, although the soapbox derby raceway is currently not operational.

Baja Beach – Located immediately south of Benbrook Dam on the western side of the lake, this day use only area contains a beach and a fishing pier. Access is only available to local residents who pay a required yearly deposit. It is operated by the City of Benbrook.

Fort Worth Thunderbirds Radio-Controlled Model Airplane Field – The field is located between Bear Creek and Mustang Point areas of Mustang Park. The Fort Worth Thunderbirds Radio-Controlled Model Airplane Club leases and operates the model airplane field and parking lot.

5.3.3. Boat Ramps and Marinas

There are twelve (12) boat ramps operated by USACE at Benbrook Lake and marina with boat ramp operated by a private sublease that provide recreational access to the lake. These have varying hours of operation and have a fee associated with their use. Ramps may be closed from time to time due to flooding or other damage. The maps in Appendix A of this Plan indicate the location of these ramps. Currently, there are no plans to expand or add additional boat ramps at Benbrook Lake. Management will continue to maintain and improve facilities as time and funding permits.

Benbrook Marina– Located on the Dutch Branch Creek within Dutch Branch Park on Benbrook Lake, the marina amenities include private boat slips; a land-based boat storage facility; a two-lane boat ramp; boat dock; bait and tackle store; and bank fishing. It is part of the City of Benbrook lease area and subleased and operated by a private party.

5.3.4. Trails

As stated in the TORP, there is a growing demand for trails of all kinds. Benbrook Lake features a wide variety of trails and connects to the Fort Worth Trinity Trail network at Memorial Oak, part of Pecan Valley Park. Fort Worth Trinity Trail has approximately twenty-five miles of paved hike and bike trails running along the Trinity River and some of its tributaries. The paved trail continues through the Winscott Prairie, along Winscott Road, and ends at Dutch Branch Park. A map of the Fort Worth Trinity Trail showing the trails and trailhead on Federal property is located in Appendix A.

Unpaved trails continue through prairies, upland and bottomland forests, and along portions of the lake shoreline. Part of the National Trails System, Benbrook Lake

offers fourteen miles of equestrian and hiking trails with trailheads in Dutch Branch Park, Holiday Park Campground, and Westcreek Circle. An additional ten miles of trails are within and north of Rocky Creek Park, with the trailhead located just outside the Rocky Greek Park gatehouse. These trails are for day-use trips only, and camping is not allowed anywhere along the trails; however, there is a single designated campsite in the Holiday Park Campground that is intended for use by equestrian trail users. USACE owns and operates all the equestrian trails; however, volunteers through the Texas Equestrian Trail Riders Association (TETRA) maintain some of the equestrian trails at Benbrook Lake. TETRA's Benbrook Horse and Nature Trails map is located in Appendix A.

5.4. ENVIRONMENTALLY SENSITIVE AREAS

Two different types of assessments were completed at Benbrook Lake to examine the quality of natural resources; a Wildlife Habitat Appraisal Procedure (WHAP) completed 8-11 April 2019, and a Prairie Survey 7-11 October 2019. The Wildlife Habitat Appraisal Procedure (WHAP) is a tool developed by TPWD to evaluate the quality of habitat for wildlife, giving each point a rating based on a set criteria (see Appendix C). The Prairie Survey is a United States Agriculture Department (USDA) used to describe the prairie quality (see Appendix C). These assessments were used, in part, to assist in determining which areas should be classified as ESA. Other factors, including public and stakeholder comment, the presence of cultural resources, presence of species of conservation concern, and visual esthetics were also included in the selection of ESA areas. These areas are to be protected from intense development or disturbance from future land use actions such as utility or road easements. Passive public use such as natural surface trails, bank fishing, and nature study are appropriate for these areas.

At Benbrook Lake, seventeen areas totaling approximately 1,122 acres were classification as ESA. Each of these areas are numbered on the land classification maps in Appendix A. Table 5.1 provides a listing, brief description, and management priorities for the ESA areas, including habitat type, acreage, WHAP scores and a location description. WHAP scores can be as high as 1.00; in general, scores above 0.60 are considered good habitat, and scores above 0.80 are considered excellent habitat. More information about the WHAP are available in the WHAP Report in Appendix C.

Table 5.1 ESA Listing

ESA#	Acres	WHAP Score(s)	Location and Description
ESA1	33.3	0.69, 0.71, 0.85	ESA1 is primarily grassland within the Grand Prairie Ecoregion. Benbrook Lake resides in the sub section of the Grand Prairie named the Fort Worth Prairie. In general, grasslands across Texas are shrinking, and specifically the Fort Worth Prairie is subsequently shrinking as well. One of the highest scoring grasslands from the WHAP was within this area, scoring 0.85. This

ESA#	Acres	WHAP Score(s)	Location and Description
			ESA also starts a contiguous tract of grasslands between ESA1–ESA5.
ESA2	61.8	0.52, 0.58, 0.78, 0.92	ESA2 includes grassland within the Fort Worth Prairie as well as some shoreline wetlands, containing both herbaceous and woody species. One of the highest scoring grasslands from the WHAP was within this area, scoring 0.92. This ESA includes a contiguous tract of grasslands between ESA1–ESA5.
ESA3	43.1	0.68, 0.69, 0.76, 0.88, 1.00	ESA3 includes grassland within the Grand Prairie Ecoregion. Grasslands across Texas are shrinking, and specifically the Fort Worth Prairie is shrinking across the DFW Metropolitan area. One of the highest scoring grasslands from the WHAP was within this area, scoring 1.00. This ESA includes a contiguous patch of grasslands between ESA1–ESA5.
ESA4	43.2	0.55, 0.63, 0.68 0.69, 0.78	ESA4 includes grassland within the Grand Prairie Ecoregion. Grasslands across Texas are shrinking, and specifically the Fort Worth Prairie is shrinking across the DFW Metropolitan area. This ESA includes a contiguous patch of grasslands between ESA1–ESA5.
ESA5	35.9	0.68, 0.69, 0.73, 0.90	ESA5 transitions from grassland to upland forest and includes riparian habitat. It is a mixed “gallery forest” within a prairie environment and includes some species that are uncommon at Benbrook Lake. One of the highest scoring grasslands from the WHAP was within this area, scoring 0.90. This ESA includes a contiguous patch of grasslands between ESA1–ESA5.
ESA6	32.5	0.67, 0.67, 0.73, 0.78,	ESA6 includes upland forest and riparian habitat. It transitions to a steeper-slope along the upland forest and includes some species that are uncommon at Benbrook Lake.
ESA7	27.6	0.57, 0.76, 0.80, 0.86	ESA7 includes upland forest and riparian habitat. It transitions to a steeper-slope along the upland forest and includes some species that are uncommon at Benbrook Lake.
ESA8	17.9	0.78, 0.83, 0.85, 0.94	ESA8 includes upland forest along a steep slope. It includes many species that are uncommon at Benbrook Lake. Three of the highest-scoring forested areas from the WHAP were within this ESA, with scores of 0.85, 0.83, and 0.94.

ESA#	Acres	WHAP Score(s)	Location and Description
ESA9	69.7	0.81, 0.85	ESA9 is mostly riparian habitat along the Clear Fork Trinity River. The habitat includes bottomland hardwood and both herbaceous and woody wetlands. Two higher scoring WHAP points within ESA9 scored 0.81 and 0.85. This area is also home to a diverse range of bird species, both resident and migratory birds.
ESA10	207.7	0.34, 0.57, 0.60, 0.62, 0.81	ESA10 includes bottomland hardwood habitat along Clear Fork Trinity River and transitions to Cross Timbers Forest and includes some species that are found nowhere else at Benbrook Lake. The highest scoring WHAP point in this ESA was 0.81.
ESA11	83.8	0.66, 0.71, 0.72, 0.74	ESA11 includes the riparian habitat and wetlands between Bear Creek and Clear Fork Trinity River. It contains many large trees including cottonwoods, boxelders, and red mulberries. The large trees are often used as nesting habitat for a diverse range of bird species, including sensitive and protected species.
ESA12	10.7	0.88	ESA12 is a narrow riparian corridor of Bear Creek Park. The area is contiguous with a larger forested area outside of USACE property containing many mature trees. A point within this ESA received a WHAP score of 0.88.
ESA13	26.8	None in the ESA	ESA13 contains grassland within the Grand Prairie Ecoregion. Grasslands across Texas are shrinking, and specifically the Fort Worth Prairie is shrinking across the DFW Metropolitan area. This particular prairie is adjacent to a much larger prairie on neighboring property.
ESA14	7.7	0.90	ESA14 contains grassland within the Grand Prairie Ecoregion. Grasslands across Texas are shrinking, and specifically the Fort Worth Prairie is shrinking across the DFW Metropolitan area. This ESA contained a WHAP point which scored 0.90. This prairie is contiguous with a larger grassland to the north but is becoming increasingly pressured from private development outside of USACE property as well as aggressively spreading cedars and other woody species.
ESA15	56.7	0.22, 0.60, 0.71, 0.72, 0.90	ESA15 contains some narrow, protected bluffs with aesthetic woodlands and pocket prairies. One WHAP point within a very isolate pocket prairie scored 0.90. The prairies within this ESA

ESA#	Acres	WHAP Score(s)	Location and Description
			are under pressure from aggressively spreading cedars and other woody species.
ESA16	330.7	0.45, 0.47, 0.52 0.56, 0.61, 0.61, 0.61, 0.71, 0.73, 0.80, 0.88, 0.90, 0.90, 0.92	ESA16 contains some narrow, protected bluffs with woodlands as well as a riparian corridor along East Dutch Branch Creek. The area also includes one of the most unique prairies in the DFW Metroplex and is contiguous with a much larger prairie outside of USACE property, collectively known as Richardson Slough Tract. Grasslands across Texas are shrinking, and specifically the Fort Worth Prairie is shrinking across the DFW Metropolitan area. This particular prairie has been included in active prairie management, including previous burning. This prairie is very diverse, containing several species that are not found anywhere else at Benbrook Lake. The WHAP points in this prairie scored very high: 0.92, 0.90, 0.90, 0.88, and 0.80. This prairie is under moderate pressure from encroaching cedars and woody species but has benefited from the recent burning. It could also face pressures from growing residential developments as the population continues to grow.
ESA17	33.2	0.61, 0.61, 0.69	ESA17 is an isolated grassland called Winscott Prairie, which contains native grasses and forbs as well as a narrow storm channel that hosts some larger woody species. Grasslands across Texas are shrinking, and specifically the Fort Worth Prairie is shrinking across the DFW Metropolitan area. Winscott Prairie is the largest urban prairie in the DFW Metroplex (located within the “urban” city limits). Located between a suburban housing development and Pecan Valley Golf Course, Winscott Prairie provides increasingly scarce habitat for bees, butterflies, and other pollinators. Winscott Prairie lies within the City of Fort Worth and is part of Fort Worth’s lease. It contains a concrete walking and biking trail which is actively used by members of the Benbrook and Fort Worth communities. Normally hard surface trails are not permitted within an ESA, but because this trail already exists and is part of Fort Worth’s existing trail system, the trail will be “grandfathered” to continue through the ESA.

5.5. MULTIPLE RESOURCE MANAGEMENT LANDS

Multiple Resource Management Lands (MRML) at Benbrook Lake are organized into three sub-classifications. These sub-classifications are Low Density Recreation, Wildlife Management, and Vegetative Management. The following is a description of each sub-classification's resource objectives, acreages, and description of use. Management of multiple resource management lands rely on funding and resource availability.

5.5.1. Wildlife Management

These are lands designated primarily for the stewardship of fish and wildlife resources but are open to passive recreation use such as natural surface trails, hiking, and nature study. There are currently 128 acres under this classification, which are managed by USACE. The majority of these lands are prior agricultural fields and management priority will be to restore these lands to support native vegetation adapted to soil type and elevation with respect to the flood control pool. Where topography, soil type, and hydrology are suitable; areas within the riparian floodplains may be selected for wetland development.

5.5.2. Vegetative Management

These are lands that have native vegetative types considered to be sensitive and needing special classification to ensure protection. Parcels were selected to recognize current and future native prairie restoration efforts. Efforts to date have required clearing of woody species on select parcels that are good candidates for prairie restoration. These areas are periodically burned to promote the native grasses and forbs already present on the sites. Other parcels were selected that were contiguous to Environmentally Sensitive Areas but were deemed less unique or valuable than those ESAs. Currently there are 1,129 acres classified for the primary use of Vegetative Management.

5.6. WATER SURFACE

At conservation pool level of 694.0 feet NGVD29 there are 3,635 acres of surface water. Buoys are managed by USACE. These buoys help mark hazards, swim beaches, boats keep-out, and no-wake areas.

5.6.1. Restricted

Restricted areas are around swim beaches, public water supply intakes and near the USACE gate control tower on the dam. Vessels are not allowed to enter Restricted water surface. Water surface zoned as Restricted totals approximately 9 acres at Benbrook Lake.

5.6.2. Designated No-wake

No-wake areas are located near boat launch areas for the safety of launching and loading boats or personal watercraft, and in areas where boats approach marinas. At Benbrook Lake, no-wake buoy information is available at the lake office. Growing interest in kayaks and paddle boats indicates a possible future need for designated no-wake areas where kayaks or paddle boats can be operated without competing with motorized vessels. USACE is open to the concept of paddle trails and will work with interested parties to fulfill this need. Currently, approximately 115 total acres of Benbrook Lake is designated for No-wake.

5.6.3. Open Recreation.

The remaining water surface area is open to recreational use. No specific zoning exists for these areas, but the buoy system mentioned above is in place to help aid in public safety. It is incumbent on boaters to be aware of lake conditions and to operate vessels responsibly. Approximately 3,511 acres of Benbrook Lake is classified for Open Recreation.

CHAPTER 6 – SPECIAL TOPICS/ISSUES/CONSIDERATIONS

6.1. COMPETING INTERESTS ON THE NATURAL RESOUCES

Benbrook Lake is a large, multi-purpose project with numerous authorized purposes. The authorized purposes accommodate the needs of federal, state, and municipal users which have developed over time and have contractual rights that must be honored. The benefits provided by virtue of authorized purposes are critical to the local and regional economies and are of great interest to the public. Aside from operating the reservoir to meet the needs of those entities with contractual rights, there are many competing interests for the utilization of federal lands including recreational users, adjacent landowners, those who own mineral rights, utility providers, and all entities that provide and maintain public roads. A growing population and increasing urbanization places additional stresses on these competing interests through increased demand for water resources and recreation spaces as well as diminishing quality and space for natural habitat and open spaces. Balancing the interests of each of these groups to ensure that valid needs are met while at the same time protecting natural and cultural resources is a challenge. The purpose of this Plan is to guide management into the foreseeable future to ensure responsible stewardship and sustainability of the project's resources for the benefit of present and future generations.

6.2. UTILITY CORRIDORS

USACE policy encourages the establishment of designated corridors on project lands, where feasible, to serve as the preferred location for future outgrants such as easements for roads or utility lines. After obtaining public input and examining the location of existing roads and utility lines on project lands, USACE determined that utility corridors would be designated at Benbrook Lake.

The following 12 utility corridors have been proposed across USACE land at Benbrook Lake with each corridor incorporating and/or running parallel to an existing easement. These corridors are shown on the maps in Appendix A. Future use of these corridors, where the corridor is limited to or incorporates an existing easement, would in most cases require prior approval of those entities that have legal rights to the easement. These non-corridor easements may be used for placement of additional utilities by the grantee holding the easement, but only for purposes which directly serve the grantee or are of direct benefit to the Government. Expansion or widening of existing non-corridor easements will generally not be permitted.

Table 6.1 Proposed Utility Corridors (see map in Appendix A)

UC#	Description
UC1	TRWD Water Line, Electrical Lines, Storm Drains exist New utilities will lie within existing easements, as close as possible to existing utilities
UC2	Corridor on the North Side of the road Existing electrical, storm drains Limit new easements as close as possible to existing easements
UC3	Corridor along neighborhood development Existing storm drains, electrical, and water Limit new easements as close as possible to existing easements Actively managed, mowed
UC4	Existing water, power, and fiber Limit new utilities to existing easements, as close as possible to existing easements Actively managed and mowed
UC5	Energy pipelines Limit new easements as close as possible to existing easements Part of UC is along ESA 16 Energy company mows along edge of UC
UC6	Existing overhead electrical line Part of line crosses ESA 13 Limit to existing easement size
UC7	Existing overhead electrical line Crosses through Mustang Park Limit to existing easement size
UC8	Existing overhead electrical line Part of line crosses ESA 11 Limit to existing easement size Crosses Bear Creek Park
UC9	Existing overhead electrical line Part of line crosses ESA 10 Limit to existing easement size
UC10	Crosses ESA 10 in a north-south direction across the Clear Fork Use of the corridor is restricted to sub-surface boring Bore pit cannot be located on government property
UC11	Overhead electrical line Part of line crosses ESA 10 Limit to existing easement size
UC12	Existing electrical line along Farm to Market (FM) Road 1187 Existing FM Road 1187 will be expanded to a highway Size of corridor is limited to 50 feet from edge of road surface

6.3. SHORELINE MANAGEMENT POLICY

On 13 December 1974 the USACE published a regulation, ER 1130-2-406, in the Federal Register entitled “Civil Works Projects: Lakeshore Management.” This regulation was published as Part 327.30 of Chapter III, Title 36 of the Code of Federal Regulations. A subsequent change to the regulation was published in the Federal Register on 31 October 1990, incorporating the results of recent legislation and changing the name to “Shoreline Management at Civil Works Projects.” The focus of this regulation is to establish national policy, guidelines, and administrative procedures for management of certain private uses of Federal lands administered by USACE. A key requirement in the regulation is that private shoreline uses, as defined in the regulation, are not allowed at lakes where no such private uses existed as of 13 December 1974. No private shoreline uses such as private docks have been permitted since the changes to the Federal Register, and as such, private docks will not be allowed on Benbrook Lake.

The private uses described in the regulation primarily include privately-owned floating facilities such as floating boat docks, fixed or movable piers, and vegetation modification activities such as plantings, mowing, and selective removal of shrubs and trees to the extent that exclusive benefits accrue to an individual or group and the general public is denied use of public lands or waters. Not included in the above definition are certain limited private activities that do not provide exclusive benefits to an individual or group, nor preclude general public use. These limited private activities may be allowed at Benbrook Lake by written shoreline use permit for reasons of public safety, erosion control, benefits to wildlife, or to provide reasonable pedestrian access to the shoreline. USACE regulations at ER 1130-2-406 requires the preparation of a Shoreline Management Policy Statement (SMPS). In response to this requirement a SMPS was prepared for Benbrook Lake in 1975.

In 2012, an administrative update to the Benbrook Lake Shoreline Management Policy was prepared to incorporate current terminology and to ensure compliance and compatibility with the most current versions of ER 1130-2-406 and ER 1130-2-540, as well as Fort Worth District policy decisions related to shoreline management. One of the primary reasons for the administrative update was to incorporate language that supports the USACE natural resources mission statement to “manage and conserve natural resources consistent with ecosystem management principles” as set forth in ER 1130-2-540.

The purpose of the SMPS is to set forth the policy and procedures by which USACE manages certain private uses of public lands at Benbrook Lake. Private uses that accrue exclusive benefits to an individual are not allowed at Benbrook Lake. The non-exclusive private uses that may be authorized by written permit from USACE include mowing and removal of underbrush to the extent needed for protection from wildfire and limited clearing to provide a pedestrian access path from private property to the shoreline. These non-exclusive uses may not be authorized in all areas and are subject to restrictions set forth in the SMPS. Inquiries regarding the SMPS at Benbrook Lake should be directed to the USACE office at Benbrook Lake.

6.4. FLUCTUATING WATER LEVEL'S EFFECT ON RECREATION

USACE received comments from the public and from the City of Benbrook noting how water levels fluctuate rapidly and the level is often drawn down very early in the year, negatively affecting recreation. The Master Plan cannot provide a solution to the problem since water management and water contracts are outside the scope of Master Planning, but the Plan documents the comments received and acknowledges that the water level has negatively affected water-based recreation. The 1972 Plan documented the effect during drought years, but the frequency of low water levels as well as how early in the season the low water levels occur has increased dramatically since the 1990s. This is due primarily to the pumping and drawing down of water for municipal use by local water providers.

The Marina is significantly affected when the water level drops below 688 feet NGVD29, which leaves many boats grounded and unable to leave their marina slips. The first boat ramp becomes unusable at 691 feet NGVD29, with all boat ramps becoming unusable below 685 feet NGVD29. Since the 1990s, these low water levels are often reached before peak summer water-based recreational season, which normally begins around Memorial Day and ends around Labor Day. Comments and water level data have been forwarded to those in the USACE who manage both water control and water supply contracts. The effect of fluctuating water levels on recreation is also mentioned in the 2018 Water Control Manual.

As one of the project purposes at Benbrook Lake, USACE has a goal of maintaining ample recreation opportunities. The 1966 Plan documented the primary purpose of Benbrook Lake as navigation, but the authority for recreational land at reservoir projects was authorized under the Flood Control Act approved 22 December 1944 (Public Law 534, 78th Congress, 2d Session) as amended by subsequent acts. The 1972 Plan documented the project purpose as both flood control and navigation storage with heavily utilized recreational purposes. Reformation of recreational development was required due to Engineer Regulations 1110-2-400, 1110-2-404, 1120-2-400, Public Law 89-72 (Federal Water Project Recreation Act), Senate Document No. 97, changing conditions, North Central Texas Council of Governments, and emphasis on environmental features. The reformation added recreation to the authorized project purpose of Benbrook Lake and many other federal projects. The project purpose for navigation storage has been deauthorized, as indicated in the Corps' Federal Register notices of project deauthorizations of June 26, 2003 (68 FR 38022) and March 25, 2016 (81 FR 16147). The excess navigation water was transitioned to storage for municipal water supply; however, recreation is still an authorized purpose, and water supply contracts will be managed while considering the effects on recreation.

6.5. NATIVE PRAIRIE CONSERVATION

USACE received comments from the public including a nonprofit entity wanting the Plan to take additional steps to preserve prairie habitat, which has been greatly reduced in the DFW area. USACE in partnership with the Natural Resources Conservation Service conducted a prairie assessment in addition to the typical WHAP

assessment to gather additional data from prairie and grassland areas around Benbrook Lake. The assessment aided in distinguishing the most diverse and ecologically unique grasslands and helped to influence which prairies should be designated as Environmentally Sensitive Areas and Vegetative Management Areas. The data gathered during the assessment can also guide future rehabilitation efforts that could include prescribed burns, invasive species removal, and planting more native species.

The Fort Worth Mayor has acknowledged the importance of prairies by signing the National Wildlife Foundation's Mayors Monarch Pledge and issuing a proclamation to raise awareness about the decline of monarch butterfly habitat, which includes home gardens, parks, and wilderness spaces. Furthermore, the proclamation changed the city's mowing ordinance to allow for more native prairie and pollinator habitat and promote the use of native milkweeds and other nectar-producing plants. The prairies at Benbrook Lake provide a diverse habitat and can help meet critical monarch and other pollinator habitat goals.

6.6. PUBLIC HUNTING PROGRAM

The Benbrook Lake Project offers approximately 1,400 acres (958 acres land + approximately 400 acres of water surface) for public hunting. Rising costs of private land hunting opportunities, coupled with a general scarcity of public land available for hunting within the zone of influence, has resulted in significant public interest in hunting opportunities at Benbrook Lake. Other public lands available for hunting within the zone of influence include USACE land at nearby Grapevine Lake, Lewisville Lake, and Ray Roberts Lake. Hunting is not the exclusive use of these hunting areas; hunters must exercise caution, because areas may be used by hikers, equestrian riders, bird watchers, and others. While much of the boundary is fenced and marked, some areas are not. It is the hunter's responsibility to become familiar with the hunting area and the limits of public lands. Hunting on public land does not give any person the right to cross or enter private property.

The Benbrook Lake Hunting Program requires hunters to register for a lottery to acquire a no-cost, seasonal permit from the Lake Office. In the 2018-2019 hunting season, there were 190 regular hunting season hunters, 25 spring turkey season hunters, and 4 youth hunters in the first annual youth hunt. In the 2019-2020 hunting season, there were 190 regular hunting season hunters, 30 spring turkey season hunters, and 6 youth hunters in the annual youth hunt. The Benbrook Lake Youth Hunt is an annual hunt for youth education and natural resource conservation. The USACE staff at Benbrook Lake partners with the Texas Youth Hunting Program and Texas Parks and Wildlife to ensure safe and ethical hunting. Through the partnership, youth hunters are selected to come to the lake and attempt to harvest white-tail deer. The youth are taught hunting safety, ethics, laws, conservation, deer management, water safety, and land stewardship. All hunting is safely guided by experienced hunting guides in predetermined hunting locations.

Comments received from the public expressed gratitude for providing public land for hunting. Administration of a hunting program of this size requires significant

investment of resources, including labor and materials. Although USACE does not charge for hunting permits, USACE has authority to charge an administrative fee for issuing permits and may charge a fee in the future. Lottery and permit rules and requirements as well as the area hunting map are subject to change and are available on the Benbrook Lake hunting webpage and the lake office. Permit periods will be concurrent with the Texas Parks and Wildlife hunting license renewal dates. All hunters must have a Texas state hunting license and are expected to follow all Texas Parks and Wildlife Department hunting regulations.

CHAPTER 7 – PUBLIC AND AGENCY COORDINATION

7.1. PUBLIC AND AGENCY COORDINATION OVERVIEW

USACE is dedicated to serving the public interests in support of the overall development of land uses related to land management for cultural, natural, and recreational resources of Benbrook Lake. An integral part of this effort is gathering public comment and engaging stakeholders in the process of planning. USACE policy guidance in ER and EP 1130-2-550 requires thorough public involvement and agency coordination throughout the master plan revision process including any associated NEPA process. Public involvement is especially important at Benbrook Lake to ensure that future management actions are both environmentally sustainable and responsive to public outdoor recreation needs in a region which is experiencing rapid population growth. The following milestones provide a brief look at the overall process of revising the Benbrook Lake Master Plan.

The USACE began planning to revise the Benbrook Lake Master Plan in October of 2018. The objectives for the Master Plan revision are to (1) revise land classifications to reflect changes in USACE land management policies since 1972, (2) prepare new resource objectives, and (3) revise the Master Plan to reflect new agency requirements for Master Plan documents in accordance with ER 1130-2-550, Change 7, January 30, 2013 and EP 1130-2-550, Change 5, January 30, 2013.

- 8-12 April 2019 – USACE and TPWD conducted wildlife habitat evaluation field work on Benbrook Lake project lands.
- 16 September 2019 – USACE held a meeting with the City of Benbrook to discuss fluctuating water level concerns at Benbrook Lake as well as land classifications and future development plans.
- 7-11 October 2019 – USACE, TPWD, and NRCS conducted prairie assessment evaluation field work on Benbrook Lake project lands.
- 21 August 2019 – Held initial public scoping meeting in the City of Benbrook to announce initiation of the revision process and to request public input; approximately 125 non-USACE visitors attended.
- October - November 2019 – Public comments received and considered for preparation of draft.
- January 2020 – February 2020 – Work continues on the draft MP.
- 5 March 2021 – Virtual Public Presentation to announce the Draft Master Plan.

7.2. INITIAL STAKEHOLDER AND PUBLIC MEETINGS

The first public action was a scheduled public scoping meeting providing an avenue for public and agency stakeholders to ask questions and provide comments. The public scoping meeting was held on 21 August 2019 at the Benbrook Senior Center, 1010 Mercedes St, Benbrook, TX 76126. The Fort Worth District placed advertisements on the USACE webpage, social media, and print publications two weeks prior to the public scoping meeting.

Photo 7.1 Benbrook Lake Master Plan Public Scoping Meeting 21 August 2019

USACE employees hosted the meeting, which was conducted in an open format. Participants were asked to sign in at a table where staff provided the participants with information regarding the structure of the scoping meeting and comment forms. After signing in, participants were directed to be seated in the auditorium and a slide presentation was given by the Project Delivery Team for the master plan revision to convey information about the following topics:

- Public Involvement Process
- Project Overview
- Overview of the NEPA process
- Master Plan and current land classifications
- Instruction for Submitting Comments

At the conclusion of the presentation USACE representatives were available to answer questions and receive written comments at information tables. Interested persons had the opportunity to comment about the project using a variety of methods, including the following:

- Filling out a comment form at the open house
- Taking a comment form home to be returned within the 30-day comment period
- Submitting a comment using electronic mail (e-mail)
- Submitting a comment and mailing it in on letterhead or choice of paper

In total, approximately 125 individuals, not including USACE personnel, attended the 21 August 2019 public scoping meeting. Among the attendees were representatives from the cities of Benbrook and Fort Worth, Tarrant County, TPWD, and numerous citizens. A total of 74 written comments were received following this public scoping meeting. Much like national forests or parks, Benbrook Lake is a federally owned and managed public property. It is USACE's goal to be a good neighbor as well as steward of the public interest as it concerns Benbrook Lake. As such, USACE is bound to the equal enforcement of policies and rules for this publicly held national asset. Table F.1 in Appendix F summarizes the comments received during and following the initial scoping comment period for the Master Plan, as well as the USACE response. Comments in Table F.1 groups similar comments from the public together and divides comments with multiple topics into separate comments.

7.3. PUBLIC AND AGENCY REVIEW OF DRAFT MP, EA, AND FONSI

Appendix F Table F.2

This section will be completed following the draft release virtual public input process and 30-day comment period.

CHAPTER 8 – SUMMARY OF RECOMMENDATIONS

8.1. SUMMARY OVERVIEW

The preparation of the Benbrook Lake Master Plan followed the USACE master planning guidance in ER 1130-2-550 and EP 1130-2-550, both dated 13 January 2013. Three major requirements set forth in the guidance include (1) the preparation of contemporary resource objectives, (2) classification of project lands using the newly approved classification standards, and (3) the preparation of a resource plan describing in broad terms how the land in each of the land classifications will be managed into the foreseeable future. Additional important requirements include public involvement throughout the process, and consideration of regional recreation and natural resource management priorities identified by other federal, state, and municipal authorities. The study team endeavored to follow this guidance to prepare a master plan that will provide for enhanced recreational opportunities for the public, improve environmental quality, and foster a management philosophy that promotes partnerships and the success of each stakeholder involved in the management of the lands and surface waters of Benbrook Lake. Factors considered in the Plan were identified through public involvement and review of statewide planning documents including the following:

- TPWD's 2018 and 2012 TORP
- TCAP – Cross Timbers Ecoregion
- 2006 Dutch Branch Land Use Plan provided by the City of Benbrook
- 2019 and 2020 City of Benbrook Capital Improvement Program
- 2020 City of Benbrook Comprehensive Plan
- 2020 City of Benbrook Future Land Use Map
- North Central Texas Council of Governments Mobility 2045 Plan, Revised June 18, 2018
- TRWD Integrated Water Supply Plan from 2013
- Fort Worth Parks, Recreation and Open Space Master Plans from 2015 and 2020

This Master Plan will ensure the long-term sustainability of the outdoor recreation program and natural resources associated with Benbrook Lake.

8.2. LAND CLASSIFICATION PROPOSALS

A key component in preparing this Master Plan was examining prior land classifications and addressing the needed transition to the new land classification standards. During the public involvement process USACE sought public input into whether, besides the simple change in nomenclature, a shift in land classification was desired (for example, should lands with a recreation classification be reclassified to a wildlife classification or vice versa.). Chapter 7 of the Plan describes the public input process.

Based on an evaluation of documents such as the TORP and the 2012 TCAP, development of goals and objectives, public and stakeholder comments, interviews with adjacent cities and concerned agencies, as well as subject matter experts, the planning team prepared the land reclassification proposal for Benbrook Lake. All changes reflect historic and projected public use and new guidance from ER 1130-2-550 and EP 1130-2-550. A summary of acreage changes from prior land classifications to the current classifications is provided in Table 8.1, water surface classifications in Table 8.2, and key decision points in the reclassification of project lands are presented in Table 8.3.

Table 8.1 Change from Prior Land Classification to New Land Classification

Prior Land Classifications (1972 Plan)	Acres		New Land Classifications (2021)	Acres
Operations and Maintenance	176		Project Operations	234
Recreational Areas	2,896		High Density Recreation	1,761
Special Use Areas	146		--	
--	--		Environmentally Sensitive Areas	1,122
Aesthetics Area and Multiple Use Recreation Areas	1,254		Multiple Resource Management – Vegetative Management	1,129
Wildlife Area	193		Multiple Resource Management – Wildlife Management	128
Total Land Acres	4,665		Total Land Acres	4,375

Total Acreage differences from the 1972 total to the 2021 totals are due to improvements in measurement technology, deposition/siltation, and erosion. As real estate boundaries are researched, acreages may change slightly to reflect more precise boundary mapping. The fee simple and easement acreage identified in this master plan was obtained from the Real Estate Management Information System and is subject to change as the acquisition documents are audited.

Table 8.2 Change from Prior Water Surface Classification to New Water Surface Classification

Prior Water Surface Classifications (1972 Plan)	Acres		New Water Surface Classifications (2021)	Acres
Flowage Easement	2,823		Flowage Easement*	3,200

Permanent Pool	3,770		Permanent Pool	3,635
--	--		– Restricted	9
--	--		– Designated No Wake	115
--	--		– Open Recreation	3,511

Total Acreage differences from the 1972 total to the 2021 totals are due to improvements in measurement technology, deposition/siltation, and erosion. * Flowage easement acres are approximate, and buildings for habitation will not be constructed on flowage easement land.

Table 8.3 Reclassification Proposals

Proposal	Description	Justification
Project Operations (PO)	The Project Operations classification was increased from 176 acres to 234 acres. • Approximately 1.4 acres of PO along Old Grandbury Road and near water surface for municipal water operations. • Adjust PO around dam so it more precisely matches the dam footprint and most recent GIS shoreline, including approximately 80.2 acres. • Approximately 77.7 acres of Recreation to PO between dam and Lakeside Drive, area used for dam maintenance and operations as well as municipal water operations. • Approximately 74.7 acres to include spillway and outlet channel were changed from Recreation to PO.	The increase in acreage for Project Operations is to account for areas used for operations that are not currently classified as PO. The new area expands to include the entire dam, uncontrolled spillway, and discharge channel. The area also classified operations by others which includes municipal water operations near the dam and along Old Grandbury Road.
High Density Recreation (HDR)	Approximately 1,761 acres have been classified as HDR. The previous classification Recreation Areas contained 2,896 aces and is similar to the current HDR classification. Additionally, 146 acres previously classified as Special Use Recreation Areas were reclassified as HDR.	The previous Recreation Areas and Special Use Recreation Areas date back to 1972 and did not account for types or intensity of recreational use. Since 1972, the recreational demand and usage has changed to include many well-developed parks. The new HDR classification includes

	• Approximately 521.7 acres of Dutch Branch Park was classified from Recreation to HDR. • In North Holiday Park, approximately 140.1 acres adjacent to Dutch Branch Park changed from Recreation to HDR, which includes space for future recreational development. • Within South Holiday Park approximately 153.0 acres on the lake side of Lakeview Drive are classified from Recreation to HDR. • At the south end of the lake, 51.1 acres between campground at Westcreek Circle, Bear Creek Campground, and Mustang Park are changed from Recreation to HDR. • Approximately 264.0 acres containing Thunderbird Field and north of Peninsula Road is also classified as HDR. • Approximately 16.2 acres around the entrance from Briar Creek Road and Winscott Plover Road are also classified from Recreation to HDR. • Approximately 182.9 acres on the southeast side of the lake at Rocky Creek, from Rocky Creek Park Road to the shoreline is HDR all the way until the road ends near St. Francis Village. This area also includes the site of the long-closed marina and approximately 55 acres of	areas with existing intense recreational development and many undeveloped acres that have the potential to meet future recreation needs. The City of Benbrook has expressed interest in expanding facilities, and there is ample undeveloped HDR acreage within Dutch Branch Park, North Holliday Park, and Baja Beach to accommodate their future needs. There are also many undeveloped acres in Mustang Park and Rocky Creek Park to accommodate future demand as residential developments continue to expand in areas East and South of Benbrook Lake.

	high ground available for future recreational development. • Approximately 63.4 acres at Longhorn Park which does not include the area around the Benbrook Lake Office is classified from Recreation to HDR up to Southwest Christian School. • Below the dam, 368.4 acres including Pecan Valley Park and Golf Course were classified from Recreation to HDR. This includes the old soapbox derby and Memorial Oak trailhead.	
Environmentally Sensitive Areas (ESA)	Approximately 1,122 acres have been classified as ESA areas – 798 acres were classified to ESA from Recreation, and the remaining 324 acres were classified to ESA from Aesthetic and Multiple Use Recreation Areas. Of the Recreation Areas changed to ESA, approximately 34 acres were from Rocky Creek Park, 114 acres from South Holiday Park, and 181 acres from North Holiday Park. • See Section 5.4 for a detailed breakdown of all ESA areas.	The Environmentally Sensitive Area classification did not exist when the 1972 plan designated land classifications. The new areas classified as ESA include unique or sensitive prairies, woodlands, wetlands, and aesthetic areas. In Holiday Park, most of the acreage west of Lakeview Drive was reclassified as ESA from the original Recreation Areas classification. Much of the riparian and wetland acreage associated with the Clear Fork Trinity River was changed from Wildlife Area and Recreation Area to ESA. On the east side of the lake, several sensitive prairies and aesthetic areas were changed from Wildlife Area and Recreation area to ESA. See Table 5.1 for a complete description of each ESA.
MRML – Wildlife Management (WM)	Approximately 128 acres have been classified as MRML – Wildlife Management. This is similar to the previous Wildlife	The land previously classified as Wildlife Area along Clear Fork Trinity River has been reclassified as ESA. A new area has been

	Area classification, which included 193 acres. • On the northeast side of the lake, between Southwest Christian School and the municipal water supply, approximately 128.5 acres between the shoreline and the trail/service road were classified as WM.	classified as WM along the shoreline of Longhorn Park. This area currently allows hunting but also acts as an important corridor for wildlife.
MRML – Vegetation Management (VM)	Approximately 1,129 acres have been classified as MRML – Vegetation Management. There was no previous land classification similar to MRML – VM. • On the northeast side of the lake, between Southwest Christian School and the municipal water supply, approximately 197.8 acres between the trail/service road and the boundary are classified from Aesthetic to VM. • On the south side of the lake, a narrow strip composing of approximately 136.7 acres between the shoreline and boundary were classified as VM from the park entrance at Winscott Plover Road and the entrance to Rocky Park Approximately 52.6 acres was previously classified Aesthetic while the rest was Recreation. • Between Winscott Plover Road, Peninsula Road, and Briar Creek Drive, approximately 346.3 acres was classified from	Parcels were selected to recognize current and future native prairie restoration efforts. Efforts to date have required clearing of woody species on select parcels that are good candidates for prairie restoration. These areas are periodically burned to promote the native grasses and forbs already present on the sites along Clear Fork Trinity River. The area previously classified as Wildlife Area and not changed to ESA was changed to VM. This area includes frequently flooded hardwood and herbaceous wetlands as well as former grazing land undergoing early succession to mixed shrub and forest habitats. On the south and southeast sides of the lake, less developed park areas that were not unique or critical enough to designate as an ESA were changed to VM. Much of this area also includes early succession with many young cedar elms, hackberries, ash, and other pioneer species and demonstrates significant signs of browsing by wildlife. Along the northeast side of the lake, in Longhorn Park, the area between the WM area and neighboring property was also designated as

	Recreation to VM, south to the boundary. • South of the Clear Fork Trinity River near US 377, the 265.7 acres not included as ESA and south to the boundary was changed from Aesthetic to VM and includes former agricultural and grazing land. • Approximately 49.2 acres north of Winscott Road which includes a trail, stormwater drains, and utilities was classified from Recreation to VM. • Approximately 14.2 acres of mowed area between Lakeside Drive and the golf course was classified from Recreation to VM. • Approximately 19.2 acres of prairie near Rocky Creek were classified from Recreation to VM. • Approximately 98.4 acres near the Rocky Creek Park Road entrance was classified from Recreation to VM.	VM. This area is contiguous to neighboring grasslands but did not score as high and were not as unique as other nearby grasslands which were designated as ESA. The area north of Winscott Road and a narrow band north of Lakeside Drive are regularly mowed but contains some native vegetation which is beneficial to native pollinators has also been changed to VM.
Water Surface Restricted	Approximately nine acres of water surface have been classified as Restricted water surface where boats are not allowed.	These are comparatively small parcels that surround water intake structures, the USACE gate control tower, the approach to the uncontrolled spillway, and designated swimming beaches
Water Surface No Wake Designation	Approximately 115 acres of water surface have been classified as Designated No Wake area where vessels are not allowed to create a wake when underway.	These parcels include areas surrounding boat ramps, the marina area at Dutch Branch Park, and former marine area located at Rocky Creek Park.
Water Surface Open Recreation	Approximately 3,511 acres of water surface have been classified as Open Recreation	Water surface that has not been classified as Restricted or No Wake are available for water-based recreation. Operation of a

	that are available for water-based recreation.	boat in these areas is at the owner's risk. Specific navigational hazards may or may not be marked with a buoy.

Note: The land classification changes described in this table are the result of changes to individual parcels of land ranging from a few acres to more than 100 hundred acres. Acreages were measured using GIS technology. The acreage numbers provided are approximate.

8.3. UTILITY CORRIDORS

USACE policy encourages the establishment of designated corridors on project lands, where feasible, to serve as the preferred location for future outgrants such as easements for roads or utility lines. After obtaining public input and examining the location of existing roads and utility lines on project lands, USACE proposed a total of 12 utility corridors which are described in Section 6.2 and included in the maps in Appendix A.

CHAPTER 9 – BIBLIOGRAPHY

American Ornithologists' Union (AOU). 1983. Check-list of North American Birds, 6th edition. Allen Press, Inc., Lawrence, Kansas. 877 pp.

Cordell & Green, National Survey on Recreation and the Environment, Texas Reports 1994-95, 2000-01 and 2006-09, 2009.

Environmental Protection Agency (EPA). 2016. https://www.epa.gov.

Google Maps. 2016, 2018, 2020. Map/Image data: Google Earth, Landsat/Copernicus.

Matthews, J.R. and C.J. Moseley (eds.). 1990. The Official World Wildlife Fund Guide to Endangered Species of North America. Volume 1. Plants, Mammals. xxiii + pp 1-560 + 33 pp. appendix + 6 pp. glossary + 16 pp. index. Volume 2. Birds, Reptiles, Amphibians, Fishes, Mussels, Crustaceans, Snails, Insects, and Arachnids. xiii + pp. 561-1180. Beacham Publications, Inc., Washington, D.C.

National Oceanic and Atmospheric Administration (NOAA), National Weather Service Forecast Office. 2020A. First/Last Occurrence Summary for BENBROOK DAM, TX from 2000 to 2020. Retrieved from https://w2.weather.gov/climate/xmacis.php?wfo=fwd.

National Oceanic and Atmospheric Administration (NOAA), National Weather Service Forecast Office. 2020B. Monthly Mean Avg Temperature for Benbrook Dam, TX from 2000 to 2020. Retrieved from https://w2.weather.gov/climate/xmacis.php?wfo=fwd.

National Oceanic and Atmospheric Administration (NOAA). 2016. US Climate Data; National Centers for Environmental Information. Retrieved from http://www.weather.gov.fwdann/.

National Vegetation Classification System. 2016. EP 1130-2-540. Level 1 inventory.

Natural Resources Conservation Service (NRCS). 2018. Custom Soil Resource Report for Tarrant County, Texas. Retrieved from https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx.

NatureServe. 2016. Whooping Crane: Ecology Life History. Retrieved from http://explorer.natureserve.org/servlet/NatureServe?searchName=Grus+americana.

NatureServe. 2019A. Agalinis auriculata: Ecology & Life History. Retrieved from http://explorer.natureserve.org/servlet/NatureServe?searchName=Agalinis+auriculata.

NatureServe. 2019B. Thamnophis sirtalis annectens: Ecology & Life History. Retrieved from http://explorer.natureserve.org/servlet/NatureServe?searchName=Thamnophis+sirtalis+annectens.

North Central Texas Council of Governments (NCTCOG). 2010. North Texas 2050 Retrieved from http://www.visionnorthtexas.org/main.html.

North Central Texas Council of Governments (NCTCOG). 2018. Air Quality Website: Retrieved from https://www.nctcog.org/trans/air.

North Central Texas Council of Governments (NCTCOG). 2018. Metropolitan Transportation Plan – Mobility 2040. Retrieved from https://www.nctcog.org/trans/mtp/2040/.

Responsive Management. 2017. Texas Residents' Participation in and Attitudes Toward Outdoor Recreation (Conducted for the Texas Parks and Wildlife Department by Responsive Management).

Texas Commission on Environmental Quality (TCEQ). 2016. Retrieved from https://www.tceq.texas.gov/agency/air_main.html.

Texas Commission on Environmental Quality (TCEQ). 2020A. Dallas-Fort Worth: Current Attainment Status. Retrieved from https://www.tceq.texas.gov/airquality/sip/dfw/dfw-status.

Texas Commission on Environmental Quality (TCEQ). 2020B. 2020 Texas Integrated Report - Texas 303(d) List. Retrieved from https://www.tceq.texas.gov/assets/public/waterquality/swqm/assess/16txir/2016_303d.pdf.

Texas Department of State Health Services (DSHS). 2020. Fish Consumption Advisory Viewer. Retrieved from https://dshscpd.maps.arcgis.com/apps/View/index.html?appid=2a02cfc25e1d49a880385fd5c561f201.

Texas Department of State Health Services. October 2006. Fish and Shellfish Consumption Advisory. Retrieved from https://dshscpd.maps.arcgis.com/apps/View/index.html?appid=2a02cfc25e1d49a880385fd5c561f201.

Texas Department of Transportation (TXDOT). 2018. Retrieved from https://www.txdot.gov/inside-txdot/projects/project-tracker.html.

Texas Department of Transportation (TXDOT). 2019. Planned Projects for 2019. Retrieved from https://www.txdot.gov/inside-txdot/projects/project-tracker.html.

Texas Natural Diversity Database (TXNDD). 2020. Element Occurrence Data Export for the Following Quadrangles: Benbrook, Primrose, and Cresson. Wildlife Diversity Program of Texas Parks & Wildlife Department. Received on Oct 16, 2020.

Texas Parks and Wildlife Department (TPWD). 2012. Texas Conservation Action Plan 2012 – 2016: Statewide/Multi-region Handbook. Retrieved from https://tpwd.texas.gov/huntwild/wild/wildlife_diversity/nongame/tcap/.

Texas Parks and Wildlife Department (TPWD). 2012. Texas Outdoor Recreation Plan. 2012 Statewide Comprehensive Outdoor Recreation Plan (TORP/SCORP). TPWD, State Parks Division. Retrieved from https://tpwd.texas.gov/business/grants/pwd_rp_p4000_1673_TORP.pdf.

Texas Parks and Wildlife Department (TPWD). 2018. Landscape Ecology Program: Ecological Mapping Systems. Retrieved from https://tpwd.texas.gov/landwater/land/programs/landscape-ecology/ems/.

Texas Parks and Wildlife Department (TPWD). 2018. Texas Outdoor Recreation Plan. 2018 Statewide Comprehensive Outdoor Recreation Plan (TORP/SCORP). TPWD, State Parks Division. Retrieved from https://tpwd.texas.gov/business/grants/pwd_rp_p4000_1673_TORP.pdf.

Texas Parks and Wildlife Department (TPWD). 2019J. Texas Ecological Mapping Systems – Mernik Ecoregions Level III. Retrieved from https://tpwd.texas.gov/gis/data/baselayers/omernikecoregionsleveliii_emst.png/image_view_fullscreen.

Texas Parks and Wildlife Department (TPWD). 2020. Rare, Threatened, and Endangered Species of Texas. Tarrant County https://tpwd.texas.gov/gis/rtest/.

Texas Railroad Commission. 2020. GIS Data. Retrieved from https://gis.rrc.texas.gov/GISViewer/.

Texas Residents' Participation in and Attitudes Toward Outdoor Recreation by Responsive Management (Survey). 2017 Completed for Texas Parks and Wildlife Department as part of TORP 2018.

Texas State Historical Association. 2016.

Texas Water Development Board (TWDB). 2012. Texas State Water Plan: Water for Texas. Texas Water Development Board, Austin, Texas. Retrieved from http://www.twdb.texas.gov/.

U.S. Climate Data. 2019. Climate Benbrook – Texas. Retrieved from https://www.usclimatedata.com/climate/benbrook/texas/united-states/ustx1505.

U.S. Environmental Protection Agency (EPA) National Ambient Air Quality Standards (NAAQS). 2016. Retrieved from https://www.epa.gov/criteria-air-pollutants/naaqs-table.

U.S. Fish & Wildlife Service (USFWS). 2019. National Wetlands Inventory website. U.S. Department of the Interior, Fish and Wildlife Service, Washington, D.C. Retrieved on 22 November 2019 from http://www.fws.gov/wetlands/.

U.S. Fish & Wildlife Service (USFWS). 2021. IPAC: Information, Planning, and Consultation System, Environmental Conservation Online System. Official Species List. Event Code: 02ETAR00-2021-E-02697. Consultation Code: 02ETAR00-2020-SLI-0338. Created on February 24, 2021. https://ecos.fws.gov.

U.S. Fish and Wildlife Service (USFWS). 2016. Classification of Wetlands and Deepwater Habitats of the United States https://www.fws.gov/wetlands/.

U.S. Global Change Research Program (USGCRP). 2014. Climate Change Impacts in the United States: The Third National Climate Assessment. Retrieved on November 20, 2015, from http://nca2014.globalchange.gov/report.

US Bureau of the Census. 2016. American Fact Finder Website. https://factfinder.census.gov/faces/nav/jsf/pages/community_facts.xhtml

USACE Maintenance Guidance and Procedures. HQ, USACE. https://www.publications.usace.army.mil/

USACE. 2013. EP 1130-2-550, Project Operations, Recreation Operations and Maintenance Guidance and Procedures. HQ, USACE. https://www.publications.usace.army.mil/

USACE. 2016. OMBIL Environmental Stewardship Module. USACE, Fort Worth District, Texas.

USACE. 2016. OMBIL Recreation Module. USACE, Fort Worth District, Texas.

USACE. 2016. Value to the Nation – Recreation Fast Facts: Retrieved from http://corpsresults.us/recreation/recfastfacts.cfm.

USACE. 2018. Water Control Manual. Appendix B. Master Reservoir Regulation Manual.

USACE. 2019. OMBIL Environmental Stewardship Module. USACE, Fort Worth District, Texas.

U.S. Geological Survey (USGS). 2018. Retrieved from https://txpub.usgs.gov/dss/texasgeology/.