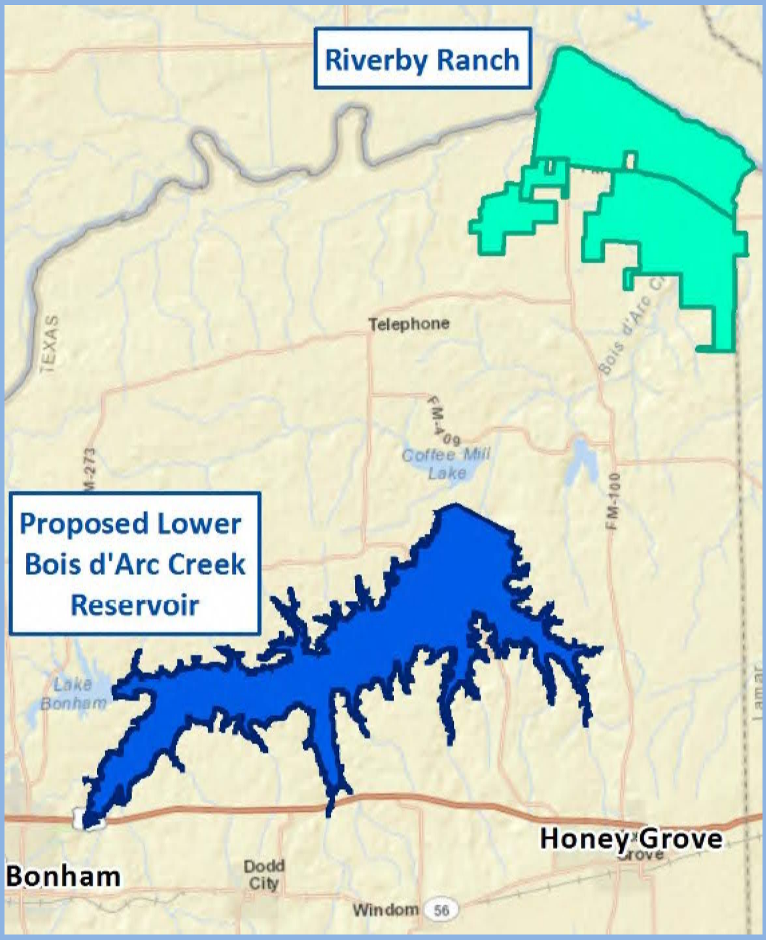
LOWER BOIS D'ARC CREEK RESERVOIR
Fannin County, Texas
SECTION 404 PERMIT APPLICATION

Draft Environmental Impact Statement
Volume II – Appendices

U.S. Army Corps of Engineers
Tulsa District



February 2015

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ABSTRACT

The Tulsa District of the U.S. Army Corps of Engineers (USACE) received an application for a Department of the Army Permit under Section 404 of the Clean Water Act (CWA) from the North Texas Municipal Water District (NTMWD) to construct Lower Bois d'Arc Creek Reservoir (LBCR) and related facilities (e.g. pipeline, water treatment plant, terminal storage reservoir) in Fannin County, Texas. The Proposed Action consists of a regional water supply project intended to provide up to 175,000 acre-feet/year of new water, with an estimated firm yield of 126,200 acre-feet/year, for NTMWD's member cities and direct customers in all or portions of nine counties in northern Texas. A dam approximately 10,400 feet (about two miles) long and up to 90 feet high would be constructed, and much of the reservoir footprint would be cleared of trees and built structures. The total "footprint" of the proposed project site, including the dam, is 17,068 acres, and the reservoir would have a total storage capacity of approximately 367,609 acre-feet.

In accordance with the National Environmental Policy Act (NEPA), the USACE determined that issuance of a Section 404 permit may have a significant impact on the quality of the human environment and, therefore, requires the preparation of an Environmental Impact Statement (EIS). This Draft EIS analyzes the direct, indirect, and cumulative effects of the Proposed Action. The purpose of the Draft EIS is to provide decision-makers and the public with information pertaining to the Proposed Action and alternatives, and to disclose environmental impacts and identify mitigation measures to reduce impacts.

The project site is located in an area of largely rural countryside with scattered residences. Approximately 38 percent of the reservoir footprint is cropland and 37 percent consists of bottomland hardwoods and riparian woodlands, with the remaining 25 percent mostly upland deciduous forest. Construction of the reservoir and related facilities would result in permanent impacts to approximately 6,180 acres of wetlands and 651,024 linear feet of streams. Other adverse and beneficial impacts of substance would occur to soils and farmland, biological resources, recreation, land use, roads, socioeconomics, and cultural resources.

The applicant (NTMWD) has prepared an aquatic resources mitigation plan to comply with the federal policy of "no overall net loss of wetlands" and to provide compensatory mitigation, to the extent practicable, for impacts to other waters of the U.S. that would be caused by construction of the proposed reservoir. NTMWD has purchased a 14,960-acre parcel of land known as the Riverby Ranch, which borders the Red River. This working ranch is located downstream of the proposed project within both the same watershed (Bois d'Arc Creek) and the same county (Fannin). NTMWD acquired the Riverby Ranch

specifically because its biophysical features have the potential to provide appropriate mitigation for the proposed project. Additional mitigation would be provided within the proposed reservoir itself and on Bois d'Arc Creek downstream of the reservoir as a result of an operations plan and flow regime established in consultation with the Texas Commission on Environmental Quality (TCEQ), and stipulated in the Draft Water Right Permit issued by TCEQ to NTMWD.

The decision whether to issue a Section 404 permit will be based on an evaluation of the probable impacts, including cumulative impacts, of the Proposed Action on the public interest. That decision will reflect the national concern for both protection and utilization of important resources. The benefits that reasonably may be expected to accrue from the proposal must be balanced against the reasonably foreseeable detriments. All factors that may be relevant to the proposal will be considered, including the cumulative effects thereof; among those are conservation, economics, aesthetics, wetlands, fish and wildlife values, flood hazards, floodplain values, land use, navigation, shoreline erosion and accretion, recreation, water supply and conservation, energy needs, safety, food and fiber production, mineral needs, considerations of property ownership and, in general, the needs and welfare of the people. In addition, the evaluation of the impact of the work on the public interest will include application of the guidelines promulgated by the Administrator, Environmental Protection Agency, under authority of Section 404(b) of the Clean Water Act (40 C.F.R. Part 230).

Comments on the DEIS may be sent to:

Andrew R. Commer
USACE, Tulsa District Regulatory Office
1645 S 101 E Avenue, Tulsa, OK 74128-4609

or via e-mail: ceswt-ro@usace.army.mil

Comments must be received within 60 days of publication of the Notice of Availability in the *Federal Register*, or until April 21, 2015.

Draft Environmental Impact Statement
Proposed Lower Bois d'Arc Creek Reservoir

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APPENDIX A – ACRONYMS AND ABBREVIATIONS

ABB	American burying beetle
ACHP	Advisory Council on Historic Preservation
AF	Acre-foot or acre-feet
AFY	Acre-feet per year
AIRFA	American Indian Religious Freedom Act
ANSI	American National Standard Institute
APE	Area of Potential Effects
AQCR	Air Quality Control Region
AQCR 215	Metropolitan Dallas Fort Worth Intrastate Air Quality Control Region
ARC	AR Consultants
ARPA	Archeological Resources Protection Act
BEG	Bureau of Economic Geology
BLM	Bureau of Land Management
BMP	Best Management Practice
°C	Degrees Celsius or Centigrade
CAA	Clean Air Act
CADSWES	Center for Advanced Decision Support for Water and Environmental Systems
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
cfs	cubic feet per second (volumetric flow rate of water)
cmbs	Centimeters below the surface
CO	Carbon Monoxide
COCs	Chemicals of concern
CRP	Conservation Reserve Program
CWA	Clean Water Act
dB	Decibel
dBA	A-weighted decibel
dbh	diameter at breast height
DEIS	Draft Environmental Impact Statement
de minimus	of minimal importance
DFCs	Desired Future Conditions
DFW	Dallas-Fort Worth International Airport
DNL	Day-Night Sound Level
DWU	Dallas Water Utilities
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
ESA	Environmental Site Assessment
°F	Degrees Fahrenheit
FCAD	Fannin County Appraisal District
FM	Farm-to-Market Road
FNI	Freese and Nichols, Inc
Ft	Foot or feet
FTE	Full Time Equivalent
GHG	Greenhouse Gas
GIS	Geographic Information System
GMA	Groundwater Management Area

GPCD	Gallons Per Capita Per Day
GTUA	Greater Texoma Utility Authority
GYI	North Texas Regional Airport
HAP	Hazardous Air Pollutant
HC	Hydrocarbon
HEP	Habitat Evaluation Procedure
HSI	Habitat Suitability Index
Hz	Hertz
I	Interstate
IBI	Index of Biological Integrity
IBT	Inter-Basin Transfer
ICEM	Incised Channel Evolution Model
kg	kilogram
km	kilometer
kWh	kilowatt hour
lbs	Pounds
LBCR	Lower Bois d'Arc Creek Reservoir
LBJ	Lyndon B Johnson
LEDPA	Least Environmentally Damaging Practical Alternative
LOI	Limits of Investigation
LRH	Lake Ralph Hall
L_{eq}	Equivalent Sound Level
m	Meter
MAG	Managed Available Groundwater
MCLs	Maximum Contaminant Levels
MGD or mgd	Million Gallons per Day
mg/L	milligrams per liter (equals parts per million)
mm	Millimeter
MOA	Memorandum of Agreement
MSA	Metropolitan Statistical Area
MSL or msl	Mean Sea Level (elevation in feet above mean sea level)
NAAQS	National Ambient Air Quality Standards
NAGPRA	Native American Graves Protection and Repatriation Act
NAIP	National Agriculture Imagery Program
NCTCOG	North Central Texas Council of Governments
NEPA	National Environmental Policy Act of 1969
NETMWD	Northeast Texas Municipal Water District
NGO	Non-Governmental Organization
NHPA	National Historic Preservation Act
NOI	Notice of Intent
NOx	Nitrogen Oxides
N_2O	Nitrous Oxide
NOAA	National Oceanic and Atmospheric Administration
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
NRI	National Resources Inventory
NTMWD	North Texas Municipal Water District
O_3	Ozone
OHWM	Ordinary High Water Mark
OSD	Office of the State Demographer

PA	Programmatic Agreement
PAH	polycyclic aromatic hydrocarbon
PET	Potential Evapotranspiration
PHDI	Palmer Hydrological Drought Index
PILT	Payment in Lieu of Taxes
PJD	Preliminary Jurisdictional Determination
PM	Particulate Matter
PM_{10}	Particulate Matter under 10 microns in diameter (fine)
$PM_{2.5}$	Particulate Matter under 2.5 microns in diameter (very fine)
PMF	Probable Maximum Flood
PSA	Public Service Announcement
RCRA	Resource Conservation and Recovery Act
RGA	Rapid Geomorphic Assessment
RGL	Regulatory Guidance Letter
ROD	Record of Decision
ROI	Region of Influence
RPW	Relatively Permanent Water
RRA	Red River Authority
RRC	Railroad Commission of Texas
RWPG	Regional Water Planning Group
SB	Senate Bill
SCS	Soil Conservation Service
SHPO	State Historic Preservation Office
SQF	Stream Quality Factor
SQRU	Scenic Quality Rating Unit
SQU	Stream Quality Unit
SRA	Sabine River Authority
TAC	Texas Administrative Code
TARL	Texas Archeological Research Laboratory
TASA	Texas Archeological Sites Atlas
TCEQ	Texas Commission on Environmental Quality
TDA	Texas Department of Agriculture
TDS	Total Dissolved Solids
THC	Texas Historical Commission
THPO	Tribal Historic Preservation Officer
THSA	Texas Historic Sites Atlas
T&E	Threatened and Endangered (species)
TPWD	Texas Parks and Wildlife Department
tpy	tons per year
TRA	Trinity River Authority
TRWD	Tarrant River Water District
TSR	Terminal Storage Reservoir
TWC	Texas Water Code
TWDB	Texas Water Development Board
TX	Texas
T&E	Threatened and Endangered (species)
T&PR	Texas and Pacific Railroad
TNW	Traditional Navigable Water
TxDOT	Texas Department of Transportation
USACE	U.S. Army Corps of Engineers

USC	United States Code
USCB	U.S. Census Bureau
USDA	U.S. Department of Agriculture
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
UTRWD	Upper Trinity Regional Water District
VOC	Volatile Organic Compound
Vpd	vehicle trips per day
VRM	Visual Resource Management
WAM	Water Availability Model
WCAC	Water Conservation Advisory Council
WMA	Wildlife Management Area
WRP	Wetlands Reserve Program
WRPI	Water Resources Planning and Information
WTF	Water Treatment Facility
WTP	Water Treatment Plant
WUG	Water User Group
WWP	Wholesale Water Provider
WWTP	Wastewater Treatment Plant

APPENDIX B – GLOSSARY AND TERMS

Amortization: The paying off of debt in regular installments over a period of time.

Cost Synergy: A cost synergy refers to the opportunity of a combined corporate entity to reduce or eliminate expenses associated with running a business. Cost synergies are realized by eliminating positions that are viewed as duplicate within the merged entity.

Decibel: A unit used to measure the intensity of a sound.

Easement: The right of a person, government, agency, or public utility company to use or restrict public or private land owned by another for a specific purpose.

Economies of Scale: Reductions in unit cost as the size of a facility and the usage levels of other inputs increase.

Eminent Domain: A power reserved by a government agency, usually at the state or local level, to use its legislatively-granted police power to condemn a piece of property for the public use.

Genetic Distribution: The total number of genetic characteristics in the genetic makeup of a species.

Leakage: A non-consumption use of income, including saving, taxes, and imports. The notion of leakage is best viewed through the circular flow, in which saving, taxes, and imports are "leaked" out of the main flow between output, factor payments, national income, and consumption.

Leaseback: An arrangement where the seller of an asset leases back the same asset from the purchaser. In a leaseback arrangement, the specifics of the arrangement are made immediately after the sale of the asset, with the amount of the payments and the time period specified. Essentially, the seller of the asset becomes the lessee and the purchaser becomes the lessor in this arrangement.

Lien: An official claim of debt against something, where the asset will be in hands of lender and the lender himself can adjusts the sale value of the asset to the debt without prior notice to the borrower.

Market Saturation: A situation in which a product has become diffused (distributed) within a market; the actual level of saturation can depend on consumer purchasing power; as well as competition, prices, and technology.

Overbanking: Flooding over the bank of a stream or river.

Parity Debt: Bonds and other debt securities that have an equal and ratable claim on the same underlying asset as collateral.

Photosynthesis: Process by which green plants and some other organisms use sunlight to make food from carbon dioxide and water.

Pledge: Transferring property as collateral for a debt. The lender cannot adjust the secured asset without having given prior notice and until the due date.

Pro-rata: Assigning an amount to a fraction, or a proportionate allocation, according to its share of the whole. For example, a pro-rata dividend means that every shareholder gets an equal proportion for each share he or she owns. Pro-rating also refers to the practice of applying interest rates to different time frames. If the interest rate was 12% per annum, you could pro-rate this number to be 1% a month (12percent/12 months).

Step-up provision: The readjustment of the value of an appreciated asset for tax purposes upon inheritance. The value of the asset is determined to be the higher market value of the asset at the time of inheritance, not the value at which the original party purchased the asset.

Stratification: When water forms layers because of differences in salinity, oxygen levels, density, or temperature. These layers often act as a barrier to water mixing.

Tax Roll: A breakdown of all taxable property that can be taxed within a given jurisdiction, such as a city or county. The tax roll lists each property separately in addition to its assessed value, and is usually created by the taxing assessor or other authority within the jurisdiction.

Thermocline: A sudden temperature gradient in a body of water such as a lake, this area is marked by a layer above and below with waters of different temperatures.

APPENDIX C – LIST OF PERSONS AND AGENCIES CONSULTED

Person	Affiliation
Jon Albright	Freese and Nichols, Inc.
Kathy Alexander	Texas Commission on Environmental Quality
David Bradsby	Texas Parks and Wildlife Department
Tony Bosecker	Freese and Nichols, Inc.
John Botros	Texas Parks and Wildlife Department
Ashley Burt	North Texas Municipal Water District
Stephanie Capello	Freese and Nichols, Inc.
Tom Cloud	U.S. Fish and Wildlife Service
Jim Crooks	U.S. Forest Service
Brenda Shemayne Edwards	Caddo Nation of Oklahoma
Mark Fisher	Texas Commission on Environmental Quality
David Galindo	Texas Commission on Environmental Quality
Patrick Garnett	Freese and Nichols, Inc.
Dakus Geeslin	Texas Commission on Environmental Quality
Karen Hardin	Texas Parks and Wildlife Department
Randall Howard	Freese and Nichols, Inc.
Simone Kiel	Freese and Nichols, Inc.
Lynn Jackson	U.S. Forest Service
Chalonda Jasper	U.S. Forest Service
Louis Kindler	Texas Commission on Environmental Quality
Chris Loft	Texas Commission on Environmental Quality
Robert McCarthy	North Texas Municipal Water District
Bill Martin	Texas Historical Commission
Ryan McGillicuddy	Texas Parks and Wildlife Department
Doyle Mosier	Texas Parks and Wildlife Department
John Nielsen-Gammon	Texas A & M
James Parks	North Texas Municipal Water District
Jeanene Peckham	Environmental Protection Agency, Region 6 (Dallas)
Dave Peterson	U.S. Forest Service
Thomas Phillips	U.S. Forest Service

Sid Puder	U.S. Fish and Wildlife Service
Nolan Raphelt	Texas Water Development Board
Mike Rickman	North Texas Municipal Water District
Clint Robertson	Texas Parks and Wildlife Department
Clint Robertson	Texas Parks and Wildlife Department
Peter Schaefer	Texas Commission on Environmental Quality
Jessica Strickland	Freese and Nichols, Inc.
John Sunder	Texas Parks and Wildlife Department
Tami Sundquist	Environmental Protection Agency, Region 6 (Dallas)
Steve Watters	Freese and Nichols, Inc.
Mark Wentzel	Texas Water Development Board
Henry Wied	Red River Authority
Mark Wolfe	Texas Historical Commission

APPENDIX D

SCOPING REPORT

Lower Bois d'Arc Reservoir EIS
Scoping Report

May 2010

Prepared by the Mangi Environmental Group

for the

U.S. Army Corps of Engineers
Tulsa District

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1. Introduction

On Friday, 13 November 2009, in the *Federal Register* (Vol. 74, No. 218, pp. 58616-58617), the U.S. Army Corps of Engineers, Tulsa District (USACE) published a Notice of Intent (NOI) to prepare an EIS for the proposed construction of Lower Bois d'Arc Creek Reservoir in Fannin County, Texas. This NOI (Attachment A) was published subsequent to the USACE receiving an application for a Department of the Army Permit under Section 404 of the Clean Water Act (CWA) from the North Texas Municipal Water District (NTMWD) to construct Lower Bois d'Arc Creek Reservoir.

In accordance with the National Environmental Policy Act (NEPA) of 1969 (42 U.S.C. 4321 et seq.), the USACE determined that issuance of such a permit may have a significant impact on the quality of the human environment. Therefore, the USACE decided to require the preparation of an Environmental Impact Statement (EIS).

Within NEPA, scoping is the process by which a lead agency charged with carrying out a NEPA analysis and preparing an EIS or an Environmental Assessment (EA) determines the scope of the document, that is, which topics, issues, alternatives, and potential impacts it will address. During the scoping period, all interested public agencies and citizens are encouraged to let the lead agency know what they think the EIS should cover.

On the afternoon and evening of 8 December 2009, the USACE conducted a public scoping meeting in the Fannin County Multi-Purpose Complex in Bonham, Texas. This meeting was advertised beforehand in the online and print editions of a local newspaper (*Bonham Journal*), local radio stations, and by means of a public notice issued by the USACE (Attachments B and C). The format of the meeting was that of an "open house." At their leisure, attendees could pass through the large facility looking at exhibits, maps, reports, and information arranged on tables. They could also speak informally and at length with representatives of the USACE, the Texas Commission on Environmental Quality (concurrently conducting a public meeting on the 401 water quality certification associated with the 404 permit application), NTMWD, and contractors/consultants working for the USACE and the NTWMD. In addition, they could submit written comments on a comment form as well as on a diagram depicting phases and elements of the proposed action. Approximately 100 people participated in this event (Attachment D).

On the next day, 9 December 2009, the USACE held an inter-agency scoping meeting in Wylie, TX. Representatives of a number of federal and state agencies were in attendance. Attachment E is the attendee list for this meeting. Attachment F is notes from this agency meeting. Several concerns and issues were mentioned verbally by agencies in this meeting that do not appear in Table 2 on the following pages, among them the following:

- cumulative impacts from concurrent construction of Lake Ralph Hall (also in Fannin County)
- cumulative impacts on water flows in the Red River downstream of the proposed Lower Bois d'Arc reservoir project when considered in conjunction with consumptive water use

in “hydrofracking” [hydraulic fracturing] for natural gas extraction from the Haynesville Shale formation

- effects of the proposed action on the spread of terrestrial invasive species, particularly Chinese tallow, salt cedar, and tree-of-heaven.
- the need for a lakeshore management plan to protect water quality in the lake, and
- possible impacts on U.S. Forest Service plans to restore Lower Bois d’Arc Creek in its original channel at the Caddo National Grasslands downstream of the project site.

2. Issues Raised in Scoping

During scoping, members of the public and public agencies broached a wide variety of issues and topics related to the proposed action – reservoir construction and operation. Tables 1 and 2 show this diversity of opinions and topics. Table 1 lists comments that members of the public were invited to write with magic markers onto several large posters depicting flow diagrams, or more properly, C-E-Q (Cause-Effects-Questions) diagrams, which were prominently displayed on tables at the public scoping meeting in Bonham on December 8, 2009.

Table 1 – Comments/questions written onto C-E-Q Diagram* at public scoping meeting

SHEET #1 OVERVIEW – LOWER BOIS D’ARC CREEK DAM AND RESERVOIR	
Box(es) in C-E-Q Diagram	**Comment or Question**
Dam and Reservoir	What are the local economic implications?
Clearing trees	How many trees?
Facility Construction	Who?
Recreational facilities	What kind?
Facility Operation	Who?
Water supply	Needed. 2060 is around the corner
Recreation	What kind? How much $?
Plugging water wells	Oil and gas wells?
[New box added by commenter]	Wastewater treatment
Raw Water Transmission Line	Who does this effect? [sic]
New Water Treatment Plant	Cost?
Alternatives to Proposed Action	Recycle/Reuse? [New box added by commenter]
Ogallala Aquifer Alternative	Won’t have for too much longer!
Water conservation alternative	[Commenter changed to: Water conservation alternatives] Why not?
SHEET #2 SITE PREPARATION	
Box(es) in C-E-Q Diagram	**Comment or Question**
Equipment and Workers	Will local contractors and people be first in line for contracts?
Increasing housing needs?	Exceed school capacities Increase Fannin County land taxes
Disposal of construction waste	Where?
Burning of waste	What?
Exceed landfill capacity	What?

Harm wildlife/vegetation?	What happens to the endangered wildlife?
Construction of access roads	Where? Impact?
SHEET #3 SITE PREPARATION	
Box(es) in C-E-Q Diagram	**Comment or Question**
Clearing and grading	Local contractors given contracts first?
Loss of prime farmland?	*First commenter*: We still have lots left! *Second commenter*: I disagree
Loss of tax revenue?	To Fannin, Lamar, Collin, Grayson, Bryan counties
SHEET #4 FACILITY AND DAM CONSTRUCTION	
Box(es) in C-E-Q Diagram	**Comment or Question**
Equipment layout site – Harm wildlife/vegetation?	Bears, eagles, timber rattlers, American burying beetle
SHEET #5 FACILITY CONSTRUCTION – RESERVOIR IMPOUNDMENT	
General comments on this sheet: *First commenter*: Most people I know are 100% for the lake. *Second commenter*: You do not know very many people.	
Box(es) in C-E-Q Diagram	**Comment or Question**
Downstream – Decrease water flow?	Big Time Compromise existing irrigation systems
Decrease stream level?	Especially during drought
Change water chemistry?	Decreased water flow in Bois d'Arc will eventually change chemistry especially salinity
Change groundwater hydrology?	Will it?
Impoundment area	Evaporation? [New box added by commenter]
Sediment loading from upstream?	How much?
Block migration of terrestrial wildlife?	Where will they go?
Isolate populations?	Decrease areas for beef production Farm production? DFW FOODSHED?
Impact fisheries?	Due to increased salinity from Red River backflow Mussels
Upstream	Flooding of creek bottoms & farms? Will this lead to construction of Upper Bois d'Arc Reservoir?
Leaching of metals and minerals?	Residual pesticides from agricultural use of land?
Degrade water quality?	Inflows from sewer treatment and plants City of Bonham landfill (currently closed) County Road 2935.

*A C-E-Q (Cause-Effects-Questions) Diagram is like a flow chart with boxes and arrows connecting these boxes, which together depict elements of the proposed project and possible impacts of those elements.

Table 2 summarizes all written comments received by the USACE from both the public and agencies during the scoping comment period. These comments were furnished in several different modes: 1) on comment forms available at the public scoping meeting; these forms could be filled out and dropped into a box or mailed later; 2) emails sent to the USACE; and 3) hard copy letters mailed to the USACE.

The USACE received a total of 84 comment forms, emails, and letters submitted by more than 100 individual citizens and agencies. Several individuals sent more than one comment form, email or letter. Each form, email or letter contained multiple comments on different issues, sometimes many dozens of issues. Each of these was tallied as a separate "comment" on that given issue or topic. For example, Table 2 indicates that 33 separate commenters covered the topic "Impacts on native wildlife species and habitat." Even if a given commenter made more than one remark or observation concerning wildlife species and habitat, this was still tallied just one time for that commenter.

Table 2 needs the following disclaimer: During the review of submitted comments, attempts have been made to identify distinct topics and associate similar comments. While we are confident that all issues raised during the scoping process appear within the following table, the tabulation of numbers of commenters raising a particular issue implies precision that does not truly exist, as comments were expressed in similar form but may have emphasized different aspects of a particular issue.

By way of example, two commentors may have raised concerns for impacts to existing cemeteries or burials. In one instance, the emphasis may have been on potential flooding risks whereas in another comment, emphasis may have been on the unknown historical values at risk. Consequently, the numbers in the following table should be considered approximate and reflect a proportional level at which the issue was shared by other commentors. The numbers should be considered a rough gauge of how widely a listed concern is shared by the public.

Table 2 – Issues Raised in Written Scoping Comments

Topics and related comments	**Number of commenters who cited**
Air Resources	
• Increased water surface & subsequent evaporation from all existing and planned reservoirs may increase humidity in region	3
• Effects on air quality and greenhouse gas emissions	1
Alternatives	
• Reservoir is unnecessary and better alternatives are available	10
• Each alternative needs to include water conservation	3
• Pipeline(s) from existing reservoirs would be cheaper & better option	3
• Water conservation and reuse is better alternative	2
• Mitigation needs and costs for each alternative should be identified	2
• Desalination plant at Gulf to tap into inexhaustible water of ocean	2
• Identify the least environmentally damaging alternative (LEDPA)	1

Topics and related comments	Number of commenters who cited
Alternatives (cont.)	
• Consider combinations of alternatives	1
• Groundwater alternative – Carrizo-Wilcox formation is renewable	1
• Oklahoma has “vast water resources”	1
• Obtain water from Red River itself	1
• Dam the Trinity; it’s closer to Dallas and would provide more recreation	1
• Higher water pricing will curtail water use	1
• More water could be desalinated from Lake Texoma	1
• NTMWD doesn’t actively encourage water conservation because it would lose money	1
• Is there a practicable alternative with less adverse impact to jurisdictional waters?	1
• Why are other existing reservoirs rejected solely on basis of cost?	1
• Need for reservoir not established	1
Biological Resources	
• Impacts on native wildlife species and habitat	33
• Spread of invasive species, e.g. zebra mussel, hydrilla, feral hogs	9
• Endangered, threatened, rare species and habitats	8
• Impacts on trees and bottomland/riparian forests	7
• Impacts to Louisiana black bear	3
• Impacts to American burying beetle	3
• Removal of timber from areas being purchased for reservoir	3
• Effect on Caddo Grasslands and its wildlife	2
• Displaced wildlife will compete with existing wildlife on other sites	2
• Impacts to timber rattlesnake	2
• Importance of ensuring that mitigation areas adequately replace lost area	2
• Impacts to rare plants	1
• Impacts to bald eagle	1
• Impacts to wild turkey & habitat	1
• Impacts to migratory birds	1
• Impacts to fisheries	1
• Impacts to cougars	1
• Impacts to state-listed freshwater mussels	1
• Proposed mitigation site does not have same habitat as Lower Bois d’Arc Creek	1
• State-listed species	1
• Wildlife will get mired in mudflats	1
• Aquatic life below the reservoir and means of minimizing adverse impacts	1
• TPWD has creek as an Ecologically Significant Stream Segment	1
• Need to develop a mitigation plan to offset unavoidable impacts	1
• Mitigation ratio	1

Topics and related comments	Number of commenters who cited
Cultural Resources	
• Impacts to Indian artifacts or burial sites	11
• Impacts to unmarked slave and pioneer cemeteries	9
• Damage to historic/cultural/archeological properties	7
• Camp Benjamin Confederate Soldiers near former Onstatt Lake	4
• Need for surveys given high cultural resource potential of area	1
• Paleontological resources (e.g. sharks teeth)	1
• Historic farmhouses	1
Geology and Soils	
• Possible oil and gas resources beneath reservoir footprint	5
• Permanent loss of fertile, productive soils	2
Human Health and Safety	
• Increase in disease vectors, e.g. mosquitoes	7
• Health in jeopardy	1
• Traffic control, police coverage, emergency access	1
• Health risks from chemicals used to control mosquitoes and aquatic weeds	1
• Emotional stresses on the local population	1
Land Use	
• Zoning effects on property rights and lakefront development	8
• Fate of mitigation land (Riverby property)	6
• Adverse impact to Legacy Ridge golf course and Country Club	4
• County's best farmland is in reservoir footprint	3
• Loss of acreage for beef production	2
• Public infrastructure and utilities	1
• Areas will be made inaccessible	1
• Who enforces Rural Property Protection Act?	1
• Purpose of land purchase near Leonard	1
Recreation	
• Shallow &fluctuating lake will not be conducive to aquatic recreation opportunities	10
• Impact on existing hunting opportunities	5
• Added recreational opportunities in county	1
• Encourage development of scuba park/training area in reservoir	1
• Impact on existing recreation opportunities and potential for future ones	1
Socioeconomics	
• Adverse impact to agricultural economy & livelihoods in county	29
• Less tax revenue to county and heavier tax burden on remaining residents	23

Topics and related comments	Number of commenters who cited
Socioeconomics (cont.)	
• Displacement of multi-generational residents, farmers and ranchers; loss of farming/ranching/rural heritage	20
• Reputed recreational & related economic benefits are questionable because of fluctuating lake level and shoreline, mudflats, etc. – look at other reservoirs in area where claimed benefits have not been realized	17
• Losing own home, land, and/or job	9
• Lost food production and its economic value	8
• Will benefit Lake Lavon (by maintaining water level) and its residents at expense of Fannin County residents	8
• Project will encourage beneficial local economic development	7
• New reservoir won't be able to compete with established lakes that already offer high-quality recreational experience & real estate properties	7
• Eliminating family businesses	4
• Culture of area will change against wishes of longtime residents due to influx of outsiders who don't share values; social cohesion eroded	4
• Landowner compensation needs to be fair, by purchasing entire, not partial, properties	4
• Cost of relocation	2
• Direct, indirect and cumulative impacts of economic development stimulated by the lake	2
• Lakefront zoning effects on property rights and quality of development	2
• Project will undermine economic prospects of Fannin County	2
• This project will be detrimental to cattle production	2
• Tax revenues will increase because of project	1
• A few people will make a lot of money	1
• Crime will worsen	1
• Reservoir will provide for increased population in service area	1
• Water from reservoir will be used to hold cost down	1
• Life of Woodbine Aquifer will be extended due to reservoir	1
• NTMWD's acquisition of all water rights in basin will prevent cattle production, which needs irrigation, from expanding	1
• Loss of revenue stream from timber harvest over time	1
• Loss of revenue from hunting and fishing	1
• Impacts on Sam Rayburn ISD	1
Transportation	
• Potential for adverse effects on existing roads and bridges	3
• Effects on private roads	1
• Traffic and control	1
• Opening Red River to barges and freight traffic	1
• Navigation potential of Red River may be compromised from lower flow	1

Topics and related comments	Number of commenters who cited
Utilities	
• Who is responsible for rerouting infrastructure during construction?	2
• Issues arising from NTMWD's demand for electricity to pump water	1
Water Resources	
• Water is being wasted and needs to be conserved	23
• Concerned that reservoir may cause flooding in Bonham, along tributaries, and upstream areas	19
• Fluctuating lakeshore and resultant unattractive mudflats	12
• Limited viable lifetime of reservoir (storage capacity loss over time from siltation)	11
• Shallow depth of reservoir/reservoir only partially full much of year	7
• Benefit of adding more water supply/additional water will be needed	7
• Impacts on wetlands and their values and functions	5
• What is the scope and purpose of the reservoir?	5
• Taking Fannin County's water	3
• Hydrological and ecological effects upstream and downstream	3
• Ill-suited site for reservoir because of low gradient	3
• Will deep water well systems have to move to this surface supply?	3
• Lake evaporation rate and losses	2
• Reducing availability of water for neighbors downstream	2
• Cumulative impacts on aquatic resources over time, including Red River	2
• Impacts of the pipeline on water resources at stream crossings	2
• Continuation of existing irrigation rights	2
• How much water will Fannin County have access to?	2
• Impact on farmers downstream on Bois d'Arc who use it for irrigation	2
• How realistic are yield projections?	1
• Is it necessary for each house to have a swimming pool?	1
• Reservoir will reduce flooding	1
• Inter-basin transfer of water is good	1
• Backflow from Red River will increase Lower Bois d'Arc salinity	1
• Do groundwater rights go with surface water rights or are they separable?	1
• Does water right condemnation to build lake require taking flood easement and/or groundwater?	1
• Potential for shoreline erosion due to alignment of lake with SW winds	1
• Impacts of pipeline at stream crossings and wetlands	1
• Impacts of reservoir itself on wetlands and waters of the U.S.	1
• Existing condition of Pilot Grove Creek and impacts of inter-basin transfer	1
• Will citizens be allowed to use their own groundwater?	1
• Impacts of project on flood attenuation and nutrient storage services provided by existing wetlands	1
• Changes in volume and frequency of upstream and downstream flows	1
• Mitigation Plan for biological and wetlands resources using HEP	1

Topics and related comments	Number of commenters who cited
Water Quality	
• Poor water quality in reservoir from upstream pollutants	17
• Upstream wastewater treatment plant discharges (treated & raw sewage)	10
• Effects of chemical (arsenic) residues from cotton farming	9
• Impact of reservoir on water quality of private wells nearby	6
• Old VPG plant contaminants	5
• Impact on underground sewer and septic systems	4
• Effects on Woodbine, and by extension, Whiteshed Water and Bois d'Arc Mud water systems	3
• Water from lake will be unreliable, of lower quality and cost more	2
• Lake likely to become hog wallow; effects on WQ?	1
• Effects of trihalomethanes from decomposing tree tops	1
• Threat of water contamination from MTBE (gasoline additive)	1
• Unacceptable odors in water	1
• Will ranchers be allowed to water their cattle in the lake?	1
• Releases from dam to downstream creek will be lower temp. & oxygen	1
• Maintenance of water quality during and after construction	1
• Existing water quality in Pilot Grove Creek and effects of adding water transferred from Lower Bois d'Arc Creek	1
• Stagnant, shallow water in reservoir	1
Miscellaneous comments on process and preferred outcome*	
• Project and lake will be negative for county	8
• Project and lake will be positive for county	7
• USACE previously denied this project, proving it does not make sense; why is USACE reconsidering it?	6
• NTMWD is treating landowners fairly in purchasing their properties	4
• Need 3rd party study of who really gains and loses from reservoir	4
• NTMWD is treating landowners unfairly	3
• NTMWD purchasing land without approved permit	2
• Unduly lengthy approval and permitting process	1
• Reservoir opponents are stubborn and resist change	1
• Local residents believe project is being pushed on them	1
• Stop this atrocious infringement upon the rights and liberties of county citizens	1
• Wants to delay or prevent project	1
• Majority of county residents opposed to project	1
• Majority of county residents support project	1
• Lack of communication with NTMWD	1
• If homes are flooded many lawsuits will be filed	1
• Lower Bois d'Arc Creek should be preserved as a wilderness area	1
• Rights are being trampled and due process is just a formality	1

*These miscellaneous comments were received by the USACE and are here documented in this scoping report, but are not necessarily within the scope of topics to be covered in the EIS, which by the NEPA statue and CEQ regulations considers potential environmental consequences.

3. Main Issues and Topics Raised in Scoping

Table 3 lists the top issues/topics from Table 2, as cited by the members of the public and governmental agencies. These are a gauge of the highest priority concerns that agencies and the public feel need to be addressed in the EIS.

Table 3 – Top Issues Raised by Proposed Lower Bois d'Arc Reservoir

Place	Issue/Topic	Number of commenters who cited
1	Impacts on native wildlife species and habitat	33
2	Adverse impact to agricultural economy & livelihoods in county	29
3	Reduced tax revenues to county and heavier tax burden for remaining residents	23
3	Water is being wasted and needs to be conserved	23
5	Displacement of multi-generational residents, farmers and ranchers; loss of farming/ranching/rural heritage	20
6	Concerned that reservoir may cause flooding in Bonham, along tributaries, and upstream areas	19
7	Reputed recreational & related economic benefits are questionable because of fluctuating lake level and shoreline, mudflats, etc. – look at other reservoirs in area where claimed benefits have not been realized	17
7	Poor water quality in reservoir from upstream pollutants	17
9	Fluctuating lakeshore and resultant unattractive mudflats	12
10	Impacts to Indian artifacts or burial sites	11
10	Limited viable lifetime of reservoir (storage capacity loss over time from siltation)	11
12	Shallow &fluctuating lake will not be conducive to aquatic recreation opportunities	10
12	Upstream wastewater treatment plant discharges (treated & raw sewage)	10
14	Effects of chemical (arsenic) residues from cotton farming	9
14	Spread of invasive species, e.g. zebra mussel, hydrilla, feral hogs	9
14	Impacts to unmarked slave and pioneer cemeteries	9
14	Losing own home, land, and/or job	9
18	Endangered, threatened, rare species and habitats	8
18	Zoning effects on property rights and lakefront development	8
18	Lost food production and its economic value	8
18	Will benefit Lake Lavon (by maintaining water level) and its residents at expense of Fannin County residents	8
22	Impacts on trees and bottomland/riparian forests	7
22	Increase in disease vectors, e.g. mosquitoes	7
22	Damage to historic/cultural/archeological properties	7

22	Project will encourage beneficial local economic development	7
22	New reservoir won't be able to compete with established lakes that already offer high-quality recreational experience & real estate properties	7
22	Shallow depth of reservoir/reservoir only partially full much of year	7
22	Benefit of adding more water supply/additional water will be needed	7

It should be emphasized that this particular delineation/breakdown of issue topics is somewhat arbitrary. Thus, this particular ordering of priority issues is also somewhat arbitrary. Nevertheless, from a close examination of the wide diversity of hundreds of comments received by citizens and public agencies during the Lower Bois d'Arc Reservoir scoping process it is clear that the main concerns relate to: 1) possible impacts on wildlife and habitat; 2) socioeconomic impacts on the area's residents and agricultural economy and fiscal impacts on county government and services; 3) water conservation and quality; 4) flooding; 5) the possibility of overstated economic and recreational benefits due to the proposed lake's shallow depth, allegedly fluctuating shoreline, and limited useful life; and 6) possible impacts to cultural resources. The EIS will address these issues and concerns.

The EIS will also address the significant issues raised by written comments the USACE received in response to the Public Notice on the original 404 permit application. As noted in the attached NOI (Attachment A to this Scoping Report):

> Issues to be given analysis in the EIS are likely to include, but will not be limited to: The effects of the lake on the immediate and adjacent property owners, nearby communities, downstream hydraulics and hydrology, wetlands, surface water quality and quantity, groundwater quality and quantity, geological resources, vegetation, fish and wildlife, federally-listed threatened and endangered species, soils, prime farmland, noise, light, aesthetics, historic and pre-historic cultural resources, socioeconomics, land use, public lands, public roads, air quality, and the effects of construction of related facilities.

The USACE verbally reiterated these issues at the outset of the 9 December 2009 agency scoping meeting in Wylie, TX, stating:

> Things the USACE sees [being covered in the EIS] include, but are not necessarily limited to: the magnitude of the project; its impacts on landowners and livelihoods; impacts on forested wetlands and other wetland habitats and other aquatic resources; mitigation of projected wetland losses; impacts on downstream lands including riparian forest lands, U.S. Forest Service (USFS) Caddo National Grasslands, social and economic impacts (e.g., roads); changes to downstream flow regime; conversion of agricultural lands to lakebed or mitigation lands (loss of agricultural production on local economy); changes (loss to quasi-public purposes) to the tax base in Fannin County; impacts to the school district (quality and funding); project alternatives (alternative lake sites or water sources); environmental and social costs incurred by Fannin County when other counties benefit from the water; whether adequate conservation measures are in place; potential archeological/ cultural resources. This is not an exhaustive list.

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electronic means," or "reasonable means." What changes, if any, are needed to the rule regarding electronic certificates? Should foreign manufacturers be required to issue a certificate?

IV. Details Regarding the Workshop

The workshop will be held from 9:30 a.m. to 4 p.m. on Thursday, December 10, 2009, and Friday, December 11, 2009 at the CPSC's headquarters building at 4330 East West Highway, Bethesda, Maryland 20814, in the 4th Floor Hearing Room.

The workshop will open with a review of CPSC staff's current work on sections 14(a) and 14(d)(2) of the CPSA, including a discussion of the factors involved in sampling and an overview of the economic issues, followed by break-out sessions on the following subjects:

- The Consumer Product Labeling Program;
- Reasonable Testing Programs;
- Sampling Plans;
- Safeguarding Against Undue Influence on Product Testing;
- Additional Third-Party Testing Requirements for Children's Products; and
- Verification of Children's Product Testing Results.

The panels at the break-out sessions will consist of Commission staff and invited members from the public. If you would like to make a presentation at the workshop or be considered as a panel member for a specific break-out session, please send, via electronic mail (e-mail), a note indicating your desire to participate and/or indicating which of the break-out sessions you wish to join. We ask that you limit the number of break-out sessions to no more than three. We will select panelists and persons who will make presentations at the workshop, based on considerations such as: The individual's familiarity or expertise with the topic to be discussed; the practical utility of the information to be presented (such as a discussion of specific standards, methods, or other regulatory approaches), and the individual's viewpoint or ability to represent certain interests (such as large manufacturers, small manufacturers, consumer organizations, *etc.*). The e-mail should be sent to Robert Howell at *rhowell@cpsc.gov* no later than November 20, 2009. In addition, please inform Mr. Howell of any special equipment needs required to make a presentation. While an effort will be made to accommodate all persons who wish to make a presentation, the time allotted for presentations will depend on the number of persons who wish to speak on a given topic and the workshop schedule. We recommend that individuals and organizations with common interests consolidate or coordinate their presentations and request time for a joint presentation. If you wish to make a presentation and want to make copies of your presentation or other handouts available, you should bring copies to the workshop. We will notify those who are selected to make a presentation or participate in a break-out session panel at least 3 weeks before the workshop. Selections will be made in attempt to ensure that a wide variety of interests are represented.

If you do not wish to make a presentation, you do not need to notify the CPSC, but please be aware that seating will be on a first-come, first-served basis.

If you need special accommodations because of disability, please contact Mr. Howell at least 7 days before the workshop.

In addition, we encourage written or electronic comments to the docket. Written or electronic comments will be accepted until January 11, 2010. Please note that all comments should be restricted to how the CPSC should interpret and implement the requirements found in sections 14(a) and 14(d)(2) of the CPSA so as to promote increased product safety while minimizing possible adverse impacts or unintentional consequences of the implementing regulations to be developed.

Dated: November 9, 2009.

Todd A. Stevenson,

Secretary, Consumer Product Safety Commission.

[FR Doc. E9–27328 Filed 11–12–09; 8:45 am]

BILLING CODE 6355–01–P

DEPARTMENT OF DEFENSE

Department of the Army; Corps of Engineers

Intent To Prepare an Environmental Impact Statement for the Proposed Construction of Lower Bois d'Arc Creek Reservoir in Fannin County, TX

AGENCY: Department of the Army, U.S. Corps of Engineers, DoD.

ACTION: Notice of Intent.

SUMMARY: The U.S. Army Corps of Engineers, Tulsa District (USACE) has received an application for a Department of the Army Permit under Section 404 of the Clean Water Act (CWA) from the North Texas Municipal Water District (NTMWD) to construct Lower Bois d'Arc Creek Reservoir. In accordance with the National Environmental Policy Act (NEPA) of 1969 (42 U.S.C. 4321 *et seq.*), the USACE has determined that issuance of such a permit may have a significant impact on the quality of the human environment and, therefore, requires the preparation of an Environmental Impact Statement (EIS).

The USACE intends to prepare an EIS to assess the direct, indirect, and cumulative environmental, social, and economic effects of issuance of a Department of the Army permit under Section 404 of the CWA for discharges of dredged and fill material into waters of the United States (U.S.) associated with the construction of the proposed water supply reservoir. In the EIS, the USACE will assess potential impacts associated with a range of alternatives. The preparation of an EIS begins with a scoping process to determine the issues to be addressed in the EIS.

The NTMWD provides wholesale treated water supply, wastewater treatment, and regional solid waste services to 45 member cities and customers in a service area covering all or parts of Collin, Dallas, Denton, Fannin, Hunt, Kaufman, Rains, and Rockwall Counties in north central Texas. The Lower Bois d'Arc Creek Reservoir, if constructed, would be a non-federal project constructed, owned and operated by NTMWD.

DATES: A Public Scoping Meeting will be held December 8, 2009, from 3 p.m. to 8 p.m.

ADDRESSES: The Public Scoping Meeting location is Fannin County Multi-Purpose Complex, 700 FM 87, Bonham, Texas 75418, approximately 1.5 miles west of Bonham off Highway 56.

FOR FURTHER INFORMATION CONTACT: For further information or questions about the proposed action and EIS, please contact Mr. Andrew R. Commer, Supervisory Regulatory Project Manager, by letter at Regulatory Office, CESWT–RO, U.S. Army Corps of Engineers, 1645 South 101st East Avenue, Tulsa, Oklahoma 74128–4609; by telephone at 918–669–7400; by electronic mail *Andrew.Commer@usace.army.mil*. For special needs (visual or hearing impaired, Spanish translator, etc.) requests during scoping meetings, please contact Andrew Commer by November 24, 2009.

SUPPLEMENTARY INFORMATION:

1. *Description of Proposed Project:* The proposed reservoir dam would be located in Bois d'Arc Creek, in the Red River watershed, approximately 15 miles northeast of the town of Bonham,

between Farm-to-Market (FM) Road 1396 and FM Road 409, in Fannin County, TX. The proposed project site consists of 17,068 acres. Approximately 38 percent of the project site is cropland, 37 percent is bottomland hardwoods and riparian woodlands. The remaining 25 percent is mostly upland deciduous forest.

The purpose of the proposed project is to impound the waters of Bois d'Arc Creek and its tributaries to create a new 16,641 acre water supply reservoir for NTMWD. Approximately 427 acres would be required for the construction of the dam and spillways. NTMWD has requested the right to impound up to 367,609 acre-feet of water, to produce an estimated firm yield of 126,200 acre-feet of water per year. State population projections show the NTMWD service population to increase from 1.6 million to 3.3 million by 2060. The Lower Bois d'Arc Creek Reservoir would provide a new water supply to help meet this increasing demand.

Lower Bois d'Arc Creek Reservoir Dam would be about 10,400 feet in length and would have a maximum height of about 90 feet. The design top elevation of the embankment would be 553.5′ msl with a conservation pool elevation of 534.0′ msl controlled by a service spillway at elevation 534.0′ msl with a crest length of 150 feet. The service spillway would be located at the right (east) abutment of the dam. Required low-flow releases would be made through a 36-inch diameter low-flow outlet. An emergency spillway would also be located in the right abutment of the dam. The emergency spillway would be a 1,400-foot wide uncontrolled broad crested weir structure with a crest elevation of 541′ msl. This elevation was selected to contain the 100-year storm such that no flow passes through the emergency spillway during this event.

Raw water from the reservoir would be transported by 29 miles of 90-inch pipeline to a proposed water treatment plant near the City of Leonard in southwest Fannin County. To allow the NTMWD the ability to treat water from Lower Bois d'Arc Creek Reservoir at its existing facilities in Wylie, TX, 14 miles of 66-inch pipeline would also extend from the water treatment plant to an outfall on Pilot Grove Creek, a tributary of the East Fork of the Trinity River, to deliver raw water to Lake Lavon, in the Trinity River basin.

Construction of the dam and impoundment of the water within the normal pool elevation of 534′ msl would result in direct fill impact or inundation of approximately 120 acres of perennial streams, 99 acres of intermittent streams, 87 acres of open water, 4,602 acres of forested wetlands, 1,223 acres of herbaceous wetlands, and 49 acres of shrub wetlands.

2. *Alternatives:* Alternatives available to the USACE are to: (1) Issue the Department of the Army permit; (2) issue the Department of the Army permit with special conditions; or (3) deny the Department of the Army permit. Alternatives available to NTMWD include: (1) Construct Lower Bios d'Arc Creek Reservoir as proposed; (2) construct Lower Bois d'Arc Creek Reservoir as proposed by NTMWD, with modifications; (3) developing or acquiring other water supply sources; or (4) no action. As part of the EIS process, a full range of reasonable alternatives, including the applicant's preferred alternative, will be evaluated.

3. *Scoping and Public Involvement:* A public notice for the Section 404 CWA permit application was issued on the proposal on October 14, 2008 soliciting comments from federal, state, and local agencies and officials, interested individuals and the general public. The 30-day comment period was extended by 30 days until December 12, 2008 to afford ample opportunity for public and agency comment on this project. A public Scoping Meeting will be held regarding the proposed action to seek public comments on the proposed project and its potential effects to the human environment (*See* **DATES AND ADDRESSES**). The USACE will be conducting the public scoping meeting to describe the project, preliminary alternatives, the NEPA compliance process, and to solicit input on the issues and alternatives to be evaluated and other related matters. Written comments for scoping will be accepted until January 9, 2010.

4. *Significant Issues:* Issues to be given analysis in the EIS are likely to include, but will not be limited to: The effects of the lake on the immediate and adjacent property owners, nearby communities, downstream hydraulics and hydrology, wetlands, surface water quality and quantity, groundwater quality and quantity, geological resources, vegetation, fish and wildlife, federally-listed threatened and endangered species, soils, prime farmland, noise, light, aesthetics, historic and pre-historic cultural resources, socioeconomics, land use, public lands, public roads, air quality, and the effects of construction of related facilities.

5. *Cooperating Agencies:* The USACE has invited the U.S. Environmental Protection Agency, U.S. Fish and Wildlife Service, U.S. Forest Service, Texas Commission on Environmental Quality, Texas Parks and Wildlife Department, Texas Historical Commission, and Texas Water Development Board to be Cooperating Agencies (CA) in the formulation of the EIS. No decisions have been made on CA status at this time. Regardless of final CA status decisions, these agencies, as well as other federal, tribal, state, and local governmental entities are expected to be involved in the review and comment of the Draft EIS.

6. *Additional Review and Consultation:* Compliance with other Federal and State requirements that will be addressed in the EIS include, but are not limited to, state water quality certification under Section 401 of the CWA, protection of water quality under the Texas Pollutant Discharge Elimination System, protection of air quality under the Texas Air Quality Act, protection of endangered and threatened species under Section 7 of the Endangered Species Act, and protection of cultural resources under Section 106 of the National Historic Preservation Act.

7. *Availability of Draft EIS:* The Draft EIS is projected to be available by September 2010. There will be a public comment cycle (a public meeting(s) and opportunity for public hearing) following the release of the Draft EIS.

David A. Manning,

Chief, Regulatory Office.

[FR Doc. E9–27262 Filed 11–12–09; 8:45 am]

BILLING CODE 3720–58–P

DEPARTMENT OF DEFENSE

Department of the Army

Record of Decision for Stationing and Training of Increased Aviation Assets Within U.S. Army Alaska

AGENCY: Department of the Army, DoD.

ACTION: Notice of Availability (NOA).

SUMMARY: The Department of the Army announces the availability of its Record of Decision (ROD) that documents and summarizes the decision for implementing actions to increase numbers and types of aviation assets and training within U.S. Army Alaska (USARAK). The decision is based on the analysis described in the Final Environmental Impact Statement (FEIS) for Stationing and Training of Increased Aviation Assets within U.S. Army Alaska (August 2009), supporting studies, and comments provided during formal comment and review periods.

ADDRESSES: Requests for copies of the Army's ROD may be made to Ms. Carrie McEnteer, Directorate of Public Works,

Attachment B – Display Ad/Public Notice in *Bonham Journal*

PROPOSED LOWER BOIS D'ARC CREEK RESERVOIR

Published: Monday, November 30, 2009 10:11 AM CST

Public Meeting in Bonham

Tuesday, December 8, 2009 (3 to 8 p.m.)

Fannin County Multi-Purpose Complex

The U.S. Army Corps of Engineers, Tulsa District (USACE) has received an application for a Permit under Section 404 of the Clean Water Act from the North Texas Municipal Water District (NTMWD) to construct Lower Bois d'Arc Creek Reservoir. The USACE has determined that issuing this permit may have a significant impact on the quality of the human environment and, therefore, requires the preparation of an Environmental Impact Statement (EIS).

The USACE intends to prepare an EIS to assess the environmental, social, and economic effects of issuing a Section 404 permit for discharges of dredged and fill material into waters of the U.S. associated with the construction of the proposed water supply reservoir. In the EIS, the USACE will assess potential impacts from a range of alternatives. EIS preparation begins with a scoping process to determine the issues to be addressed in the EIS and the public helps to determine what issues are important.

The NTMWD provides wholesale treated water supply, wastewater treatment, and regional solid waste services to 45 member cities and customers in a service area covering all or parts of eight counties in north-central Texas. The Lower Bois d'Arc Creek Reservoir, if constructed, would be a non-federal project constructed, owned and operated by NTMWD.

The USACE will be conducting a public scoping meeting to describe the project, preliminary alternatives, the NEPA compliance process, and to solicit input on the issues and alternatives to be evaluated and other related matters. Written comments for scoping will be accepted until January 9, 2010.

A Public Scoping Meeting will be held on Tuesday, December 8, 2009, from 3 to 8 p.m., at the Fannin County Multi-Purpose Complex, 700 FM 87, Bonham, Texas 75418. The Complex is about 1.5 miles west of Bonham, north of Hwy 56.

For further information or questions about the proposed action and EIS, please contact Mr. Andrew R. Commer, Supervisory Regulatory Project Manager, by letter at Regulatory Office, CESWT-RO, U.S. Army Corps of Engineers, 1645 South 101st East Avenue, Tusla, Oklahoma, 74128-4609; by telephone at 918-669-7400; by electronic mail

Andrew.Commer@usace.army.mil. For special needs (visual or hearing impaired, Spanish translator, etc.) request during scoping meetings, please call Mr. Commer.

Attachment C – USACE public notice for scoping meeting

Public Notice

U.S. Army Corps of Engineers
Tulsa District

Reply To:

U.S. Army Corps of Engineers
ATTN: Regulatory Office
1645 South 101st East Avenue
Tulsa, OK 74128-4609

SWT-0-14659
EIS Scoping Meeting
Public Notice No.

November 6, 2009
Public Notice Date

January 9, 2010
Expiration Date

PURPOSE
The purpose of this public notice is to inform you of a proposal for work in which you might be interested and to solicit your comments and information to better enable us to make a reasonable decision on factors affecting the public interest.

SECTION 10
The U.S. Army Corps of Engineers is directed by Congress through Section 10 of the Rivers and Harbors Act of 1899 (33 USC 403) to regulate all work or structures in or affecting the course, condition, or capacity of navigable waters of the United States. The intent of this law is to protect the navigable capacity of waters important to interstate commerce.

SECTION 404
The U.S. Army Corps of Engineers is directed by Congress through Section 404 of the Clean Water Act (33 USC 1344) to regulate the discharges of dredged and fill material into all waters of the United States. These waters include lakes, rivers, streams, mudflats, sandflats, sloughs, wet meadows, natural ponds, and wetlands adjacent to other waters. The intent of the law is to protect these waters from the indiscriminate discharge of material capable of causing pollution and to restore and maintain their chemical, physical, and biological integrity.

NOTICE TO PUBLISHERS
This public notice has been provided as a public service and may be reprinted at your discretion. However, any cost incurred as a result of reprinting or further distribution shall not be a basis for claim against the Government.

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS, TULSA DISTRICT
1645 SOUTH 101ST EAST AVENUE
TULSA, OKLAHOMA 74128-4609

November 6, 2009

Application No. SWT-0-14659

PUBLIC NOTICE

U.S. Army Corps of Engineers (Corps), Tulsa District

Announcement of Public Scoping Meeting

Proposed Lower Bois d'Arc Creek Reservoir
Environmental Impact Statement (EIS) Process

Interested parties are hereby notified that the District Engineer has scheduled a Public Scoping Meeting related to the Clean Water Act (CWA) Section 404 permit application by North Texas Municipal Water District (NTMWD) for the proposed construction of Lower Bois d'Arc Creek.

The application is to construct a dam on Bois d'Arc Creek to impound a water supply reservoir, Lower Bois d'Arc Creek Reservoir. The purpose of the work is to expand water supply resources of the North Texas Municipal Water District.

The Corps intends to prepare an EIS to assess the direct, indirect, and cumulative environmental, social, and economic effects of issuance of a Department of the Army permit under Section 404 of the CWA for discharges of dredged and fill material into waters of the United States associated with the construction of the proposed water supply reservoir. In the EIS, the Corps will assess potential impacts associated with a range of alternatives. The preparation of an EIS begins with a scoping process to determine the issues to be addressed in the EIS.

Date and Location of Meeting: **December 8, 2009**
3:00pm to 8:00pm
Fannin County Multi-Purpose Complex
700 FM 87
Bonham, Texas
(Complex is about 1.5 miles west of Bonham, north of Hwy 56)

A public notice for the Section 404 CWA permit application was issued on the proposal on October 14, 2008 soliciting comments from Federal, State, and local agencies and officials, interested individuals and the general public. The 30-day comment period was extended by 30 days until December 12, 2008, to afford ample opportunity for public and agency comment on this project. A public Scoping Meeting is being held regarding the proposed action to seek public comments on the proposed project and its potential effects to the human environment. The Corps will be conducting the public scoping meeting, assisted by its Third Party EIS Contractor (Mangi Environmental Group), to describe the project, preliminary alternatives, the National Environmental Policy Act compliance process, and to solicit input on the issues and alternatives to be evaluated and other related matters. Written comments for scoping will be accepted **until January 9, 2010**.

Project Description: The proposed reservoir dam would be located in Bois d'Arc Creek, in the Red River watershed, approximately 15 miles northeast of the town of Bonham, between Farm-to-Market (FM) Road 1396 and FM Road 409, in Fannin County, Texas. The proposed project site consists of 17,068 acres. The purpose of the proposed project is to impound the waters of Bois d'Arc Creek and its tributaries to create a new 16,641-acre water supply reservoir for NTMWD. Lower Bois d'Arc Creek Reservoir Dam would be about 10,400 feet in length and would have a maximum height of about 90 feet. The design top elevation of the embankment would be 553.5 feet mean sea level (' msl) with a conservation pool elevation of 534.0' msl controlled by a service spillway at elevation 534.0' msl with a crest length of 150 feet. Raw water from the reservoir would be transported by 29 miles of 90-inch pipeline to a proposed water treatment plant near the City of Leonard in southwest Fannin County. To allow the NTMWD the ability to treat water from Lower Bois d'Arc Creek Reservoir at its existing facilities in Wylie, Texas, 14 miles of 66-inch pipeline would also extend from the water treatment plant to an outfall on Pilot Grove Creek, a tributary of the East Fork of the Trinity River, to deliver raw water to Lake Lavon, in the Trinity River basin.

Texas Commission on Environmental Quality (TCEQ): Permitting under the CWA Sections 401 and 404 is conducted jointly between the Corps and the TCEQ, with the TCEQ making a State water quality certification decision concurrent with the Corps permit application decision. For the purposes of conducting a TCEQ public meeting, the TCEQ will participate in this EIS Scoping Meeting and will be available for questions and comments regarding the TCEQ's role in reviewing the 404/401 permit application submitted by the NTMWD for the proposed Lower Bois d'Arc Creek Reservoir.

For Additional Information: For further information or questions about the proposed action and EIS, please contact Mr. Andrew Commer, Supervisory Regulatory Project Manager, by letter at Regulatory Office, CESWT-RO, U.S. Army Corps of Engineers, 1645 South 101st East Avenue, Tulsa, Oklahoma, 74128-4609; by telephone at 918-669-7400; by electronic mail *Andrew.Commer@usace.army.mil*. For special needs (visual or hearing impaired, Spanish translator, etc.) requests during scoping meetings, please contact Andrew Commer by November 24, 2009.

David A. Manning
Chief, Regulatory Office

Attachment D – Attendee List for Public Scoping Meeting

Proposed Lower Bois d'Arc Creek Reservoir, Fannin County
Texas Environmental Impact Statement
December 8, 2009 Public Scoping Meeting – Bonham, TX
Sign-In Sheet

Name	Address	Affiliation
Jim Crooks	PO Box 507 Decatur, TX 76234	USFS
Jackie Lackey	PO Box 225 Dodd City, TX 75438	Landowner
Kenneth Tredway	PO Box 92 Dodd City, TX 75438	Landowner
Carl Bysen	13508 E. FM 1396 Windom, TX 75492	Landowner
Tom & Tommie Sue Turner	300 E. Russell Bonham, TX 75418	Commercial Office Rental
Maeta Lee	703 W Market Honey Grove, TXX 75446	Landowner
Glenn Lee	703 W Market St Honey Grove 75446	Landowner
Craig Richards	908 E. 10th St Bonham, TX 75418	Landowner
Gloria Walker	340 Boyd Loop Bonham, TX 75418	Landowner
Harry Allen	14891 FM 1396 Windom, TX 75492	
Dick & Eleanna Crawford	690 CR 37500 Summer, TX 75486	
Diane Payne	1775 CR 2655 Telephone, TX 75488	
Chad Clour	2996 CR 2655 Telephone, TX 75488	
Thomas R. Brewer	126 Carpenter loop Bonham, TX 75418	
RET. US Navy Chief George Sutterfield	283 CR 2273 Telephone, TX 75488-6216	
Tami Sundquist	1445 Ross Ave Dallas, Tx 75202	
Harry Hammett	1494 CR 2917 Dodd City, TX 75438	

Mike Scheiler	2628 S. Hwy. 121 Bonham, TX 75418	
Carlos A. Pardo	2653 C.D. 2900 Bonham, TX 75248	
Michael Yarbrough	2325 CR 2765 Honey Grover, TX 75446	Rancher
Troy & Carol Boreham	2160 CR 2950 D. Dodd City, TX 75438	Rancher
Ronnie Knight	317 CR 2950 Dodd City, TX	Cattle
Randy Moore	200 E. 1st st. Bonham, TX 75418	USDA- NRCS
Wes Reed	4519 W. Lovers Lane Dallas, TX 75209	Rancher
Dustin Knight	1037 CR 2950 Dodd City, TX 75438	Cattle
Ken Jones	3054 CR 2730 Honey Grove, TX 75446	Rancher
Sandra Loschke	874 CR 2750 Honey Grove, TX 75446	Rancher/ farmer
Don Belk	205 CR 2650 Telephone, TX 75488	Rancher Live on Boisedearc
Nathan Ryser	602 Oak St. Honey Grove, TX 75446	Farmer
Harold & Jean Gillineath	1283 CR 2960 Dodd City, TX 75438	
John Yarbrough	3576 CR 2765 Honey Grove, TX 75446	
Charles Yarbrough	404 Pecan St Honey Grove, TX 75446	
Stewart Richardson	9086 FM 100 Honey Grove, TX 75446	
Beth R. Porter	418 Jo Aynn Circle Bonham, TX 75418	
Ralph W. Thomas, Jr.	614 Chestnut St. Bonham, TX 75418	
Mary & Kyle Payne	626 CR 2615 Telephone, TX 75488	
Bob Payne	1775 CR 2655 Telephone, TX 75488	
John Loschke	874 CR 2750 Honey Grove, TX 75446	Farmer
Nathan & Ellen Nelson	3385 E. State Hwy 56 Dodd City, TX 75438	Farmer/ Landowner
Gregory Hall	328 CR 1035 Ravenna, TX 75476	

Julia Russell	790 CR 2900 Dodd City, TX 75438	
Michele Holmes	15924 E FM 1396 Windom, TX 75492	
Chad Knight	489 CR 2950 Dodd City, TX 75438	
Sam Bullock	785 CR 2620 Telephone, TX 75488	
Jarett & Rachael Tucker	4484 CR 2610 Bonham, TX 75418	
Doug Kopf	2713 CR 2998 Windom, TX 75418	Landowner
Rebecca Knight	317 CR 2950 Dodd City, TX 75438	Landowner
Dennis Troutz	PO Box 996 Windom, TX 75492	Landowner
John & Kay Burnett	402 Mockingbird Bonham 75418	Bonham City Council
Larry N. Patterson	PO Drawer 305 Lewisville, TX 75067	UTRWD
Sue Carpenter	2177 CR 2945 Dodd City, TX 75438	
Joe Carpenter	2177 CR 2945 Dodd City, TX 75438	
Justin Staton	281 CR 265 Telephone, TX 75488	
Leroy Tarpley	295 S. St. Hwy 78 Bonham, TX 75418	
Jimmy Newhouse	2438 CR 2730 Honey Grove, TX 75446	
Larry Franklin	15387 E FM 1396 Windom, TX 75492	
Patti Chun	6232 South FM 1743 Windom, TX	
Tony Brawner	9898 E FM 273 Ivanhoe, TX 75447	
Ross Griffith	PO Box 28 Bonham, TX 75418	
Millard D. Brant	PO Box 46 Dodd City, TX 75438	
Danny R. Gilbreath	3315 Oliver Dallas, TX 75202	
Pat Hilliard	32015 FM 2099 Bonham, TX 75418	FanninCo.
Dale McQueen	1352 E FM 1396 Ivanhoe, TX 75447	
Denise Hickey	505 E. Brown Wylie, TX 75098	

Wayne & Betty Burk	2000 CR 2950 Dodd City, TX 75438	
Ronnie & Ronda Fitzwater	Bonham, TX 75418	
Joe L. Ward	1626 CR 2315 Telephone, TX 75488	
Roger Skipper	3243 CR 2955 Dodd City, TX 75438	Texas AgriLife Extension
Joan Snider	615 Willow Bonham, TX 75418	Fannin Co.
Ray Floyd	408 Rainey Bonham, TX 75418	City of Bonham
Lynda Floyd	408 Rainey Bonham, TX 75418	
Curtis E. Carlson Jr.	PO Box 292 364 Lewisville, TX 75029	Landowner
Jack Black	13759 Bandera Ranch CR Roanoke, TX 76262-5866	Landowner
Glenn Estes	232 CR 2650 Telephone, TX 75488	Telephone
Corby Alexander	301 E 5th Bonham, TX 75418	City of Bonham
Ronny & Marilyn Hart	1782 CR 2925 Dodd City, TX 75438	
Richard Danner	321 CR 2040 Ravenna, TX 75476	Solid Ground Realtors
Jessica Kirkpatrick	2501 N Center Bonham, TX 75418	Fannin Newspapers
Galen L. Raper	767 CR 4779 Winnsboro, TX 75494	Six Pines Natural Resources
W.A. Harcues Jr.	5782 CR 2610 Bonham, TX 75418	
Joyce Hassell	14562 CR 565 Farmersville, TX 75442	
Kenneth Hassell	14262 CR 565 Farmersville, TX 75442	
Joseph Y. Reed	116 Hilltop Pottsboro, TX 75076	Landowner
J. D. Moore	10165 W Hwy 82 Savoy, TX 75479	
Dennis Holman	989 CR 2650 Telephone, TX 75488	Landowner
Allen Rich	425 CR 2601 Bonham, TX 75418	
Wilma Arnold	2203 Pecan St. Bonham, TX 75418	

Ronald Ford	PO Box 103 Bonham, TX 75418	City of Bonham
Joe Hafertepe	5331 Yolanda Dallas, TX 75229	Landowner
Joel Shepard	1112 CR 2145 Telephone, TX 75488	USPA Forest Service
Gordon Locke	2601 N SH 121 Bonham, TX 75418	Landowner
Cathy Melson	3385 E. HWY 56 Dodd City, TX 75438	Landowner

Attachment E – Attendee List/Sign-in Sheet for Agency Scoping Meeting
December 9, 2009 – Wylie, Texas

Name	Agency	Address
Robert McCarthy	NTMWD	505 E. Brown Wylie, TX 75087
Mike Rickman	NTMWD	505 E. Brown Wylie, TX 75087
Ashley Burt	NTMWD	505 E. Brown Wylie, TX 75087
Tami Sundquist	US EPA, Region 6	1445 Ross Ave. Dallas, TX 75202
Lynn Jackson	U.S. Forest Service	415 S. First Street Ste.110 Lufkin, TX 75901
Chalonda Jasper	U.S. Forest Service	415 S. 1st St. Ste.110 Lufkin, TX 75901
Dave Peterson	USFS	415 S. 1st St. Ste.110 Lufkin, TX 75901
Mark Fisher	TCEQ	MC-150 P.O. Box 13087 Austin, TX 78711-3087
Jeanene Peckham	EPA	1445 Ross Ave. Dallas, TX 75202
Andrew Commer	U.S. Army Corps of Engineers	1645 S. 101st E. Ave. Tulsa, OK 74128
Randall Howard	Freese & Nichols, Inc.	10814 Jollyville Blvd. 4 Ste. 100 Austin, TX 78759
Steve Watters	Freese & Nichols, Inc.	4055 International Plaza Fort Worth, TX 76109
Alan Skinner	AR Consultants, Inc.	11020 Audelia Rd. Ste. C105 Dallas, TX 75243
Gordon M. Wells	Freese & Nichols, Inc.	4055 International Plaza Fort Worth, TX 76109
Shane Charlson	U.S. Army Corps of Engineers	1645 S. 101st E. Ave. Tulsa, OK 74128
David Galindo	TCEQ	12100 Park 35 Cin. Austin, TX 78711
Peter Schaefer	TCEQ	12100 Park 35 Cin. Austin, TX 78711
Clint Robertson	TPWD	P.O. Box 1685 San Marcus, TX 78667
Ryan McGillicuddy	TPWD	4200 Smith School Rd Austin, TX 78744
Leon Kolankiewicz	Mangi Environmental	7927 Jones Branch Dr. #150 McLean, VA 22102
Tom Cloud	U.S. F.W.S	711 Stadium Dr., #252 Arlington, TX 76011
Sid Puder	U.S. F.W.S	711 Stadium Dr. Arlington, TX 76011
Jim Crooks	U.S.F.S	PO Box 507 Decatur, TX 76234

Thomas Philipps	U.S.F.S	415 South First St Lufkin, TX 75901
Anna Lundin	Mangi Environmental	24858 Richmond Hill Rd. Conifer, CO 80433
Joel Stone	Daniel B. Stephens & Associates, Inc.	4030 W. Braker Ln. Ste.325 Austin, TX 78759
Nick Trierweiler	Ecological Communications Corp.	4009 Banister Ln. Ste. 300 Austin, TX 78704
Tom Gooch	Freese and Nichols	4055 International Plaza Ste.200 Fort Worth, TX 76132
Michael Votaw	Freese & Nichols	4055 International Plaza Ste.200 Fort Worth, TX 76132
Karen Hardin	TPWD	4200 Smith School Rd Austin, TX 78744

Attachment F – Agency Scoping Meeting Notes

Proposed Lower Bois d'Arc Reservoir EIS
Agency Scoping Meeting, Wylie, TX
December 9, 2009

AGENCY SCOPING MEETING NOTES

USACE (Andy Commer) opened the meeting with introductory remarks on the purpose of the scoping meeting. It helps the USACE focus its vision on what needs to be covered in EIS in order to inform decision-making on the 404 permit application. Environmental, social, and economic impacts will all get covered in the EIS. The internal Preliminary Draft EIS is the next step. The next opportunity for agencies to engage is at publication of the DEIS.

The proposed project is being handled by the USACE, which is the decision-maker and lead federal agency. The USACE has invited cooperating agency status from other federal and state agencies, not all of which have yet responded. Texas Parks and Wildlife and the US Fish and Wildlife Service have both accepted while the Texas Water Development Board has declined. The USACE is still awaiting replies from the U.S. Forest Service and Environmental Protection Agency.

Since there is no funding for internal EIS preparation by the USACE, costs are borne by 404 permit applicants. A third party contractor prepares the EIS, in this case the Mangi Environmental Group.

Mangi (Leon): EIS project manager from Mangi, made brief remarks about Mangi's and his own role and experience.

USACE (Andy) then had everyone introduce themselves and state their agency affiliation.

See Attachment A for the full list of attendees along with their affiliations and contact info.

NTMWD (Mike) gave an overview for the North Texas Municipal Water District. The population will more than double within its service area. They need to find additional water supplies. NTMWD has to bring online the equivalent of one Lake Lavon every decade for the next five decades in order to meet the water needs of people coming here. The City of Bonham can't meet its own needs past 2020. The Lower Bois d'Arc Creek Project will also meet needs in the immediate vicinity of the lake in Fannin County. Lake Bonham cannot alone supply all of Fannin County's water supply needs with its projected future growth.

Since the last meeting, NTMWD has opened an office in Bonham and begun acquisition of lands. So far, land purchase in the basin has been done on a willing seller basis only. NTMWD has acquired almost 10,000 acres of the reservoir footprint already. Recently, they became aware of the Riverby Ranch for sale along the Red River and recognized its potential as a mitigation site. They entered into contract to purchase this ranch, about 14,700 acres in size and with seven miles of Red River frontage. NTMWD is scheduled to close on the deal in mid-February; they are well aware that they are taking a risk in having purchased this, if the 404 permit is not approved, but they would be able to re-sell it.

USACE (Andy) then opened the meeting to the agencies present, in order to provide a forum for the agencies to ask questions and raise issues. What issues need to be addressed in the EIS? Some of those present have already been involved in the Habitat Evaluation Procedures (HEP) and instream flow studies. This meeting is for the USACE to listen to agency concerns.

EPA (Jeanene): What issues are in the USACE's focus, that is, what does the USACE see as being within the scope of the EIS now?

USACE (Andy): Things the USACE sees include, but are not necessarily limited to: the magnitude of the project; its impacts on landowners and livelihoods; impacts on forested wetlands and other wetland habitats and other aquatic resources; mitigation of projected wetland losses; impacts on downstream lands including riparian forest lands, U.S. Forest Service (USFS) Caddo National Grasslands, social and economic impacts (e.g., roads); changes to downstream flow regime; conversion of agricultural lands to lakebed or mitigation lands (loss of agricultural production on local economy); changes (loss to quasi-public purposes) to the tax base in Fannin County; impacts to the school district (quality and funding); project alternatives (alternative lake sites or water sources); environmental and social costs incurred by Fannin County when other counties benefit from the water; whether adequate conservation measures are in place; potential archeological/ cultural resources. This is not an exhaustive list. All comments received by the USACE as a result of the Public Notice are part of the EIS scoping.

EPA (Jeanene): Last night at the public scoping meeting I heard someone say that this project had been proposed and rejected twice by the USACE in the past.

USACE (Andy): Those earlier projects were different (multi-purpose), and the USACE's conclusions are being inappropriately transferred by opponents to the current project. The earlier USACE proposals were rejected by the USACE itself in the past due to cost/benefit analyses and multi-purpose needs stipulations. The USACE determined that the lakes weren't feasible. However, we cannot extrapolate the findings of those projects onto this proposal. Also, the USACE needed a local sponsor and may not have been able to find one. Both Upper and Lower Bois d'Arc Creek locations were determined not to be feasible for further investigation. The differences between the present project and past proposals evaluated and rejected previously are that 1) this is not a USACE project, and 2) this is a water supply lake, not a multi-purpose proposal. That is, the water supply purpose stands on its own. While there may be recreation added, recreation is not a primary purpose. Thus, some of the comparisons between the present proposal under consideration, and for which a 404 permit is being sought, and past discarded proposals, are not appropriate.

TCEQ (Mark Fisher): Regarding that earlier USACE proposal, what phase of analysis/ investigation did it reach?

USACE (Andy): The earlier proposal never got to the point of discussing a permit.

NTMWD (Mike): The USACE could not find a local sponsor. Having a local sponsor is a funding requirement.

USACE (Andy): I think now that joint projects need 35% local funding, but don't quote me.

TCEQ (Mark): Should this history be included in the EIS?

USACE (Andy): The EIS will provide clarifying information on why the USACE is considering once more what it rejected earlier.

TCEQ (Mark): What is the timeframe of the EIS?

Mangi (Leon): We're shooting for the latter part of 2010 for the draft EIS.

EPA (Jeanene): What about Mangi review of work that has been done to date?

Mangi (Leon): Mangi will provide an independent review of all prior work, neither accepting it nor dismissing it out of hand, nor repeating what has already been done, if it's adequate. Everything that has been done to date appears to be kosher – although that doesn't mean it's complete.

EPA (Jeanene): All roads that are impacted need to be evaluated, not just public roads.

EPA (Jeanene): One of my comments [in EPA's letter on the 404 permit application] is that the EPA wants to include a plan to reduce water use in the EIS – a conservation plan – will Mangi be looking at such a plan?

Mangi (Leon): Conservation has to be part of at least one alternative; however, even with conservation measures, there is not currently adequate water supply to meet projected demands.

EPA (Jeanene): We are asking for a plan to reduce water use. Also, as a cumulative impact, we want the impacts of all water impounded to date in the State of Texas included and considered in the EIS. Data on this topic (total impoundment acreage) were in EPA's comment letter and date to 2006. For cumulative impacts, the EIS should also consider reasonably foreseeable impoundment proposals in its cumulative analysis. Would the most current estimates of the amount of impounded water in the State be updated and included in the EIS?

Mangi (Leon): You want both existing and planned impoundments in the state to be included in the cumulative analysis of the EIS? OK.

USFS (Tom): Does the water district have legislative authority to mandate conservation measures?

NTMWD: No

Mangi (Leon): The EIS will look at legislative options, e.g. what it would take to mandate conservation.

EPA (Jeanene): What about funding?

NTMWD (Mike): NTMWD would fund the Lower Bois d'Arc Creek Reservoir 100% through bonds.

EPA (Jeanene): Is NTWD seeking funds from TWDB?

NTWMD (Mike): It's a possibility.

EPA (Jeanene): How would rates be affected by the project?

NTMWD (Mike): The proposed project will impact (increase) consumer rates.

USFS (Tom): How about the impact on USFS lands (Caddo National Grasslands)? Would there be a land exchange? There is no congressional authority needed to designate the donated land (e.g., the mitigation bank) as part of the National Grasslands as per the Bankhead-Jones Act. This 1930's era statute gives the USFS authority to accept that land; only administrative activity will be needed. (The Grasslands boundary is an "Administrative Boundary" and not a "Proclamation Boundary" under Bankhead Jones. This allows the USFS to include, acquire, or receive lands that are outside of the administrative boundary. A proclamation boundary would not allow such.)

EComm (Nick) : The Texas Historical Commission (THC) is not here. Has anything been initiated with them?

USACE (Andy): Yes, a programmatic agreement (PA) is all but signed with THC. It lays down the rules of engagement and will contain methodology on how to evaluate cultural resources in the EIS. The PA will include a research design for cultural resource investigations, and once the PA is signed and executed, the research design will be implemented and the field sampling will begin. Work on a research design has begun. The next step is fulfilling the research design and doing stratified, random samples in select areas of the basin. There will be surface searches, and probably backhoe trenching, to explore the need for further research and/or recovery. Alan Skinner will probably be involved in this fieldwork.

EPA (Jeanene): With respect to the instream flow study, how far downstream does the USACE intend to look at downstream impacts? A TPWD report shows that Lower Bois d'Arc Creek is an important tributary/discharge to the Red River. The Red River is now being used for "hydrofracking" [hydraulic fracturing] for natural gas extraction from Haynesville Shale in LA and TX. Haynesville Shale exploration has mushroomed recently, and drilling as well. The EIS needs to look at cumulative impacts on the flow of the Red River.

USACE (Andy): We will be looking at the downstream impacts in the EIS. We don't know where the downstream impacts analysis will be limited to yet. Is there a lot of water use associated with the natural gas/shale activity in LA?

EPA (Jeanene): Yes, 5 MGD is needed for hydraulic fracturing of each well.

Mangi (Leon): We haven't brought up how cultural resource studies fit into the EIS; the idea is to have the results of the studies included in the EIS.

USACE (Andy): Work on the EIS is to inform the permit application. Cultural fieldwork will be concurrent; it may not be complete for the draft, but will be complete by the Final EIS. The USACE will then make its decision based on the best available information. We won't issue a 404 permit that says we'll look into impacts later; on the other hand, we may still issue a permit that calls for ongoing or future monitoring.

TPWD (Karen): Is recreation an identified purpose of the proposed project?

NTMWD: Recreation is a secondary purpose of the reservoir. Water supply is the primary purpose.

TPWD (Karen): How fully will recreation effects be evaluated in the EIS?

USACE (Andy): The current forecast of recreation projections may not be fully accurate (it may assume there would be more recreation than what would actually occur); we will make sure the projections are accurate. It is an indirect impact which will be considered in the EIS.

TPW (Karen): Why would recreation impacts be considered secondary and indirect?

USACE (Andy): The impacts to current recreation use within the actual reservoir footprint are a direct impact and will be analyzed as such.

TPWD (Karen): I don't understand why recreation is considered a purpose of this project at all. Isn't recreation more appropriately identified as a benefit of the project?

NTMWD: We're building the reservoir as a water supply lake. Recreation will be a secondary benefit.

TCEQ: If Lower Bois d'Arc is operated primarily as a water supply lake, a fluctuating water level, and lakeshore, will occur. Will water levels fluctuate and be varied according to the water supply?

NTMWD: Water levels will not be kept constant for recreation. The miles of shoreline have not been measured; the use of the shoreline is a concern to the water quality of the reservoir.

TCEQ: Wastewater treatment plants (WWTPs) discharge effluent upstream.

NTMWD: Existing effluent discharge standards for these WWTPs are based on downstream water uses. A downstream water supply reservoir such as the proposed Lower Bois d'Arc may change the standards to be achieved and may result in upgrade costs for local municipalities. (Discharge permits and effluent quality may need to be upgraded up and downstream of the project in order to protect water quality in the reservoir.) NTMWD is committing to not place financial burden on cities – if upgrades to WWTPs are required by the State, NTMWD would pay the costs of these upgrades to meet higher standards.

EPA (Jeanene): Is all of this included in the cost of the project?

NTMWD: Yes.

Ryan: How fully will recreational impacts be addressed in the EIS?

USACE (Andy): Local opposition to the lake is concerned that economic projections overstate claimed benefits. They point to other lakes where recreation hasn't really developed, or at least not developed as quickly as hoped, such as Lake Chapman. New recreation would be an indirect impact and may be hard to predict. The USACE can't take control over this with its permit decision and EIS.

USFS (Tom): Another issue that needs to be addressed is invasive species, especially giant salvinia. There needs to be a sound weed management plan and weed prevention measures in place. The new lake will need signs and wash stations.

USACE (Andy): We know aquatic invasives are an issue. The EIS also needs to look at the zebra mussel.

USFS (Dave): Zebra mussels are already in Lake Texoma. Aquatic weeds are a major problem. Another problem is that reservoirs become a sink for pollutants, primarily mercury. There are health advisories on many local lakes for fish consumption because of high mercury levels. Anytime you create a large outfall area, you have mercury and other pollutants.

Bois d'Arc Creek was channelized back in the 1940s; we want to restore the Creek back to its natural flow. This is difficult since the original channel is elevated in the flood plain above the flow line of the current channel

We are concerned with invasives and concerned with the reservoir becoming a sink for fallout from atmospheric pollution (mercury etc.). All these issues are concerns for us because the reservoir is upstream of where we want to restore the Creek. Shoreline development of the new lake is also a concern to us which hasn't really been addressed yet.

Also, the EIS should address how outflows from the reservoir would be prevented from causing downstream erosion and storm water damage. What are the potential effects on Caddo NG from the expected downcutting within the channel downstream of the dam? How does this project affect the goal that Fisheries has of restoring downstream flows in the original channel? It is proven that there is lower fisheries diversity in reservoirs; the species diversity in the Creek will drop as a result of this project. We will lose native bass in this reach; the Florida hybrid will be put in. Native northern largemouth bass have disappeared from habitats. Non-native fish will likely benefit at the expense of native species because of the project.

Don't forget about terrestrial invasives; water acts as a vector for the spread of these invasives. Chinese tallow, salt cedar, and tree of heaven are terrestrial invasives that may be affected by the project and should be considered in the EIS.

The proposed mitigation bank may have suitable habitat for sensitive species. Among possible rare plants in the mitigation tract is the globally threatened Arkansas meadow rue. The reach of the Red River that might be protected by the proposed mitigation area could possibly benefit the federally endangered Ouachita rock pocketbook mussel.

The EIS needs to have a clear explanation of how the mitigation area compensates for habitat loss – and you need to make sure the mitigation bank adequately compensates for the habitat loss.

USFWS (Tom Cloud): How does the mitigation area compensate for the loss of jurisdictional areas? The EIS needs to do a comparison of whether the mitigation site adequately addresses the loss of quality and quantity in the affected areas.

TCEQ (Mark): Is a functional assessment required?

USACE (Andy): The HEP baseline is available. HEP analysis on the lake basin is the baseline for impacts. HEP analysis will have to be done on the baseline condition of the mitigation tract. Mitigation boost will be predicted on basis of same HEP process.

TCEQ (Mark): How will the ongoing instream flow study be integrated into the EIS?

USACE (Andy): There have been difficulties scheduling field data collection because of rainfall and high water. F&N says they can finish report in March 2010.

F&N (Michael): We'll be getting back into the field ASAP, once water levels retreat. We are compiling already collected field data right now.

F&N (Steve): Conditions can be difficult and dangerous if the creek's flow is over 30-40 cfs.

TCEQ (Mark): Will the water rights permit be integrated into the EIS?

USACE (Andy): There is no linkage at all; the water rights permit is an independent process from the 404 permit.

TCEQ: If water right changes, would that require a supplement to the EIS?

USACE (Andy): Possibly.

TCEQ (Mark): I think the water right is controlling in terms of the amount of water that can be stored and used in the reservoir. The instream flow study is a coordinated effort. Ultimately, decision-making authority is vested in two separate bodies.

EPA (Jeanene): Will the local government get involved at some point (e.g., for zoning and shoreline development issues)? A Lakeshore Management Plan is needed to protect water quality

NTMWD (Mike): The local governments are already involved; the NTMWD meets regularly with County commissioners regarding zoning and the 13 cities that are incorporated in Fannin County.

EPA (Tami): Who has zoning authority in Texas?

NTMWD (Mike): Cities typically have zoning authority in Texas. Fannin County requested development authority (zoning responsibility) from the State Legislature.

Mangi (Leon): Land use will be a section in the EIS.

TCEQ: How will mitigation be considered? Land has already been acquired, but we don't want to be locked into this particular property. What will be done to be sure we're not locked in?

USACE (Andy): The District contacted the USACE about the possible mitigation site and a meeting was held. NTMWD wanted feedback from the USACE as to whether this was a viable option, not a be-all-and-end-all. Was it a good option in the USACE's opinion? I haven't visited the site, but the District presented good info on what is there, what natural features persist, for floodplain, restoration, bottomland wetlands, etc. In short, the USACE sees this as a good opportunity. The USACE told the District that if they have the opportunity, they should pursue it. Opportunities like this are unusual. No promises were made to NTMWD that this is all the mitigation that would be required. The USACE and NTMWD have had no discussion as to whether the District would receive mitigation credit for this site, or how the site would have to be developed for mitigation. Mitigation is not the only issue on the 404 permit application, but having this single large tract in close proximity to the project is something that the USACE rarely sees.

USFS (Tom): I concur with Andy that this property has real potential; its location in proximity to the proposed reservoir and on the Red River are advantages.

USFWS (Syd): I second what Tom says.

NTMWD (Mike): The NTMWD fully recognizes the risk of purchasing the land at this point.

USACE (Andy): The District is indeed taking some risk.

F&N (Steve): This is a rare opportunity for mitigation that almost never occurs. F&N will examine the potential of the site. The District will not take a risk at this point by making an irretrievable commitment. If necessary, they want to be able to turn around and sell the property.

NTMWD (Mike): The cost of the property is $34.5 million.

TCEQ (Mark): What is the baseline in terms of the functional assessment? When does formal compensatory mitigation come into place? What is the environmental baseline against which to calculate mitigation?

USACE (Andy): The HEP was conducted last summer (2008) and this is the baseline. In the last two years however, some timber cutting has been occurring on land within the reservoir footprint that has been purchased by the NTMWD as part of the NTMWD negotiations. As soon as the USACE was made aware of this, I sent a letter to the NTMWD stating that all timber cutting (irretrievable commitment of resources) must stop as part of negotiations. It has stopped.

Some cutting is still occurring but these are private actions by individual land owners, not NTMWD. From what I have seen, there haven't been violations of 404; what has gone on are private actions over which the USACE has no control. Still, we will go by the habitat conditions documented in the HEP.

NTMWD (Mike): The District is now buying timber in place.

USFWS (Syd): We have to use the date in which the HEP was done.

F&N (Steve): The area was flown just months before the HEP.

USACE (Andy): We have asked for a clearing plan in which some areas would be left in standing timber. The USACE wants to preserve some timber stands as part of this project to eventually provide structure in aquatic habitat. The only change in the scope of the project since the Public Notice is the location of the water treatment plant and its pipeline. All pipelines/roads etc. directly impacted by this proposal will be part of the EIS.

NTMWD: The NTMWD has purchased the land that the water treatment plant will be located on.

Ryan: I have a question on the geographic scope. What elements of the project will be included in EIS?

USACE (Andy): All connected actions will be covered, including water treatment plant, pipelines, and outfall on Pilot Grove Creek.

TCEQ: All infrastructure that has to be removed will be covered?

USACE (Andy): Yes, all existing facilities.

TCEQ: Potential impacts to Pilot Grove Creek are to be included?

USACE (Andy): Yes. The change in water flow due to the outflow pipe in Pilot Grove Creek will be evaluated in the EIS. The Creek flow may be monitored pre- and post- reservoir construction.

EPA (Jeanene): We are very interested in a strong look at alternatives to the proposal, possibly combinations of projects.

EPA (Tami): What is the baseline measure for the possible mitigation site?

USACE (Andy): We need to establish the baseline conditions for the mitigation site. The District will begin to work on this. We will use the same HEP tools that were used to evaluate the reservoir footprint area. We will establish existing conditions and see what might be developed and look at how credit could be built up over time.

USFS: As far as cumulative impacts, how will Lake Ralph Hall be considered?

USACE (Andy): The Lake Ralph Hall project is in the same county as this proposal and is slightly ahead of this project with respect to the EIS and permit application. The USACE is fully aware of the need to assess the cumulative impacts of both reservoirs constructed in the same county. The EIS contractor for the Lake Ralph Hall project is in contact with Mangi and a full analysis of the cumulative impacts of both projects will be included in both EISs. Economic and tax roll impacts may interact. There could be a possible increase in traffic and other simultaneous impacts. Michael Baker is the consulting firm handling the EIS on Lake Ralph Hall.

EPA (Jeanene) – Will the Marvin Nichols project also impound water into Fannin County?

NTMWD (Mike) – No, it won't.

Restroom and Coffee Break

USACE (Andy): We are conducting formal scoping now. Please have all comments to me by January 9th. Nevertheless, comments can continue to be received throughout the EIS process and we will address any new issues that arise during the process.

USFWS (Syd): Endangered species and trust species have to be part of the EIS. There is a newly discovered bald eagle nest by on USFS land near Coffee Mill Lake, though the eagle was recently taken off the ES list. There is a possibility that the interior least tern may be in the project area, as well as the Louisiana black bear.

USACE (Andy): We are fully aware that we have to comply with ESA. Interior least terns use the Red River and possibly very lower portion of Lower Bois d'Arc Creek. Other species include the American burying beetle (evidence at Camp Maxey east of Bonham) and Ouachita rock pocketbook mussel (speculative).

EPA(Jeanene): The EIS should also address state-listed species.

USACE (Andy): The EIS will address state-listed species. Species of concern, if brought to our attention, would be covered. State-listed species don't establish any separate procedures for compliance, that is, they have no regulatory protection.

TCEQ (Mark): Will the instream flow study address mussels?

F&N (Mike): It will address their presence.

TCEQ (Mark): Will any additional water quality modeling be done for downstream reaches? How is water chemistry in downstream changes being considered?

F&N (Steve): The instream flow study has four parameters: hydrology/hydraulics, biology, fluvial geomorphology, and water quality (including downstream DO concentrations), Collection of data is proceeding for these standard parameters. The proposed facility will include a multi-level control structure that will allow for low flow water quality releases from different levels of the water column within the reservoir.

TCEQ: Will the comments received today and last night be included in the EIS?

USACE (Andy): All comments from the public notice and from the public meetings will be included in an appendix to the EIS. Will check to see if there is a requirement to prepare a "scoping report" – not promised unless required.

Acronyms and Abbreviations

USACE – U.S. Army Corps of Engineers, Tulsa District
EPA – U.S. Environmental Protection Agency
F&N – Freese & Nichols
Mangi – Mangi Environmental Group
NTMWD – North Texas Municipal Water District
TCEQ – Texas Commission on Environmental Quality
TPWD – Texas Parks & Wildlife Department
USFS – U.S. Forest Service
USFWS – U.S. Fish and Wildlife Service

APPENDIX E – DRAFT MITIGATION PLAN

Please see next page.

Innovative approaches
Practical results
Outstanding service

Proposed Lower Bois d'Arc Creek Reservoir
Fannin County, Texas

Mitigation Plan

December 2014

prepared for:
North Texas Municipal Water District

prepared by:
Freese and Nichols, Inc.

THE Lower Bois d'Arc Creek RESERVOIR
NORTH TEXAS MUNICIPAL WATER DISTRICT

Proposed Lower Bois d'Arc Creek Reservoir
Fannin County, Texas

MITIGATION PLAN

December 2014

Michael Votaw, CWB, Biologist

Steve Watters, PWS, Hydrologist

Randall Howard, Biologist

Prepared for:

North Texas Municipal Water District

Prepared by:

FREESE AND NICHOLS

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EXECUTIVE SUMMARY

This Mitigation Plan was developed to compensate for impacts to aquatic and terrestrial resources associated with the proposed Lower Bois d'Arc Creek Reservoir project.

Aquatic Resources (Waters of the U.S.)

The mitigation plan for impacts to aquatic resources was developed considering applicable state and federal rules, regulations, and guidelines. Public comments, as well as state and federal resource agency comments on the Section 404 permit application for the proposed Lower Bois d'Arc Creek Reservoir project, including the scoping meeting for the Environmental Impact Statement (EIS), were also considered.

There has been extensive coordination with state and federal resource agencies throughout the permitting process for this project. Interagency teams have participated in the collection and analysis of data from the proposed reservoir site as well as the proposed mitigation site.

The compensatory mitigation proposed for the Lower Bois d'Arc Creek Reservoir project undertakes a "watershed approach" to address the project's impacts to the overall ecological function of the Bois d'Arc Creek watershed. Moreover, the aquatic resources mitigation plan was developed to comply with the federal "no overall net loss of wetlands" policy and to provide compensatory mitigation, to the extent practicable, for impacts to other types of waters of the U.S. that would be impacted by construction of the proposed Lower Bois d'Arc Creek Reservoir and associated transmission and treatment facilities. All compensatory mitigation for waters of the U.S. would be provided through in-kind mitigation that would occur through on-site or near-site mitigation strategies. Through a watershed approach to mitigation, on-site mitigation would be provided at the proposed reservoir site and near-site mitigation would be provided on the 14,958.58-acre Riverby Ranch, which is located on Bois d'Arc Creek downstream of the proposed reservoir. The North Texas Municipal Water District (NTMWD) has acquired this site specifically because of its unique characteristics and qualities to provide appropriate mitigation for the proposed project.

Some of the characteristics and benefits that are offered by the Riverby Ranch mitigation site include:

- A watershed approach to mitigation is proposed with the goal of offsetting impacts to overall ecological function of the Bois d'Arc Creek watershed;

- The mitigation site is capable of providing compensatory mitigation to meet the "no overall net loss of wetlands" policy;
- Existing habitat at the mitigation site is degraded due to past and ongoing land use practices, providing the opportunity for mitigation actions to result in considerable ecological uplift;
- The mitigation site is located near the impact site (downstream) and in the same watershed;
- The mitigation site is one large contiguous tract of land and avoids "fragmentation" of mitigation;
- The mitigation site is located adjacent to the Caddo National Grasslands and other lands that are currently protected in perpetuity through the Wetlands Reserve Program, which could provide synergistic uplift to the resources at the mitigation site and to these adjacent federally protected lands;
- The mitigation site would be protected in perpetuity by a conservation easement or other USACE-approved instrument and could be transferred to a responsible third-party for long-term management following fulfillment of mitigation requirements;
- Existing site conditions including surrounding land uses, soils, climate, and hydrology, make the site ideal for restoring waters of the U.S.;
- The risk and uncertainty of providing appropriate compensatory mitigation is minimized because the NTMWD has already acquired the proposed mitigation site from a willing seller; and
- Mitigation can begin prior to or concurrent with impacts, if permitted, thus minimizing temporal losses of aquatic resources.

The existing conditions at the proposed project site (i.e., footprint of the conservation pool area at 534 ft. msl., including the dam and spillways, footprint of the intake pump station, electrical substation, raw water pipeline, terminal storage reservoir, rail spur and water treatment plant site) and the proposed mitigation site were assessed using Habitat Evaluation Procedures (HEP). The HEP methodology is recommended by the U.S. Fish and Wildlife Service (USFWS) as their basic tool for evaluating project impacts and developing mitigation recommendations. Both impacts and mitigation credits are measured using Habitat Units (HUs), a metric specific to the HEP methodology. Existing conditions for streams within the footprint of the proposed reservoir, including tributaries to the proposed littoral zone wetlands, Bois d'Arc Creek downstream of the proposed dam, and streams at the proposed mitigation site were assessed using a Rapid Geomorphic Assessment (RGA) methodology. The RGA method used to evaluate stream condition at the impact site and the mitigation site is similar to other geomorphic assessment methods used in various regions of the U.S. These methods generally use measures of erosion channel stability, riparian habitats, instream habitats and other visual attributes of stream channels to evaluate and measure stream conditions. The RGA method integrates data from field and desktop sources into a quantitative and qualitative description of the features that affect stream stability and the potential for developing aquatic habitat features (Freese and Nichols, 2008). Both impacts and mitigation credits are measured using Stream Quality Units (SQUs), a metric developed for this assessment to assign a value to stream reaches that could be used to assess impacts, measure baseline conditions, and measure uplift at the mitigation site.

During the development of this mitigation plan, efforts were made by NTMWD to avoid and/or minimize, to the extent practicable, impacts to potential waters of the U.S. Such actions include locating the proposed intake pump station and electrical substation within the grading limits of the proposed dam and spillways, locating the proposed terminal storage reservoir and water treatment plant entirely within upland areas, minimizing impacts to streams that would be crossed by the proposed raw water pipeline by restoring preconstruction contours and stabilizing exposed slopes and stream banks, removing 14.4 miles of proposed pipeline from the proposed water treatment plant site to a discharge location on Pilot Grove Creek in the Trinity River Basin, purchase of additional lands and flowage easement around the proposed reservoir, and coordinating with local authorities to implement water quality protection measures. A summary of potential impacts to waters of the U.S. and proposed compensatory mitigation for unavoidable impacts to waters of the U.S. are shown in Table ES-1. As proposed, this mitigation plan would provide:

- Enhancement and/or protection for 452 acres of forested wetlands, 1,377 acres of emergent wetlands, 98 acres of shrub wetlands, 34 acres of open water, and 375,076 linear feet of streams;
- Restoration of 3,500 acres of forested wetlands, 1,100 acres of emergent wetlands, 325 acres of shrub wetland, and 209,437 feet of riparian corridors;

- Creation of 1,402 acres of littoral zone wetlands, creation of approximately 30,084 linear feet of stream and an offset to open water losses through the creation of abundant open water areas in the proposed reservoir; and
- A net gain of 1,115.6 HUs of forested wetlands, 762.2 HUs of emergent wetlands, and 201.3 HUs of shrub wetlands.

Table ES-1 Summary of Potential Impacts to Waters of the U.S. and Proposed Mitigation.

Type of Water of the U.S.	Amount Impacted		Amount of Mitigation		Net Gain(+) / Net Loss(-)	
	Acres	HUs	Acres	HUs	Acres	HUs
Forested Wetland	(-)4,602	(-)1,150.5	(+)3,952	(+)2,261.1	(-)650	(+)1,115.6
Emergent Wetland	(-)1,223	(-)514	(+)3,879	(+)1,276.2	(+)2,656	(+)762.2
Shrub Wetland	(-)49	23	(+)373	(+)224.3	(+)324	(+)201.3
Open Waters	(-)87	N/A	(+)15,273[1]	N/A	(+)15,186	N/A
	Linear Feet	SQUs	Linear Feet	SQUs	Linear Feet	SQUs
Streams	(-)651,024	(-)229,054	(+)404,979	(+)193,334	(-)246,045	(-)35,720

[1] This represents the offset of open waters by the creation of the reservoir, less the acreage identified for littoral wetlands.

Terrestrial Resources

In addition to providing compensatory mitigation for potential impacts to waters of the U.S., this mitigation plan would also provide compensatory mitigation for potential impacts to terrestrial resources, to the extent practicable. The proposed terrestrial mitigation components of this plan were developed to support and meet the permitting and mitigation requirements associated with the state of Texas water right permit application for the Lower Bois d'Arc Creek Reservoir submitted by NTMWD to the Texas Commission on Environmental Quality (TCEQ) on December 29, 2006. During the development of this section of the mitigation plan, specific consideration was given to Title 30 of the Texas Administrative Code (TAC) §297.53, which addresses habitat mitigation associated with water rights permitting.

It should be noted that all proposed aquatic and terrestrial mitigation (except for on-site aquatic mitigation and downstream mitigation on Bois d'Arc Creek) would occur on the Riverby Ranch, a single, approximately 15,000-acre tract of land located downstream of the proposed reservoir site (Figure 1).

Having both terrestrial and aquatic mitigation sites located together on one tract will provide synergistic ecological uplift to both ecosystems and avoid fragmentation of habitat.

The HEP methodology was used to evaluate the terrestrial resources that could be impacted following construction of the proposed reservoir and associated transmission and treatment facilities. In addition to the USFWS identifying HEP as an appropriate method to assess project impacts and make mitigation recommendations, it is also recommended by the state of Texas (30 TAC §297.53) as an appropriate tool. As such, both impacts and mitigation credits are measured using Habitat Units, a metric specific to the HEP methodology. A summary of potential impacts to terrestrial resources and proposed compensatory mitigation to offset those impacts are shown in Table ES-2.

Table ES-2 Summary of Potential Impacts to Terrestrial Resources and Proposed Mitigation.

Terrestrial Resource Type	Amount Impacted	Amount of Mitigation	Net Gain (+) / Net Loss (-)
Upland Deciduous Forest (HU)	(-) 1,046	(+) 665	(-) 381
Riparian Woodland / Bottomland Hardwood (HU)	(-) 433	(+) 855	(+) 422
Grassland / Old Field (HU)	(-) 2,886	(+) 2,393	(-) 493
Shrubland (acre)	(-) 64	(+) 41	(-) 23

Organization of this Report

Part 1, *Mitigation Plan for Impacts to Aquatic Resources,* of this mitigation plan was prepared to address Section 404 permitting and mitigation requirements as well as aquatic mitigation requirements for the state of Texas water right. Detailed discussions of impacts to waters of the U.S. and proposed mitigation to offset those impacts are included in this section. Part 2, *Mitigation Plan for Impacts to Terrestrial Resources*, was prepared to address the state of Texas water rights permit mitigation requirements. Part 3, *Site Protection, Management and Financial Assurances*, includes the proposed methods for long-term protection and management of the mitigation areas. All referenced figures in this report are located in Appendix A. Appendix B contains a table of the common and scientific names of organisms referenced in the report. Appendices C and D provide copies of previously developed technical information that was used in the development of this plan.

1.0 PROJECT INTRODUCTION AND BACKGROUND

Project Name:	North Texas Municipal Water District's Lower Bois d'Arc Creek Reservoir Project SWT Permit No.: 14659
Project Location:	The proposed reservoir site, intake pump station, electrical substation, and a portion of the raw water pipeline are located within the Bois d'Arc Creek watershed (HUC 11140101), as shown on Figure 1. The center coordinates of the proposed dam are approximately 33° 43' 05" N, 95° 58' 56" W. The proposed dam is on Bois d'Arc Creek and Honey Grove Creek approximately 15 miles northeast of the City of Bonham, Fannin County, Texas. The reservoir area is generally bounded by State Highway 82 to the south, Farm-to-Market (FM) 273 to the north, FM 100 to the east, and FM 898 to the west. The proposed water treatment plant and terminal storage reservoir are located near the City of Leonard, TX in the Trinity River watershed (Figure 1). The proposed pipeline extends from near the proposed dam site to the southwest for approximately 35 miles to the proposed water treatment plant site.
Mitigation Site Location:	The proposed mitigation site is located in the northeast corner of Fannin County and the northwest corner of Lamar County, TX near the confluence of Bois d'Arc Creek and the Red River (HUC11140101), as shown on Figure 1. The proposed mitigation site is known as the "Riverby Ranch" and the center coordinates are approximately 33° 50' 20" N, 95° 53' 55" W.
Watershed(s):	Trinity River, Sulphur River, Red River, and Bois d'Arc Creek Watersheds
County or Counties:	Fannin, Lamar

The proposed Lower Bois d'Arc Creek Reservoir is located in a rural area northeast of the City of Bonham, Texas (Figure 1). The term "project site" consists of 17,068 acres, which includes 16,641 acres at the conservation pool elevation 534 ft. msl. and 427 acres for the dam and spillways. The "project site" also includes approximately 860 acres associated with the proposed raw water pipeline, water treatment plant, terminal storage reservoir, and rail spur.

The proposed reservoir would provide approximately 120,000 acre-feet per year of water supply to the North Texas Municipal Water District (NTMWD). This project is one of several water supply projects that the NTMWD is pursuing to meet its growing water needs. As part of the development of this project, an application for a state of Texas water right permit for the Lower Bois d'Arc Creek Reservoir was submitted by NTMWD to the Texas Commission on Environmental Quality (TCEQ) on December 29, 2006. An application for a Section 404 permit, which is necessary to construct the proposed reservoir, was submitted to the U.S. Army Corps of Engineers (USACE) in June 2008.

Throughout the permitting process for this project, NTMWD and Freese and Nichols, Inc. (FNI) have coordinated extensively with numerous state and federal resource agencies, including:

- U.S. Fish and Wildlife Service (USFWS);
- U.S. Army Corps of Engineers (USACE);
- U.S. Environmental Protection Agency (USEPA);
- U.S. Forest Service (USFS);
- Natural Resources Conservation Service (NRCS);
- Texas Parks and Wildlife Department (TPWD);
- Texas Water Development Board (TWDB); and
- Texas Commission on Environmental Quality (TCEQ).

As part of the ongoing coordination effort, multiple reports documenting the findings from studies conducted for the proposed project have been prepared and submitted by NTMWD to the USACE and these agencies in support of the water right permit and 404 permit applications. The following reports were used in developing the Mitigation Plan:

- Report Supporting an Application for a Texas Water Right for Lower Bois d'Arc Creek Reservoir, 2 volumes, submitted to TCEQ on December 29, 2006.
- Section 404 Permit Application and Jurisdictional Determination Report, submitted to TCEQ water rights permitting section on October 8, 2008.
- Environmental Report, Supporting an Application for a 404 Permit for Lower Bois d'Arc Creek Reservoir, submitted to TCEQ water rights permitting section on October 8, 2008.

- Instream Flow Study Report for the Proposed Lower Bois d’Arc Creek Reservoir, May 2010, submitted to USACE and Cooperating agencies on May 27, 2010. Submitted to TCEQ on June 1, 2010.
- Instream Flow Study Supplemental Data, September 2010, submitted to USACE and cooperating agencies on September 17, 2010. Submitted to TCEQ on September 23, 2010.
- Supplemental Habitat Evaluation Procedures (HEP) Data Associated with the Proposed Lower Bois d’Arc Creek Reservoir Pipeline and Associated Treatment Facilities Technical Memorandum, December 2013, submitted to USACE on December 18, 2013.
- Rapid Geomorphic Assessment of Bois d’Arc Creek and its Tributaries for the Lower Bois d’Arc Creek Reservoir Project, January 2009, submitted to the USACE on November 16, 2009.
- Technical Memorandum on Proposed Mitigation for Stream Impacts of the Proposed Lower Bois d’Arc Creek Reservoir – Rapid Geomorphic Assessment, November 12, 2014, submitted to the USACE with this Mitigation Plan.
- Technical Memorandum on Lower Bois d’Arc Creek Littoral Zone/ Fringe Wetland Development, May 7, 2014, submitted to the USACE on September 3, 2014. (Also included as Appendix D of this Mitigation Plan.)

Additionally, a synopsis of the impacts of the proposed project on terrestrial and aquatic functions was provided to the TCEQ in the response to a Request for Information, dated May 13, 2011. A copy of this response is included in Appendix C of this mitigation plan.

This mitigation plan is organized into three parts: Part 1 discusses the mitigation plan for impacts to aquatic resources; Part 2 presents the mitigation plan for impacts to terrestrial resources; and Part 3 outlines the long-term protections, management, and financial assurances.

PART 1 MITIGATION FOR IMPACTS TO AQUATIC RESOURCES

This Part of the mitigation plan was developed to provide compensatory mitigation, to the extent practicable, for impacts to aquatic resources that could occur following construction of the proposed Lower Bois d'Arc Creek Reservoir, including the associated transmission and treatment facilities. All proposed compensatory mitigation for potential impacts to aquatic resources would be provided through in-kind mitigation that would occur through on-site or near-site mitigation strategies. Although this document has been prepared in such a way to discuss impacts and proposed mitigation to aquatic (Part 1) and terrestrial (Part 2) resources independently, mitigation would be accomplished on-site and nearby on one large, contiguous mitigation site (Riverby Ranch).

This mitigation plan was developed in compliance with Regulatory Guidance Letter 02-02, "Guidance on Compensatory Mitigation Projects for Aquatic Resource Impacts Under the Corps Regulatory Program Pursuant to Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act of 1899" and the "Aquatic Resource Mitigation and Monitoring Guidelines", Department of the Army Regulatory Program, Tulsa District U.S. Army Corps of Engineers (USACE), October 2004. This plan was also developed through consideration of public comments, as well as state and federal resource agency comments on the Section 404 permit application for the proposed Lower Bois d'Arc Creek Reservoir project, including the scoping meetings for the Environmental Impact Statement (EIS). Although this mitigation plan is not subject to the regulations governing compensatory mitigation for losses of aquatic resources provided in 33 CFR Part 332 and 40 CFR Part 230, effective June 9, 2008 (Final Mitigation Rule), such regulations were used as guidance in the development of this mitigation plan. (See Final Mitigation Rule, 73 Fed. Reg. 19,593, 19,608). *(Note – the Section 404 permit application for the proposed Lower Bois d'Arc Creek Reservoir project was submitted prior to the effective date of the Final Mitigation Rule).*

This mitigation plan was developed to meet the federal "no overall net loss of wetlands" policy and to provide compensatory mitigation, to the extent practicable, for impacts to other types of waters of the U.S. that could be impacted by construction of the proposed Lower Bois d'Arc Creek Reservoir and associated transmission and treatment facilities. All compensatory mitigation would be provided through in-kind mitigation that would occur through on-site or near-site mitigation strategies. On-site mitigation would be provided at the proposed reservoir site and near-site mitigation would be provided on the 14,958.58-acre Riverby Ranch, which is located on Bois d'Arc Creek downstream of the proposed reservoir. The NTMWD has selected this site specifically because of its unique characteristics and qualities to provide appropriate mitigation for the proposed project.

2.0 IMPACTS DUE TO THE PROPOSED PROJECT

2.1 PROJECT SITE DESCRIPTION

The proposed Lower Bois d'Arc Creek Reservoir is located in a rural area northeast of the City of Bonham, Texas. The proposed reservoir project site consists of 17,068 acres, which includes 16,641 acres for the lake and 427 acres for the construction of the dam and spillways. Much of the proposed reservoir site has been altered over the past 100 years, mainly by agricultural practices and stream channelization. In addition to the proposed reservoir, the proposed project also includes a proposed raw water pipeline, intake pump station, electrical substation, terminal storage reservoir, rail spur, and water treatment plant. All of these proposed features would be located within Fannin County and would have a total footprint of approximately 860 acres. The proposed intake pump station and electrical substation would be located within the grading limits of the proposed dam and therefore do not add or result in any additional impacts associated with the proposed project. Considering these associated components, the total project footprint would be 17,928 acres.

Ecologically, the proposed project site would be located within the Post Oak Savannah and Blackland Prairie Ecological Regions of Texas (Gould et. al., 1960). The Blackland Prairie is a true prairie grassland community that is dominated by a diverse assortment of perennial and annual grasses and forbs. Included within this area are forested or wooded areas that are restricted to bottomlands along major rivers and streams, ravines, protected areas, or to specific soils. The original plant community associated with the Post Oak Savannah Ecological Region was savannah dominated by native bunch grasses and forbs with scattered clumps of trees, primarily post oaks. Forested areas were mostly limited to hardwood bottomlands along major rivers and creeks, or in areas protected from fire (Texas Parks and Wildlife Department, February 9, 2007).

Slopes in Fannin County range from nearly level to moderately steep. According to the NRCS Soil Survey of Fannin County, Texas (2001), elevation ranges from 478 ft. msl. at the mouth of Bois d'Arc Creek and the Red River to 767 ft. msl. in the southwestern part of the county.

According to the 1946 Soil Survey of Fannin County (U.S. Department of Agriculture, 1946), historical land uses were primarily cropland and pastureland. In 1939, harvested cropland represented almost half of the area of the county, with cotton representing the largest crop, followed by corn and oats. Most of the remaining land within the county was used for pasture. During this time, practically all of the highly productive land was cultivated except for the lower floodplain of Bois d'Arc Creek, which needed protection from floods. These floodplain areas were densely forested with such species as bois d'arc, ash, water oak, willow oak, elm, hackberry, pecan, and lesser numbers of other trees. Although these areas could not be cultivated due to flooding, a considerable amount of rough lumber was cut, especially bois d'arc, due to its value as fence posts.

The 2001 Soil Survey of Fannin County indicates that agriculture is still the main land use in Fannin County. The major land uses are cropland and improved pasture with nearly half of the agriculture income being derived from the sale of livestock. Crop production has shifted away from being primarily cotton based to close-growing crops such as wheat, grain sorghum, soybeans, and peanuts. Rangeland comprises about six percent of the land area with almost half of that being located in the Caddo National Grasslands and the remainder being located in the southern part of the county. Only 0.5 percent of the land in Fannin County is used as commercial woodland.

2.2 EXISTING HYDROLOGY

The watershed for Bois d'Arc Creek is located within the Red River Basin. The proposed reservoir would have a drainage area of 327 square miles. Other reservoirs in the Bois d'Arc Creek watershed include Lake Bonham, which serves as the water supply for the City of Bonham, and Lake Crockett and Coffee Mill Lake, which are recreational lakes.

Local streams are characterized by extensive channelization, especially along Bois d'Arc Creek. Approximately 62 percent of the length of Bois d'Arc Creek within the proposed reservoir site has been channelized, as have portions of a number of tributaries. Much of the channelization was performed to reduce flooding along the creeks. The hydrology of the watershed is characterized by rapid rises and falls of stream flows in response to rain events. During dry times there may be little to no flow in the creeks. Fluvial geomorphologic analyses indicate that the prior channelization, lack of aquatic habitat, and lack of bank stability have contributed to excessive erosion and downcutting in Bois d'Arc Creek. This has resulted in reduced quality for the streams within the project site and immediately downstream of the proposed dam and spillway.

2.3 EXISTING VEGETATION

The location and distribution of all vegetative cover types within the proposed Lower Bois d'Arc Creek Reservoir site are depicted in Figure 2. The location and distribution of vegetative cover types within the footprint of the proposed transmission and treatment facilities are located within the

Supplemental Data Supporting an Application for a 404 Permit for Lower Bois d'Arc Creek Reservoir report (FNI, 2013). Following are descriptions of the typical vegetative species that occur within each wetland cover type. It is important to note that all wetland impacts were avoided during site selection for the associated transmission and treatment facilities. As such, the descriptions of wetlands impacts pertain exclusively to the proposed reservoir site.

2.3.1. Emergent Wetland

Emergent wetlands in the project site are dominated by an herbaceous layer made up of wetland obligates such as rushes, sedges, smartweed, and redstem. The herbaceous canopy includes numerous grass species such as barnyardgrass, crowngrass, and eastern gammagrass. Other plants found in the emergent wetlands include blue sedge, spikerush, flatsedge, sumpweed, frogfruit, water primrose, balloon vine, dock, and buttercup.

2.3.2. Shrub Wetland

Shrub wetlands in the study area can be considered wetlands in successional transition between emergent wetlands and bottomland hardwood forests. The shrub layer is dominated by small trees such as green ash, sugarberry, and cedar elm, as well as species such as honey locust and baccharis. Dominant herbaceous plants include sedges, ragweed, ironweed, goldenrod, evening primrose, round-leaf groundsel, and wild pea.

2.3.3. Riparian Woodland/Bottomland Hardwood Forest (Forested Wetland)

The riparian woodland / bottomland hardwood cover type includes wetland areas dominated by woody vegetation at least six meters tall, with a total vegetation cover of more than 30 percent; this designation is synonymous with the Forested Wetland cover type described in the Ecological Services Manual (ESM) 103 (USFWS 1980). The riparian woodland / bottomland hardwood cover type in the project site includes the predominantly deciduous forests of riparian zones and wetlands, and is associated with the floodplains of Bois d'Arc Creek and Honey Grove Creek.

Dominant trees include black willow, boxelder, green ash, sugarberry, and cedar elm. Dominant shrubs are often small trees of the species listed above, as well as honey locust, poison ivy, coralberry, buttonbush, baccharis, and Virginia creeper. Common herbaceous plants in the bottomland hardwood forest include Cherokee sedge, ragweed, and Virginia wildrye.

2.4 EXISTING SOILS

Soils within the footprint of the proposed Lower Bois d'Arc Creek Reservoir and associated transmission and treatment facilities are presented in Table 2-1. Descriptions of the soils can be obtained from the NRCS Soil Survey of Fannin County, Texas (2001).

Table 2-1 Soils Located within the Proposed Lower Bois d'Arc Creek Reservoir Project Site.

Map Unit Name	Hydric	Prime Farmland Classification
Austin silty clay loam, 1 to 3 percent slopes	No	All areas are prime farmland
Burleson clay, 0 to 1 percent slopes	No	All areas are prime farmland
Crockett loam, 1 to 3 percent slopes	No	Not prime farmland
Crockett loam, 2 to 5 percent slopes, eroded	No	Not prime farmland
Dams	No	Not prime farmland
Dela loam, frequently flooded	No	Not prime farmland
Dela loam, occasionally flooded	No	All areas are prime farmland
Derly silt loam, 0 to 1 percent slopes	Yes	Not prime farmland
Derly-Raino complex, 0 to 1 percent slopes	Yes	Not prime farmland
Elbon silty clay loam, frequently flooded	No	Not prime farmland
Ellis clay, 5 to 12 percent slopes, eroded	No	Not prime farmland
Fairlie clay, 0 to 1 percent slopes	No	All areas are prime farmland

Map Unit Name	Hydric	Prime Farmland Classification
Fairlie-Dalco complex, 1 to 3 percent slopes	No	All areas are prime farmland
Ferris clay, 5 to 12 percent slopes, eroded	No	Not prime farmland
Freestone-Hicota complex, 0 to 2 percent slopes	Yes	All areas are prime farmland
Frioton silty clay loam, occasionally flooded	No	All areas are prime farmland
Heiden clay, 1 to 3 percent slopes	No	All areas are prime farmland
Heiden-Ferris complex, 2 to 6 percent slopes, eroded	No	Not prime farmland
Hopco silt loam, frequently flooded	No	Not prime farmland
Hopco silt loam, occasionally flooded	No	All areas are prime farmland
Houston Black clay, 1 to 3 percent slopes	No	All areas are prime farmland
Howe-Whitewright complex, 3 to 5 percent slopes	No	Not prime farmland
Lamar clay loam, 5 to 8 percent slopes	No	Not prime farmland
Leson clay, 1 to 3 percent slopes	No	All areas are prime farmland
Morse clay, 5 to 12 percent slopes, eroded	No	Not prime farmland
Normangee clay loam, 1 to 3 percent slopes	No	Not prime farmland
Normangee clay loam, 2 to 5 percent slopes, eroded	No	Not prime farmland
Porum loam, 2 to 5 percent slopes	No	Not prime farmland
Porum loam, 5 to 12 percent slopes	No	Not prime farmland
Stephen silty clay, 1 to 3 percent slopes	No	Not prime farmland
Tinn clay, frequently flooded	Yes	Not prime farmland
Tinn clay, occasionally flooded	No	All areas are prime farmland
Whakana very fine sandy loam, 3 to 5 percent slopes	No	All areas are prime farmland
Whakana very fine sandy loam, 5 to 12 percent slopes	No	Not prime farmland
Whitewright-Howe complex, 5 to 12 percent slopes, eroded	No	Not prime farmland
Wilson silt loam, 0 to 1 percent slopes	No	Not prime farmland

2.5 EXISTING WILDLIFE USAGE

2.5.1. Emergent Wetland

Many species of birds were found in the emergent wetlands, including the northern cardinal, American crow, indigo bunting, tufted titmouse, great blue heron, great egret, red-tailed hawk, and northern harrier. Other wildlife resident in the areas include several mammals, such as raccoon, beaver, feral hog, and white-tailed deer; aquatic species including frogs, mosquitofish, crayfish, mussels; and plentiful flying insects such as mosquitoes, butterflies, bees and dragonflies.

2.5.2. Shrub Wetland

Birds observed in the shrub wetlands of the project site included northern cardinal, painted bunting, American crow, great egret, solitary warbler, and common yellow throat. Evidence of mammalian residents includes tracks of the raccoon and bite marks of beaver. The southern leopard frog and crayfish were also observed in the shrub wetlands.

2.5.3. Riparian Woodland/Bottomland Hardwood Forest (Forested Wetland)

Common avian species observed in this cover type include the indigo bunting, white-eyed vireo, yellow-billed cuckoo, American crow, Carolina wren, barred owl, egret, Carolina chickadee, and northern cardinal. Evidence of mammalian residents included raccoon tracks, hog tracks, and beaver chew marks on trees. Although not observed during field surveys, it has been reported that the river otter may also occur in the area. Reptiles such as the ornate box turtle and unidentified frogs were also found in these forests, as were numerous invertebrate species, including crayfish and land snails.

2.6 WILDLIFE HABITAT VALUE

The wildlife habitat value within the proposed project site was estimated using the Habitat Evaluation Procedures (HEP), developed by the USFWS. A discussion of the HEP methodology is located in the Determination of Credits chapter of this report. The process was conducted by an interagency team that included personnel from USFWS, USACE, USEPA, USFS, TPWD, TWDB, TCEQ, NTMWD, and FNI.

HEP methods were used to quantify the habitat value of the study area to a set of wildlife evaluation species selected by the interagency HEP team. Sixteen evaluation species were selected by the HEP team based on their ecological significance and the availability of applicable habitat suitability index (HSI) models. This evaluation was made for baseline conditions (i.e., conditions present at the reservoir site during the 2007 HEP field studies). The HEP report for the baseline conditions at the proposed reservoir site is included as Appendix D of the Environmental Report Supporting the 404 Permit Application for Lower Bois d'Arc Creek Reservoir (FNI, 2008). A supplemental HEP analysis to document existing conditions for the associated transmission and treatment facilities was completed in October and November of 2013 following the selection of the raw water pipeline route and locations of the water treatment plant and terminal storage reservoir (FNI, 2013).


Interagency HEP Team

The Lower Bois d'Arc Creek Reservoir study area, including the associated transmission and treatment facilities, was subdivided into the following nine cover types: Upland Deciduous Forest, Evergreen Forest, Tree Savanna, Shrubland, Cropland, Grassland / Old Field, Riparian Woodland / Bottomland Hardwood, Shrub Wetland, and Emergent / Herbaceous Wetland. The habitat quality within each delineated cover type was evaluated in relation to the habitat requirements of one or more of the evaluation species: the American kestrel, barred owl, brown thrasher, Carolina chickadee, downy woodpecker, eastern cottontail, eastern meadowlark, eastern turkey, field sparrow, fox squirrel, green heron, raccoon, racer, scissor-tailed flycatcher, swamp rabbit, and the wood duck.

The habitat quality, expressed in HSI, of wetland cover types for each evaluation species is presented in Table 2-2. Habitat suitability index values are dimensionless and range between zero and 1, where zero indicates no habitat value and 1 indicates the highest habitat value. The overall HSI value for the cover types was calculated as the arithmetic mean of the HSI values for all the evaluation species for that cover type. Baseline habitat units (HUs) were calculated for each cover type within the Lower Bois d'Arc Creek Reservoir project site by multiplying the average cover type HSI values by the acres in each cover type, as presented in Table 2-3.

Table 2-2 Habitat Suitability Indices for Wetland Cover Types within the Proposed Lower Bois d'Arc Creek Reservoir Project Site.

Evaluation Species	Cover Types		
	Forested Wetland	Shrub Wetland	Emergent / Herbaceous Wetland
Barred owl	0.14	--	--
Downy wood-pecker	0.34	--	--
Fox squirrel	0.03	--	--
Green heron	--	0.81	0.87
Raccoon	0.52	0.28	0.17
Swamp rabbit	--	0.52	--
Wood duck	0.22	0.22	0.22
Average HSI Values	**0.25**	**0.46**	**0.42**

**Forested wetlands were delineated as a subset of the riparian woodland / bottomland hardwood cover type during the wetland delineation shown in the JD report prepared for the proposed reservoir site.*

Table 2-3 Baseline Habitat Units by Wetland Cover Type within the Proposed Lower Bois d'Arc Creek Reservoir Project Site.

Cover Type	Average HSI Values	Area (acres)	Habitat Units (HUs)
Forested Wetland	0.25	4,602	**1,150.5**
Shrub Wetland	0.46	49	**23**
Emergent / Herbaceous Wetland	0.42	1,223	**514**
TOTAL		**5,874**	**1,687.5**

2.7 STREAM ASSESSMENT

A RGA was performed in 2008 along Bois d'Arc Creek and four of its major tributaries within the footprint of the proposed Lower Bois d'Arc Creek Reservoir site to provide estimated measures of baseline stream conditions. The RGA method integrates data collected from the field and desktop sources into a quantifiable description of the features that affect stream stability and the potential for developing aquatic habitat features (Freese and Nichols, 2008). This method was also applied to streams on the mitigation area to establish baseline conditions and to provide a basis for developing mitigation treatments described later in this document.

The RGA method used to evaluate stream conditions at the impact site and the mitigation site is similar to other geomorphic assessment methods used in various regions of the U.S. (Habberfield et al., 2014; Montgomery County, 1992; Kline et al., 2007, and Heeren et al., 2012). These methods generally use measures of erosion, channel stability, riparian habitats, instream habitats, and other visual attributes of stream channels to evaluate and measure stream conditions. Also, as noted by Habberfield et al. (2014), "visual-based rapid assessment techniques provide an efficient method for characterizing the restoration potential of streams, with many focusing on channel stability and instream habitat features," and "[g]eomorphic indices can serve as effective proxies for biological indices in highly disturbed systems." As previously discussed, extensive prior channelization, and the resulting channel down-cutting and widening, poor stream bank stability, and lack of aquatic habitat indicate that the Bois d'Arc Creek system is highly disturbed and that the use of a geomorphic assessment method such as RGA is appropriate for this stream system.

The RGA method is based on a rapid field assessment of stream properties and characteristics at representative sites along stream reaches that are being evaluated. In general, the types of data collected include observations of channel size and location, bank geometry, information describing riparian vegetation and rooting depths, general bank armoring characteristics, as well as conditions of the upper slopes, lower slopes, and channel bed. Morphological variables for channel stability were documented using the "Watershed Assessment of River Stability & Sediment Supply (WARSSS)" (Rosgen, 2006), the "Stream reach inventory and channel stability evaluation" (Pfankuch, 1975) and the "Incised Channels: Morphology, Dynamics and Control" (Schumm et al., 1984). Each are described on the USEPA technical tools website (http://water.epa.gov/scitech/datait/tools/warsss/). For each data collection point, six stream characteristics (evidence of bank erosion, bank root zone, vegetative bank cover, bank angle, sediment transport, and channel alteration) were assessed, scored, and then summed to calculate a final RGA score ranging between zero and 60. As part of developing this mitigation plan scores were normalized by dividing the score by 60 to produce a Stream Quality Factor (SQF) ranging between zero and one, where zero represents poorest stream conditions and one represents optimum stream conditions.

The calculated SQF score for a particular study reach was then multiplied by its length to calculate Stream Quality Units (SQUs) provided by that reach. This process was repeated for all study reaches within the footprint of the proposed Lower Bois d'Arc Creek Reservoir site to establish baseline SQUs (Table 2-4).

Table 2-4 Baseline Stream Quality Units within the Proposed Lower Bois d'Arc Creek Reservoir Project Site.

Stream Quality Factor (SQF)	Existing Length (feet)	Stream Quality Units (SQUs)
0 - .09	25,171	2,098
.10 - .19	91,337	11,592
.20 - .29	128,395	28,902
.30 - .39	73,580	23,013
.40 - .49	184,011	80,757
.50 - .59	141,422	77,835
.60 - .69	7,107	4,857
.70 - .79	0	0
.80 - .89	0	0
.90 – .99	0	0
1	0	0
TOTAL	**651,024**	**229,054**

2.8 WATERS OF THE UNITED STATES

A total of 1,687.5 HUs of wetlands (5,874 acres), 87 acres of open waters (ponds, stock tanks, etc.), and 229,054 SQUs of streams (651,024 linear feet) were delineated in the proposed Lower Bois d'Arc Creek Reservoir site (Table 2-3 through 2-5). The area includes the footprint of the conservation pool of the reservoir below elevation 534 ft. msl. and the limits of construction in the vicinity of the dam and spillway. The location and boundaries of waters of the U.S. at the proposed reservoir site were delineated by FNI as described in the Jurisdictional Determination (JD) Report prepared and submitted with the Lower Bois d'Arc Creek Reservoir Section 404 permit application (FNI, 2008). An additional 5,403 linear feet of streams and 0.1-acre of open water were observed within the limits of investigation of the associated transmission and treatment facilities (no wetlands were observed). However, no permanent impacts to streams or open waters would occur as a result of constructing these structures, therefore there are no impacts shown in Table 2-5.

Table 2-5 Types and Acreages of Potential Waters of the U.S. Potentially Impacted within the Proposed Lower Bois d'Arc Creek Reservoir Project Site.

Category	Length (feet)	Area (acres)
Streams		
Perennial	262,944	--
Intermittent	388,080	--
Open Waters		
Ponds, Stock Tanks, Small Lakes	--	87
Wetlands	--	5,874
TOTAL	**651,024**	**5,961**

Note: "Intermittent" stream length includes both ephemeral and intermittent streams.

2.8.1. Biological Integrity of Bois d'Arc Creek

FNI conducted an instream flow study following protocols of the Texas Instream Flow Program (TIFP). The study included analyses of hydrology, biology, geomorphology and water quality to assess the existing condition of Bois d'Arc Creek and to project the future condition of the stream with and without the proposed dam. Results of the study indicated that the stream channel is currently degrading, as exhibited by downcutting and widening, due to past disturbance. While the biological profile of the stream appeared fairly healthy, the observed species in the stream were primarily generalists and mostly lacked the fluvial specialists that might be expected in a non-disturbed stream setting.

The Bois d'Arc Creek watershed has been significantly impacted by channelization, which began in the 1920s and continued well into the 1970s. As a result of the channelization, the watershed is no longer in equilibrium to maintain a stable stream environment. Downcutting and streambank erosion have increased, and lateral migration of the stream (i.e., meander creation) has slowed. Channelization has also most likely increased the "flashy" nature of flows in the watershed, with rapid rise and fall in flow in response to rainfall events. This probably has reduced base flows in the watershed as well. Habitats in the watershed change rapidly, as high flows wash away gravel bars and large woody debris or low flows reduce connectivity along the stream. The frequency of extreme flow events, both high and low, has resulted in an environment that favors generalist species. Although water quality in the watershed is generally good, Bois d'Arc Creek is not able to support a large variety of aquatic life because the limited habitat features in the watershed are frequently washed away by high flow events, and the lack of reliable subsistence or base flow hydrology from year to year may be a limiting factor for fish and other aquatic species.

Without any changes in the watershed, Bois d'Arc Creek is expected to continue to downcut and erode. As the channel becomes even more incised, lateral connectivity with the surrounding flood plain will decrease. Due to the unstable nature of much of the stream banks along Bois d'Arc Creek and easily erodible bed materials, the stream channel will continue to enlarge. This will further reduce longitudinal connectivity at low flows and continue to constrain aquatic species to specific habitats that contain water (e.g., pools).

As part of the instream flow study, the biological integrity of Bois d'Arc Creek within the proposed reservoir site and downstream of the proposed dam was evaluated using the Index of Biotic Integrity (IBI) for fish and Rapid Bioassessment (RBA) for macroinvertebrates. Integrity scores for fish community structure were intermediate to high (mean: 43.83). Main stem site scores ranged from 33 (limited) to 49 (high). It was found that overall biological integrity of Bois d'Arc Creek's macroinvertebrate community was intermediate (mean: 28.93). Main stem sampling site scores ranged from 22 (intermediate) to 37 (high).

More detailed information can be found in the Instream Flow report prepared for Bois d'Arc Creek (FNI, 2010a and 2010b).

3.0 MITIGATION OBJECTIVES

The purpose of this mitigation plan is to identify and describe the mitigation measures proposed by NTMWD to compensate for the unavoidable adverse impacts to aquatic resources related to the proposed Lower Bois d'Arc Creek Reservoir project. Alternatives to the proposed project are evaluated in detail and documented in the Environmental Impact Statement.

Specific plan objectives are to mitigate, to the extent practicable, for unavoidable adverse impacts to forested wetlands, emergent wetlands, shrub wetlands, open water, and streams that would occur as a result of constructing the proposed Lower Bois d'Arc Creek Reservoir. This mitigation would be achieved through wetland restoration and enhancement as well as stream restoration and enhancement at the nearby mitigation site. On-site, the creation of the lake would offset impacts to open waters and some of the stream impacts, and it would provide the means for creating and enhancing emergent wetlands in shallow areas around the lake (littoral wetlands). The development of the reservoir also provides the means to enhance Bois d'Arc Creek through reductions in the frequency of destructive high flow events and the passage of sustainable environmental flows to enhance and maintain existing downstream habitats. Table 3-1 provides a summary of the types of mitigation that would be implemented for each impact type.

OBJECTIVES

Specific Plan objectives are to mitigate for impacts to:

- **1,150.5 HUs of forested wetlands**
- **514 HUs of emergent wetlands**
- **23 HUs of shrub wetlands**
- **87 acres of open water**
- **229,054 SQUs of streams**

The mitigation plan undertakes a watershed approach that is multifaceted, applying a variety of mechanisms to mitigate impacts to waters of the U.S. The proposed mitigation would also provide other services (i.e., benefits) to the public including recreation, restoring and enhancing high quality emergent, shrub, and forested wetland habitats, improving wildlife habitat, and restoring and enhancing streams and open waters.

Table 3-1 Summary of On-Site and Near-Site Mitigation Associated with the Proposed Lower Bois d'Arc Creek Reservoir Project.

IMPACT TYPE		MITIGATION COMPONENT			
		On-Site		Near-Site	
		Reservoir Site	*Reservoir / Littoral-Wetlands* [1]	*Restoration*	*Enhancement*
Wetlands	*Forested*			X	X
	Emergent		X	X	X
	Shrub			X	X
Non-wetlands	*Streams*		X	X	X
	Open Water	X			X

[1] *Littoral wetlands (emergent wetlands) will develop and be protected in the reservoir.*

4.0 MITIGATION SITE SELECTION

4.1 BACKGROUND

As part of the permitting process, potential mitigation strategies have been identified and evaluated to address regulatory requirements and agency preferences to offset impacts to aquatic resources. Mitigation strategies that were considered included a suite of options ranging from the purchase of lands to be included in the Caddo National Grasslands managed by the USFS to the purchase of mitigation bank credits.

On June 9, 2008, new regulations governing compensatory mitigation for losses of aquatic resources provided in 33 CFR Part 332 and 40 CFR Part 230 (Final Mitigation Rule) became effective. The Final Mitigation Rule, issued by the USACE and USEPA, made the purchase of mitigation bank credits and in-lieu fee payment methods the preferred mitigation method over permittee-responsible mitigation. The main justifications for changing mitigation preferences to mitigation banks and in-lieu fee payments included reducing the risk and uncertainty of compensatory mitigation projects and avoiding fragmentation of mitigation sites, especially for small projects.

NTMWD submitted its Section 404 permit application for the proposed Lower Bois d'Arc Reservoir project on June 3, 2008, prior to the effective date of the Final Mitigation Rule. As such, this mitigation plan is not subject to the regulations governing compensatory mitigation as outlined in the Final Mitigation Rule. (See Final Mitigation Rule, 73 Fed. Reg. 19,593, 19,608). However, following the publication of the Final Mitigation Rule in the Federal Register (April 10, 2008), NTMWD did evaluate the option of purchasing mitigation bank credits to compensate for all, or a portion of, the impacts to waters of the U.S. at the proposed Lower Bois d'Arc Creek Reservoir site. The evaluation showed that:

RESULTS OF EVALUATION OF PURCHASING MITIGATION BANK CREDITS

- **No mitigation bank lies within the primary service area of the project.**
- **No single mitigation bank would have enough credits to offset the impacts, causing fragmentation of mitigation.**
- **Mitigation banks generally do not provide the multi-faceted approach that may be warranted for this project.**

- The project does not lie within the primary service area of any existing mitigation bank(s). As a result, the acreage/credit purchase required would increase because NTMWD must go outside of the primary service area of a bank. The resulting cost of purchasing bank credits would far exceed the estimated cost of the entire Lower Bois d'Arc Creek Reservoir project making this mitigation method not practicable.
- No single mitigation bank would have enough credits to offset the impacts identified at the Lower Bois d'Arc Creek Reservoir site. Consequently, compensatory mitigation through bank credit purchase would be geographically fragmented.
- Large on-channel reservoir projects, like the proposed Lower Bois d'Arc Creek Reservoir project, often require multi-faceted mitigation approaches because of the typically large area of aquatic resource impacts, which differs from other types of non-water dependent development projects. These multi-faceted approaches may not be easily addressed through the use of mitigation banks.

After reviewing the practicability of satisfying the Lower Bois d'Arc Creek Reservoir mitigation requirements through purchase of mitigation bank credits or in-lieu fee compensation, NTMWD concluded that continuing its efforts to mitigate through a multi-faceted permittee-responsible approach would keep the mitigation activities within the Bois d'Arc Creek watershed where the impacts would occur and would better achieve the purpose and goals of providing mitigation. Both the Regulatory Guidance Letter 02-02 and the Final Mitigation Rule emphasize taking a "watershed approach," like the approach NTMWD is undertaking, to satisfy mitigation requirements and recognizes that this approach will support the sustainability or improve the aquatic resources located within the same watershed in which impacts would occur.

During monitoring of the proposed mitigation sites (see Chapter 10), monitoring reports comparing field measurements to performance criteria will be submitted to the TCEQ and USACE. If the data indicate that performance standards are not being met, as provided in Chapter 9, adaptive management strategies would be identified in consultation with the USACE and the TCEQ. These strategies would focus on corrective actions, but may also include the purchase of mitigation bank credits if at that time a mitigation bank has been established with a primary service area covering the reservoir project impact site.

4.2 MITIGATION SITE SELECTION STRATEGY

Recognizing the USACE mandate to compensate for impacts as close to the impact site as practicable, NTMWD's mitigation site selection strategy prioritized site location as follows: (1) on-site, within the reservoir footprint, and (2) near-site, downstream of proposed reservoir (impact site) location and within the same watershed.

4.2.1. On-Site Mitigation

On-site mitigation efforts will be utilized to the maximum extent practicable to offset impacts to waters of the U.S. resulting from the construction of the proposed reservoir. Specific sites within the proposed reservoir footprint that will be utilized for wetland mitigation efforts will be in areas that are less than or equal to three feet in depth (i.e., sites within the footprint of the reservoir with elevations that fall between 531 ft. msl. and 534 ft. msl.) and in areas where tributaries enter the reservoir into broad, flat areas. Figure 3 shows the locations where these conditions are expected to persist or develop once the reservoir is constructed. Typically, these areas are lumped into a single class of wetlands identified as littoral wetlands that develop in the shallow portions of lakes, ponds, and reservoirs. Emergent wetlands are expected to develop within the littoral zone of the proposed reservoir and provide a functional wetland community which would offset impacts resulting from the proposed reservoir project (see Appendix D). Many of the areas where these littoral wetlands are expected to develop are currently functioning emergent wetlands and would continue to function as emergent wetlands following impoundment of the reservoir. The existing wetlands would also serve as a seed source for the newly developed littoral wetlands helping to establish vegetation.

The development of littoral zone wetlands within lake shallows appears to be common in the North Texas area (additional data supporting the development of littoral zone wetlands is included in Appendix D). This can be evidenced from evaluating data collected by TPWD under the Statewide Freshwater Fisheries Monitoring and Management Program. Under this program, biologists conduct periodic surveys, normally every four years, of freshwater fisheries and prepare detailed reports on their findings. A review of the data collected from seven freshwater reservoirs located within the North Texas area (Figure 4) was performed to estimate the likelihood of the establishment of littoral wetlands around the proposed Lower Bois d'Arc Creek Reservoir. The results are summarized in Table 4-1.

Table 4-1 Summary of Lake Vegetative Cover Collected by TPWD under the Statewide Freshwater Fisheries Monitoring and Management Program for Lakes/Reservoirs in the North Texas Area.

Lake / Reservoir	River Basin	Total Surface Area (acres)	Surface Area with Aquatic Vegetation (submerged, floating leaved, emergent) (acres)	Percent of Reservoir Surface Area
Pat Mayse	Red	5,940	240	4
Lake Bonham	Red	1,020	200	19
Jim Chapman Lake (Cooper Lake)	Sulphur	19,280	3,662	19
Coffee Mill	Red	650	57	9
Davy Crockett	Red	355	160	45
Big Creek	Sulphur	520	213	41
Sulphur Springs	Sulphur	1,766	327	19
Average	**--**	**4,219**	**694**	**16**

Source: http://www.tpwd.state.tx.us/publications/pwdpubs/lake_survey/index.phtml

Based on these data it appears that, on average, approximately 16% of the total surface area of the lakes/reservoirs surveyed develop submerged, emergent, or floating leaved (or a combination of) vegetation within the littoral zone. If similar conditions were to develop at the proposed Lower Bois d'Arc Creek Reservoir site (conservation pool elevation is approximately 16,641 acres), this would equate to approximately 2,663 acres (16% of 16,641 acres) of littoral zone wetland development. However, a more conservative approach, and one that would likely have a greater probability for development, has been taken by using the reservoir area between elevations 531-534 ft. msl. Using this range of elevations, it is anticipated that approximately 1,402 acres (slightly more than eight percent of the total surface area) of littoral zone wetlands would develop around the proposed reservoir site. These areas would be owned and controlled by the NTMWD. The NTMWD is purchasing lands (fee simple) up to elevation 541 ft. msl. and placing flowage easements on lands up to elevation 545 ft. msl. The NTMWD could provide additional protections of these littoral zone wetlands through such measures as:

- Working with Fannin County to restrict development and construction below elevation 545 ft. msl.;
- Preparing a "Shoreline Habitat Plan"; or
- Requiring that the shoreline be maintained in a natural condition up to elevation 541 ft. msl.

In addition to the 1,402 acres of littoral wetlands, the proposed reservoir would provide on-site compensatory mitigation for impacts to open waters (ponds, stock tanks, small lakes, etc.) within the proposed reservoir site. The reservoir will provide over 15,000 acres of open waters, in addition to the area expected to develop into littoral wetlands. Other on-site mitigation would be provided through protection and enhancement of the contributing streams (approximately 89,465 linear feet) in the areas designated as potential for establishing fringe or littoral wetlands as shown on Figure 3. The NTMWD is purchasing land up to elevation 541 ft. msl. around the lake as the flood pool. Tributaries to the proposed Lower Bois d'Arc Creek Reservoir that are above the conservation pool but flow within land owned by the NTMWD would be protected through conservation easements. On-site stream mitigation is discussed further in the Determination of Credits section.

4.2.2. Near-Site Mitigation

The NTMWD considered a number of factors in selecting their near-site mitigation area. Chief among those factors was distance from the impact site and location within the watershed. The NTMWD began this process using a GIS-based desktop analysis attempting to identify potential mitigation sites downstream of the proposed reservoir site and within the Bois d'Arc Creek watershed. Data sources used to identify and assess site conditions included:

- Listings of real estate for sale in Fannin County;
- Historical and current aerial imagery to account for past and present land uses;
- USFWS National Wetlands Inventory (NWI) data;
- U.S. Geological Survey (USGS) National Hydrography Dataset; and
- USDA National Resource Conservation Service (NRCS) Soil Survey Geography Database (SSURGO).

Additional landscape features that were taken into consideration during preliminary site screening included overall size of the site, connectivity or adjacency to other water features, surrounding land use, and potential for ecological uplift. Specific consideration was given to the Proclamation Boundary for the Caddo National Grasslands, which is located immediately downstream of the reservoir project.

These investigations eventually led to the identification of the approximately 15,000-acre Riverby Land and Cattle Company, LLC property (Riverby Ranch) located downstream of the proposed reservoir site (Figures 1 and 5). This property was listed for sale in 2009, which met NTMWD's objective to only purchase mitigation lands from willing sellers. Once identified, conditions of the site were further evaluated by biologists and environmental scientists during a site reconnaissance performed in July of 2009. The purpose of the site reconnaissance was to verify that the site was ecologically suitable to provide mitigation for impacts to aquatic resources that could result from construction of the proposed Lower Bois d'Arc Creek Reservoir. The factors considered and conclusions drawn from this evaluation are summarized in Table 4-2.

Table 4-2 Factors Considered and Conclusions Reached During the Evaluation of the Riverby Ranch as a Proposed Mitigation Site.

Factors Evaluated	Conclusions
Hydrological Conditions	• The ranch is located within the Bois d'Arc Creek and Red River Watersheds • Hydrology has been drastically altered due to agricultural practices providing an opportunity for restoration • Many of the streams located on the ranch originate there, reducing the risk of potential upstream uses that would be non-compatible with mitigation efforts
Soil Characteristics	• Mitigation site contains nearly 7,300 acres of soils classified as hydric
Aquatic Habitat Diversity	• Mitigation site contains ephemeral, intermittent, and perennial streams, as well as forested, shrub, and emergent wetlands
Habitat Connectivity	• Mitigation site provides habitat connectivity to the Caddo National Grasslands to the south • Mitigation site provides connectivity to adjacent lands protected in perpetuity through the NRCS Wetlands Reserve Program
Size and Location of the Site	• Mitigation site is nearby and proximal to the impact site • Mitigation site is downstream of impact site • Mitigation site is one large, contiguous property (approximately 15,000 ac.), being similar in size to the impact site
Availability of Water	• Ranch comes with over 9,000 ac/ft of existing water rights and irrigation infrastructure, providing an excellent opportunity to increase mitigation success during initial phases of the planting plan

Factors Evaluated	Conclusions
	• Water rights transfer with purchase of the property
Compatibility with Adjacent Land Uses	• Mitigation site is adjacent to lands enrolled in the Wetlands Reserve Program (WRP) • Mitigation site is adjacent to the Caddo National Grasslands, managed by the USFS • The Red River constitutes the entire northern boundary of the mitigation site
Reasonably Foreseeable Effects of Mitigation Project on Aquatic and Terrestrial Resources	• A majority of the soils located on the mitigation site have a potential for forested climax plant communities; under current use, most of these soils have been converted to cropland and grassland for agricultural purposes making it ideal for forested wetland/riparian woodland restoration • Approximately 8.5 miles of potential habitat for the endangered least tern is located along the Red River, which borders the mitigation site to the north

Following the determination that the site was ecologically suitable for mitigation, NTMWD moved forward with its mitigation strategy by acquiring the Riverby Ranch in February 2010. In August of 2010, state and federal resource agencies, as well as The Nature Conservancy, were invited to participate in a multi-agency tour of the proposed mitigation site.

5.0 BASELINE CONDITION OF MITIGATION SITE

5.1 SITE DESCRIPTION

The proposed mitigation site is located in the northeast corner of Fannin County, Texas, near the confluence of Bois d'Arc Creek and the Red River. A small portion of the ranch also lies within the northwestern corner of Lamar County, Texas. The project site is generally bound by the Red River to the north, the Fannin/Lamar County line to the east, the Caddo National Grasslands to the south, and County Road 2155 to the west (Figure 6). The ranch is approximately 15,000 acres in size with approximately 2,700 acres that are currently enrolled in the NRCS Wetlands Reserve Program (WRP) (Figure 6).

Ecologically, the proposed mitigation site is located in the Post Oak Savannah Ecological Region of Texas (Gould et. al., 1960). The original plant community associated with the Post Oak Savannah Ecological Region was savannah dominated by native bunch grasses and forbs with scattered clumps of trees, primarily post oaks. Forested areas were mostly limited to hardwood bottomlands along major rivers and creeks, or in areas protected from fire (TPWD, 2007).

While the NTMWD owns the Riverby Ranch property, it is leased to the former owner until such time as the property is needed for the proposed mitigation. Current land use on the Riverby Ranch is intensive agriculture, primarily geared toward crop and cattle production. There are approximately 3,000 acres under pivot irrigation used for the production of wheat, oats, and corn; approximately 2,700 acres are either tilled or no-tilled with wheat, oats, and perennial rye for winter grazing; approximately 4,300 acres of mixed bermuda/native pasture and 2,000 acres of coastal/common bermuda are used for grazing; and nearly 2,700 acres are enrolled in the WRP. Most of the ranch is grazed at some point during the year by cattle whose numbers range between 3,500 and 8,000 head.

5.2 EXISTING HYDROLOGY

The proposed mitigation site is located within the Bois d'Arc Creek and Red River watersheds (Figure 1). In general, streams on the west side of the proposed mitigation site flow directly into the Red River and streams on the east side of the mitigation site flow into Bois d'Arc Creek, and then to the Red River. Many of the streams originate within the proposed mitigation site and are ephemeral or intermittent in nature. Additionally, the streams are characterized by channelization to expedite runoff for the ranch's ongoing agricultural operations. Many of these streams have had their riparian corridors (buffers) cleared to plant crops or non-native grasses to increase the grazing area on the ranch.

5.3 EXISTING VEGETATION

The location and distribution of vegetative cover types within the proposed mitigation site are depicted in Figure 7. Following are descriptions of the typical vegetative species that occur within each wetland cover type.

5.3.1. Emergent Wetland

Emergent wetlands at the proposed mitigation site are degraded due to current agricultural activities such as grazing and crop production. These wetlands are dominated by an herbaceous layer made up of wetland obligates such as rushes, sedges, smartweed, arrowhead and spikerush. Other species include barnyardgrass, flatsedge, water primrose, dock, and buttercup.

5.3.2. Shrub Wetland

Shrub wetlands at the proposed mitigation site were only found below the first terrace of the Red River floodplain. The shrub layer is dominated by small trees such as black willow, sandbar willow, and salt cedar, as well as species such as honey locust and baccharis.

5.3.3. Riparian Woodland/Bottomland Hardwood Forest (Forested Wetland)

The riparian woodland / bottomland hardwood (forested wetland) cover type at the proposed mitigation site includes the predominantly deciduous forests of riparian zones and wetlands, and is associated with the floodplains of local creeks, including the Red River.

Dominant trees include black willow, boxelder, green ash, sugarberry, and cedar elm. Dominant shrubs are often small trees of the species listed above, as well as honey locust, poison ivy, coralberry, buttonbush, and Virginia creeper. Common herbaceous plants in the bottomland hardwood forest include Cherokee sedge, ragweed, and Virginia wildrye.

5.4 EXISTING SOILS

Soils located within the proposed mitigation site are presented in Table 5-1. The locations of soils listed on the NRCS National List of Hydric Soils are depicted on Figure 8. Descriptions of the soils can be obtained from the NRCS Soil Survey of Fannin County, Texas (2001).

5.5 EXISTING WILDLIFE USAGE

5.5.1. Emergent Wetland

Many species of birds were found in the emergent wetlands, including the northern harrier, red-tailed hawk, American crow, greater white-fronted goose, Canada goose, plentiful dabbling and diving ducks, great blue heron, and great egret. Other wildlife resident in the areas include several mammals, such as raccoon, beaver, feral hog, and white-tailed deer; aquatic species including frogs, mosquitofish, crayfish, and mussels; and plentiful flying insects such as butterflies, bees and dragonflies.

5.5.2. Shrub Wetland

Birds observed in the shrub wetlands were primarily the same species observed in the emergent wetland cover type of the proposed mitigation site. Evidence of mammalian residents includes tracks of the raccoon, white-tailed deer, and bite marks of beaver. The cottonmouth water moccasin and copperhead were also observed in the shrub wetlands.

Table 5-1 Soils Identified on the Riverby Ranch, their Hydric Rating, and Prime Farmland Classification Status.

Map Unit Name	Hydric	Prime Farmland
Belk clay, rarely flooded	No	Yes
Dela loam, frequently flooded	No	No
Dela loam, occasionally flooded	No	Yes
Derly silt loam, 0 to 1 percent slopes	Yes	No
Derly-Raino complex, 0 to 1 percent slopes	Yes	No
Freestone-Hicota complex, 0 to 2 percent slopes	Yes	Yes
Ivanhoe silt loam, 0 to 1 percent slopes	Yes	No
Karma loam, 0 to 2 percent slopes	Yes	Yes
Karma loam, 5 to 12 percent slopes, eroded	No	No
Larton loamy fine sand, 0 to 2 percent slopes	No	No
Morse clay, 5 to 12 percent slopes, eroded	No	No
Muldrow clay loam, rarely flooded	Yes	No
Norwood silt loam, rarely flooded	No	Yes
Okay loam, 0 to 1 percent slopes	No	Yes
Oklared-Kiomatia complex, occasionally flooded	No	No
Redlake clay, rarely flooded	No	Yes
Severn silt loam, rarely flooded	No	Yes
Tinn clay, frequently flooded	Yes	No
Tinn clay, occasionally flooded	No	Yes
Waskom silt loam, 0 to 1 percent slopes	Yes	Yes
Whakana very fine sandy loam, 1 to 3 percent slopes	No	Yes
Whakana very fine sandy loam, 5 to 12 percent slopes	Yes	No

5.5.3. Forested Wetland

Common avian species observed in this cover type include the indigo bunting, white-eyed vireo, yellow-billed cuckoo, American crow, Carolina wren, tufted titmouse, barred owl, egrets, Carolina chickadee, and northern cardinal. Evidence of mammalian residents included raccoon tracks, hog tracks, white-tailed deer tracks, and beaver chew marks on trees. Reptiles such as the cottonmouth water moccasin and copperhead were also found in these forests, as were numerous invertebrate species, including crayfish and land snails.

5.6 WILDLIFE HABITAT VALUE

The wildlife habitat value of the approximately 15,000-acre area that will become the mitigation site for the proposed Lower Bois d'Arc Creek Reservoir project was also estimated using the HEP procedures. The process was conducted by personnel from the same state and federal resource agencies that participated in the HEP study completed at the proposed reservoir site. Additionally, the same HEP species models were used within the same cover types to estimate habitat value. Using the same procedures to estimate wildlife habitat value for the impact site and mitigation site allows for a consistent comparison of impacts to mitigation as well as a more accurate estimate of potential ecological uplift expected at the mitigation site.

The proposed mitigation site was subdivided into the following seven cover types: Upland Deciduous Forest, Cropland, Grassland / Old Field, Riparian Woodland / Bottomland Hardwood Forest (Forested Wetland), Shrubland, Shrub Wetland, and Emergent / Herbaceous Wetland. Tree Savanna and Evergreen Forest cover types, which were identified at the project site, were not present at the mitigation site.

During an interagency HEP meeting (August 2010) held prior to collecting HEP data at the mitigation site, it was proposed and agreed to that preservation of the existing shrub wetland areas would likely be the best mitigation approach for this cover type. This conclusion was reached based on the fact that the existing shrub wetland areas at the proposed mitigation site are located adjacent to the Red River and are susceptible to overbanking conditions. Because of these factors, implementing mitigation actions such as shrub plantings, control of invasive species, etc. within the existing shrubland areas would have a low likelihood of success. As such, it was concluded that collecting HEP data within this cover type would not be necessary.

The habitat quality within each delineated cover type (excluding shrub wetland as discussed above) was evaluated in relation to the habitat requirements of one or more of the following sixteen evaluation species selected by the interagency HEP team: the American kestrel, barred owl, brown thrasher, Carolina chickadee, downy woodpecker, eastern cottontail, eastern meadowlark, eastern turkey, field sparrow, fox squirrel, green heron, raccoon, racer, scissor-tailed flycatcher, swamp rabbit, and the wood duck.

The habitat quality, expressed in HSI, of wetland cover types for each evaluation species is presented in Table 5-2. The overall HSI value for the cover types was calculated as the arithmetic mean of the HSI values for all the evaluation species for that cover type. Baseline Habitat Units (HUs) were calculated for each cover type at the proposed mitigation site by multiplying the average cover type HSI values by the acres in each cover type, as presented in Table 5-3.

Table 5-2 Habitat Suitability Indices for Wetland Cover Types at the Proposed Riverby Ranch Mitigation Site.

Evaluation Species	Cover Types	
	Riparian Woodland / Bottomland Hardwood	Emergent / Herbaceous Wetland
Barred owl	0.32	--
Downy wood-pecker	0.58	--
Fox squirrel	0.25	--
Green heron	--	0.54
Raccoon	0.44	0.14
Wood duck	0.09	0.00
Average HSI Values	**0.34**	**0.23**

Table 5-3 Baseline Habitat Units by Wetland Cover Type at the Proposed Riverby Ranch Mitigation Site.

Cover Type	Average HSI Values	Area (acres)	Habitat Units (HUs)
Riparian Woodland / Bottomland Hardwood (Forested Wetland)	0.34	452	**153.7**
Shrub Wetland	--	98	--
Emergent / Herbaceous Wetland	0.23	1,377	**316.7**
TOTAL		**1,927**	**470.4**

5.7 STREAM ASSESSMENT

In June 2014, FNI completed field investigations to establish baseline stream conditions at the proposed mitigation site using the RGA method. Using the same method to evaluate stream conditions for the impact site and mitigation site allows for a consistent comparison of impacts to mitigation as well as a quantitative estimate of potential ecological uplift expected to occur at the mitigation site.

During the RGA study of Riverby Ranch, 36 data collection points were evaluated to quantify characteristics of the existing streams on the ranch outside the WRP area. The streams were each given a unique identifier/name and were divided into reaches based on morphological characteristics, cover types, stream order, tributary confluences, and field point RGA score. For each data collection point, six stream characteristics (evidence of bank erosion, bank root zone, vegetative bank cover, bank angle, sediment transport, and channel alteration) were assessed, scored, and then summed to calculate a final RGA score ranging between zero and 60. These RGA scores were then normalized by dividing by 60 producing a Stream Quality Factor (SQF) ranging between zero and one, where zero represents poorest stream conditions and one represents optimum stream conditions. The calculated SQF score for a particular study reach was then multiplied by its length to calculate Stream Quality Units (SQUs) provided by that reach. This process was repeated for all study reaches within the proposed mitigation site to establish baseline SQUs. A summary of the existing stream length by stream quality factor intervals is shown in Table 5-4. The total baseline SQU value for streams on the Riverby Ranch (excluding streams within the WRP area), defined as the sum of the SQUs for each reach, was calculated to be 64,140. The existing SQUs for the tributaries within the WRP total 28,561. However, it should be noted that the District is not claiming compensatory mitigation credit for streams within the WRP at this time, even though it is apparent that improvements to watersheds and stream reaches upstream of the WRP area would have a beneficial effect on reaches within the WRP. A discussion of the RGA methodology is in the Technical Memorandum for the *Proposed Mitigation for Stream Impacts of the Proposed Lower Bois d'Arc Creek Reservoir – Rapid Geomorphic Assessment* (Freese and Nichols, 2014).

Table 5-4 Summary of the Baseline Conditions for Streams at the Mitigation Site

SQF	Riverby Ranch, Excluding WRP		Tributaries within the WRP Area	
	Existing Length (ft)	SQU	Existing Length (ft)	SQU
0 - .09	8,507	457	7,649	382
.1 - .19	26,966	4,253	888	163
.2 - .29	47,790	10,764	0	0
.3 - .39	14,086	4,991	16,026	5,342
.4 - .49	37,838	17,395	19,621	9,075
.5 - .59	29,393	15,818	23,313	13,599
.6 - .69	10,905	7,239	0	0
.7 - .79	0	0	0	0
.8 - .89	3,868	3,223	0	0
.9 - .99	0	0	0	0
1.0	0	0	0	0
Total	**179,353**	**64,140**	**67,496**	**28,561**

5.8 WATERS OF THE UNITED STATES

A total of 470.4 HUs (1,829 acres) of forested and emergent wetlands, 98 acres of shrub wetland, 34 acres of open waters (ponds, stock tanks, etc.), and 64,140 SQUs for streams (approximately 179,353 linear feet) were identified at the proposed mitigation site (Table 5-3 and 5-5). (Note: The lengths of the streams contained within the WRP area of the proposed mitigation site are not included in the stream length total). The location and boundaries of waters of the U.S. at the site were delineated by FNI as described in the JD Report prepared for the proposed mitigation site (Freese and Nichols, July 2011).

Table 5-5 Types, Lengths, and Acreages of Potential Waters of the U.S. Identified within the Proposed Riverby Ranch Mitigation Site.

Category	Length (feet)	SQU	Area (acres)
Streams			
Perennial	25,078	5,377	--
Intermittent	47,605	14,361	--
Ephemeral	106,670	44,402	
Open Waters			
Ponds, Stock Tanks, Small Lakes	--		34
Wetlands			1,927
TOTAL	**179,353**	**64,140**	**1,961**

6.0 MITIGATION WORK PLAN

The purpose of the mitigation work plan is to describe the type of work that would be conducted at the proposed mitigation site as part of the overall mitigation project. This mitigation work plan was developed with the intent of achieving ecological uplift by improving aquatic habitat value for the many species of wildlife that are native to this area of Texas. The attainment of ecological uplift and improvement in habitat value for wildlife was evaluated utilizing the HEP procedures. For this work plan, multiple data sources were used to identify potential sites for enhancement and restoration including:

- United States Geological Survey (USGS) 7.5' topographic maps;
- 2010 one-foot LiDAR survey data;
- USGS National Hydrography Dataset (NHD);
- Natural Resources Conservation Service (NRCS) Soil Survey Geographic Database (SSURGO);
- Historical 1950 and 1969 aerial photographs;
- 1996 and 2007 color infrared imagery; and
- 2010 true color imagery.

In addition to these data sources, data collected during field work at the proposed mitigation site for the preliminary jurisdictional determination and the HEP procedures were also used. The plant species selected to restore vegetation within forested wetlands, riparian areas, shrub wetlands, and emergent wetlands associated with this mitigation plan were derived from two primary sources, including the NRCS 2001 Soil Survey of Fannin County, Texas and the USFWS's *National List of Plant Species That Occur in Wetlands: South Plains (Region 6)*. All species selected for restoration are native to this area of Texas and are expected to provide food, shelter, and nesting habitat for a variety of wildlife species, thus providing ecological uplift.

6.1 LOCATION MAP

The location of the impact site and proposed mitigation site are within Fannin County, Texas with a small portion of the mitigation site being located in Lamar County, TX. The mitigation plan is comprised of on-site mitigation located at the proposed reservoir site (impact site) and near-site mitigation located at the Riverby Ranch (mitigation site). The location and boundaries of these sites are depicted on Figure 1. Both sites lie within the same 8-digit Hydrologic Unit Code (HUC) Catalog Unit, HUC11140101.

6.2 TIMING OF MITIGATION ACTIVITIES

According to the Final Mitigation Rule developed by the USACE and USEPA, "implementation of the compensatory mitigation project shall be, to the maximum extent practicable, in advance of or concurrent with the activity causing the authorized impacts" (33 CFR 332.3). Because NTMWD has already purchased the proposed Riverby Ranch mitigation site that is comparable in size and located nearby and proximal to the impact site, NTMWD would be able to satisfy this goal. As part of this mitigation work plan, NTMWD proposes to implement mitigation measures such as securing conservation easements, removing cattle from proposed wetland enhancement and restoration sites, including riparian areas, as well as beginning other activities such as restoring hydrology and implementing the planting plan prior to the start of construction at the proposed reservoir site. These mitigation measures are discussed in more detail in the following paragraphs.

6.3 SOURCES OF WATER

Hydrology would be the foundation of this mitigation plan. Successful establishment of wetland hydrology would improve the likelihood of success for the establishment of wetland vegetation and, over time, ecological uplift as measured by wildlife habitat value.

Sustainable sources of water for this mitigation site would be provided by naturally occurring sources such as precipitation, normal stream flow, flood events, overland flow, surface water storage, and ground-water discharge. The goal is to avoid, to the extent practicable, the need to rely on artificial water sources such as the pumping of water and sources that would require ongoing maintenance and/or active management practices. A number of conditions that currently exist at the proposed mitigation site indicate that this goal is feasible.

One factor, as evidenced from aerial photographs and site reconnaissance, is that the existing hydrology of the ranch has been altered to maximize the area utilized for ongoing agricultural activities. Wetlands have been ditched and converted to agricultural land and stream channels have been straightened to expedite land drainage following rain events. These historical alterations now provide opportunities for the restoration of hydrology, and ultimately, the restoration of wetlands and streams. Although it would vary from site-to-site, simple measures such as site grading, placement of berms, or plugging of drainage ditches could be used to restore the hydrology. A conceptual depiction of these activities can be seen on Figure 9.

Another factor is the presence of approximately 7,300 acres of soils that are currently listed on the National List of Hydric Soils of the United States (Figure 8). Hydric soils are those soils that are sufficiently wet in the upper part to develop anaerobic conditions during the growing season. The presence of these types of soils suggests that they have the capability to hold water or stay saturated for a sufficient duration to develop or support a prevalence of vegetation typically adapted for life in saturated soil conditions. Currently, most of these soils are being utilized for cropland or grassland production on the ranch. These soils would be specifically targeted for the restoration of hydrology and wetlands.

An additional factor indicating that the proposed mitigation site can be developed without relying upon artificial sources of hydrology is the amount of precipitation the area receives. According to the 2001 Soil Survey of Fannin County, Texas, the total annual precipitation for Fannin County averages 44 inches. More than half of this amount, 25 inches, falls between April and September, which coincides with the growing season. The remaining precipitation falls during the dormant season which allows for soil moisture recharge and refilling of surface depressions.

This mitigation plan would take advantage of these conditions to develop a long-term sustainable source of water by:

- Restoring hydrology to sites that have been ditched or drained by filling, plugging, restoring stream meanders, and re-grading surface contours to increase surface water storage and slowing runoff;
- Focusing wetland restoration efforts on areas with hydric soils; and
- Re-grading surface contours to capture precipitation, flows from flood events, and overland flows to increase surface water storage on the mitigation site.

If necessary, during the early phases of this mitigation plan when establishment of vegetation is most difficult, NTMWD could utilize the existing irrigation system to increase survival rates of planted trees, shrubs, etc. However, the goal would be to develop a self-sustaining mitigation site that would not require artificial sources of water.

6.4 PLANTING PLAN FOR FORESTED WETLAND AND RIPARIAN CORRIDOR RESTORATION SITES

The following list of species would be used as a guide for the selection of species based upon site conditions (as they would likely vary from site-to-site) as well as commercial availability. Tree species identified in Table 6-1 are hard and soft mast producing trees native to this area of Texas. This mixture of hard and soft mast producing tree species is expected to provide food, shelter, and nesting habitat for a variety of wildlife species, thus providing ecological uplift. Areas identified for forested wetland and riparian corridor restoration where these species would be planted are depicted in Figure 10.

The suggested planting density or planting rate for the tree species identified in Table 6-1 would be 370 trees per acre with 80 percent being bare root seedlings and 20 percent being five gallon containerized trees, with no single species constituting greater than 40 percent of the individuals (nor less than 10 percent) being planted per acre with a minimum of five different species per acre. In addition to tree species, shrub species native to the area (Table 6-2) would also be planted at a rate of 16 plants per acre.

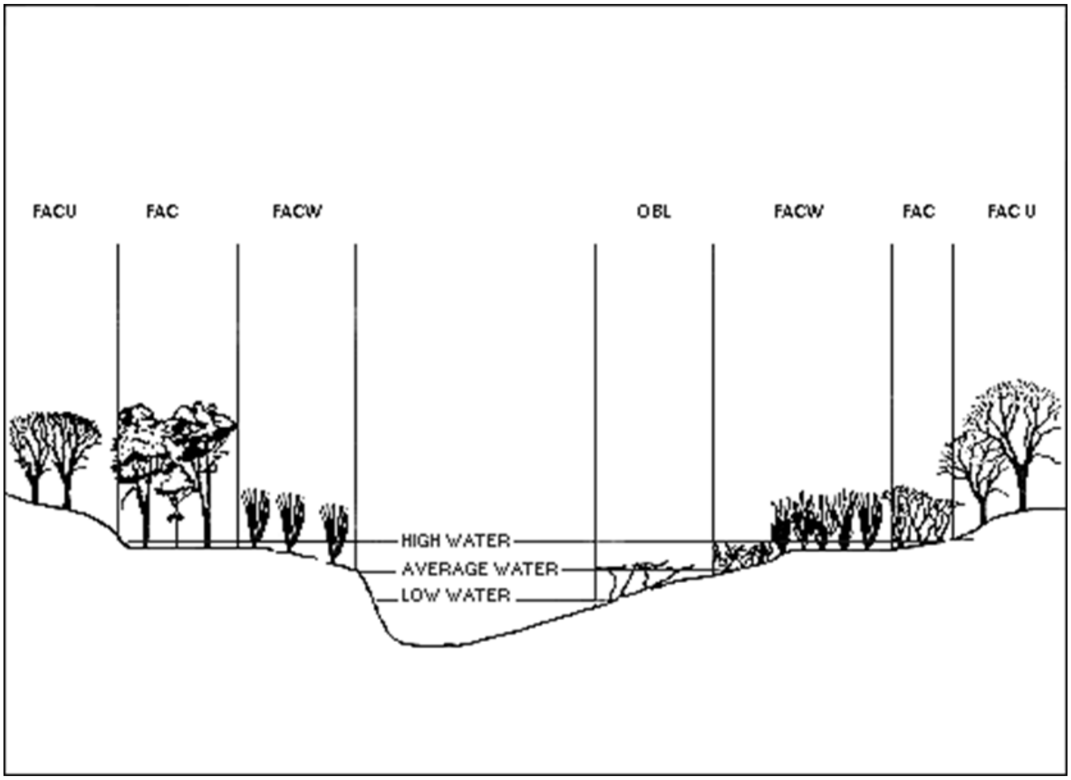
Table 6-1 Tree Species List for Forested Wetland and Riparian Area Restoration.

Common Name	Scientific Name	Region 6 Wetland Indicator Status
Bur Oak	*Quercus macrocarpa*	FACU
Shumard Oak	*Quercus shumardii*	FAC
Water Oak	*Quercus nigra*	FAC
Willow Oak	*Quercos phellos*	FACW
Overcup Oak	*Quercus lyrata*	OBL
Chinkapin Oak	*Quercus muhlenbergii*	FAC
Pecan	*Carya illinoensis*	FAC
Water Hickory	*Carya aquatica*	OBL
Black Walnut	*Juglans nigra*	FACU
Green Ash	*Fraxinus pennsylvanica*	FAC
American Sycamore	*Platanus occidentalis*	FAC
Eastern Cottonwood	*Populus deltoides*	FAC

Table 6-2 Shrub Species List for Forested Wetland and Riparian Area Restoration.

Common Name	Scientific Name	Region 6 Wetland Indicator Status
Deciduous Holly	*Ilex decidua*	FAC
American Beautyberry	*Callicarpa americana*	FACU
Swamp Privet	*Forestiera acuminata*	OBL
Buttonbush	*Cephalanthus occidentalis*	OBL
Coralberry	*Symphoricarpos orbiculatus*	FACU
Hydrolea	*Hydrolea ovata*	OBL

Prior to and during planting, additional consideration would be given to the location each species is planted within a restored forested wetland or riparian area. In Tables 6-1 and 6-2, each species is assigned an indicator status. Species listed as Obligate Wetland (OBL) occur almost always under natural conditions in wetlands (estimated probability >99%). Facultative Wetland (FACW) plants usually occur in wetlands (estimated probability 67%-99%), but are occasionally found in non-wetlands. Facultative (FAC) plants are equally likely to occur in wetlands or non-wetlands (estimated probability 34%-66%). Facultative Upland (FACU) plants usually occur in non-wetlands (estimated probability 67%-99%), but are occasionally found in wetlands (estimated probability 1%-33%). Graphic 1 depicts the proposed planting locations of tree and shrub species based on their Region 6 Wetland Indicator Status.



Graphic 1 Proposed Planting Locations for Tree and Shrub Species within a Restored Forested Wetland Site.
(Source:http://www.swf.usace.army.mil/pubdata/environ/regulatory/permitting/plantdata/index.asp)

6.5 PLANTING PLAN FOR EMERGENT WETLAND RESTORATION

The species located in Table 6-3 would be used as a guide for the selection of species based upon site conditions (as they would likely vary from site-to-site) as well as commercial availability. Following the establishment of hydrology, these species would be planted as a mixture (broadcast seeded and/or plugs) within the restored emergent wetland areas at a rate recommended by the supplier. Areas identified for emergent wetland restoration where these species would be planted are depicted in Figure 10.

Table 6-3 Species List for Emergent Wetland Restoration.

Common Name	Scientific Name	Region 6 Wetland Indicator Status
Bushy Bluestem	*Andropogon glomeratus*	FACW
Green Flatsedge	*Cyperus virens*	FACW
Eared Redstem	*Ammannia auriculata*	OBL
Grassleaf Rush	*Juncus marginatus*	FACW
Mockbishop Weed	*Ptilimnium nuttalli*	FACW
Water Lily	*Nymphaea odorata*	OBL
Arrowhead	*Sagittaria latifolia*	OBL
Inland Saltgrass	*Distichlis spicata*	FACW
Switchgrass	*Panicum virgatum*	FAC
Pennsylvania Smartweed	*Polygonum pensylvanicum*	FACW
Buttercup	*Ranunculus abortivus*	FAC
Horned Beakrush	*Rhynchospora corniculata*	OBL
Slimpod Rush	*Juncus diffusissimus*	FACW
Flatstem Spikerush	*Eleocharis compressa*	FACW

Due to the presence of existing emergent wetland vegetation and seed banks, no plant list or planting plan has been developed for existing emergent wetland sites that will be enhanced at the proposed mitigation site or in the littoral wetland areas that would develop within the proposed reservoir site. Photograph 6-1 depicts typical emergent wetland vegetation observed at the proposed mitigation site. If monitoring indicates that performance standards are not being met, the problem will be identified and corrective actions taken. These actions may include supplemental planting using the planting plan for restored emergent wetland sites (Table 6-3), change of species because of some unknown site conditions, and predator or pest control measures.

The littoral wetland areas at the proposed reservoir would be inundated within the normal conservation pool. At depths less than three to four feet the emergent wetlands would continue to exist and function as wetlands. If fluctuating water levels or other causes prevent this expected wetland development, then actions would be taken to facilitate wetland plant establishment and development as part of the adaptive management plan.

Photograph 6-1 Typical emergent wetland vegetation at the proposed Riverby Ranch mitigation site.

6.6 PLANTING PLAN FOR SHRUB WETLAND RESTORATION

The species located in Table 6-4 would be used as a guide for the selection of species based upon site conditions (as they would likely vary from site-to-site) as well as commercial availability. Areas identified for shrub wetland restoration where these species would be planted are depicted in Figure 10.

The suggested planting density or planting rate for the shrub species identified in Table 6-4 would be 370 shrubs per acre with 80 percent being bare root seedlings and 20 percent being three gallon containerized, with no single species constituting greater than 40 percent (nor less than 10 percent) of the individuals being planted per acre with a minimum of five different species per acre.

Table 6-4 Shrub Species List for Shrub Wetland Restoration.

Common Name	Scientific Name	Region 6 Wetland Indicator Status
Deciduous Holly	*Ilex decidua*	FAC
American Beautyberry	*Calicarpa americana*	FACU
Swamp Privet	*Forestiera acuminata*	OBL
Buttonbush	*Cephalanthus occidentalis*	OBL
Coralberry	*Symphoricarpos orbiculatus*	FACU
Hydrolea	*Hydrolea ovata*	OBL

6.7 INVASIVE AND NON-NATIVE SPECIES CONTROL

During monitoring events, particularly during the early stages of plant establishment, assessments would be made to identify areas where invasive and non-native species pose a potential threat to the success of the proposed mitigation. Invasive and non-native plant species control would include control of competing vegetation such as volunteer herbaceous and woody species. Only herbicides that are specifically labeled for aquatic applications would be used. If it is determined that mechanical means of controlling these species is feasible, these methods would also be considered.

Assessments would also be made during monitoring events to assess herbivory threats. Measures for controlling herbivory could include the use of tree tubes, fencing, nurse crops, trapping, hunting, chemical deterrents, attracting predators, etc. These proposed mitigation measures would be utilized in all areas identified for mitigation.

6.8 GRADING PLAN / CONSTRUCTION METHODS

NTMWD completed an aerial and LiDAR survey of the proposed mitigation site in 2010 and has obtained one-foot contours for the entire proposed mitigation site. This information will be used to develop a proposed grading plan for the restoration of wetland areas and streams at the proposed mitigation site. Wetland restoration sites would not be graded completely flat or level, but would incorporate pit-and-mound microtopography to mimic natural wetland areas, thereby increasing surface water storage and providing for greater habitat diversity for flora and fauna. Streams would be graded to create meanders and provide stable stream banks to control erosion. Upland areas would grade gently into mitigation sites utilizing gentle side slopes. Specific design features would guide implementation but some flexibility in grading may be needed in order to adapt to actual field conditions. Passive water control structures utilizing natural materials such as earth and rock would be used, where feasible, instead of structures requiring management and maintenance. A conceptual map (Figure 9) shows potential locations for some of these structures.

It is anticipated that excess overburden material could be generated during construction of the proposed mitigation plan. Although exact locations and methods of how this material would be incorporated into design of the mitigation features are not known at this time, it is anticipated that the material will be used on-site. It is expected that some of the overburden material will be needed to establish designed topography across the mitigation site. Other possible uses for the material could include creation of berms, terraces, and other features that may be necessary to restore or establish hydrology in proposed wetland areas. Incorporating excess material into the design of the proposed mitigation plan would also avoid the need to identify an off-site disposal area as well as reduce construction costs that would be incurred to haul the material away. As final design of the mitigation plan continues, and it is determined that excess material would be generated, adaptive management may be needed.

6.9 SOIL PREPARATION AND MANAGEMENT

Prior to implementation of the planting plan in forested wetland and riparian restoration areas, a routine analysis of the existing soils would be conducted to determine the soil pH, sodium absorption ratio (SAR), and levels of the primary nutrients (N – Nitrogen, P - phosphorus, K - potassium, Ca - calcium, Mg - magnesium, Na - sodium, and S - sulfur) available to plants. If it is determined that amendments are required, they would be applied as needed over the site and the site surface would be tilled with a chisel-plow or heavy disk to loosen the soil and reduce compaction. This would also mix the organics in the surface horizon to promote establishment of vegetation on the site.

In wetland and riparian restoration areas where site preparation could involve the excavation of the A and/or B-horizons (or, if over-excavation is required), the topsoil would be stockpiled and then spread back over the site following excavation or used in other restored wetland sites. This would reduce the need for additional soil amendments and would likely provide for a natural seed source of wetland plants that would help establish vegetation on these sites. If soil compaction is determined to be problematic for the establishment of vegetation, the soil could be ripped or chisel-plowed. Additionally, wide-tracked, low ground pressure equipment would be used on "soft" or moist soils to avoid additional soil compaction. These measures would facilitate the rooting and establishment of woody and herbaceous vegetation in restoration sites. It is likely that each restoration site would require a specific soil management strategy depending on the results of the soil analyses and existing site conditions.

6.10 STREAM RESTORATION

Stream restoration activities at the mitigation site would vary from site-to-site and would include restoration measures such as:

- laying back stream banks to reduce erosion and allow for tree and shrub plantings;
- restoring riparian corridors through tree and shrub plantings;
- removing cattle and protection from livestock grazing;
- plugging and/or diverting drainage ditches;
- restoring meanders to straightened portions of stream channels; and
- improving water quality by reducing sediment, pesticides, herbicides, bacteria, etc. from the actions outlined above.

A conceptual stream restoration plan for the proposed mitigation site is presented in Figure 9. The development of this conceptual plan considered existing drainage contours, meander sinuosity of unaltered streams in the watershed, soils, and existing land cover. During the detailed design phase, more precise stream locations and specific restoration activities will be identified.

6.11 EROSION CONTROL

Best management practices (BMPs), identified in the USACE Tulsa District Aquatic Resource Mitigation and Monitoring Guidelines would be employed throughout the construction phase of the mitigation project to control and reduce impacts to adjacent lands and waters. Mitigation construction would employ the following BMPs:

- erosion control practices employing mulch, composts, excelsior matting, or temporary vegetation for construction-disturbed sites;
- runoff and sedimentation basins or vegetated filter strips where necessary to control transport of sediments to aquatic areas;

- siltation barriers on land (fences and mulch socks) and in water (turbidity curtains);
- minimization of size and duration of temporary activities in aquatic areas;
- storage of fuels and materials shall occur at a location above the existing and intended Ordinary High Water Mark where they cannot be carried into aquatic areas by high flows and should be removed from any likely flood zone prior to predicted flood events;
- all fueling and servicing of vehicles and equipment should be done above the ordinary high water mark;
- if construction uncovers or disturbs any previously unknown historical, archeological, or cultural materials, or human remains, construction activities shall cease in the immediate vicinity of the discovery and the USACE Tulsa District Regulatory Branch shall be immediately contacted for further instruction.

7.0 DETERMINATION OF CREDITS

7.1 UNITS OF MEASURE

The principal unit of measure for credits and debits associated with the impacts and mitigation for wetlands (forested, shrub, and emergent) will be habitat units (HUs) derived from HEP. The principal units of measure for credits and debits associated with streams will be Stream Quality Units (SQUs) derived from the RGA and acres for open waters (ponds, lakes, etc.). A discussion of HEP and RGA, as well as the methods used for determining uplift for habitat units and stream quality units, are included in the following sections.

7.2 ASSESSMENT METHODS

7.2.1. Habitat Evaluation Procedures (HEP)

The Habitat Evaluation Procedures (HEP) is a habitat-based evaluation methodology developed by USFWS in 1974 for use as an analytical tool in impact assessments and project planning. HEP is a species-habitat analysis of the ecological value of a study area; its approach is to quantify the value of habitat available to a selected set of wildlife species within a specified geographic area of interest. The method is designed to describe wildlife habitat values at baseline and future conditions to allow for comparisons of the relative values of different areas at the same point in time or of the same area at different points in time. The HEP methodology also serves as a functional assessment for wetland cover types in that it assesses the functional value of the plant communities within the ecosystem by measuring plant characteristics and their values for fish and wildlife. The use of HEP, in conjunction with hydrologic studies and condition indices determined for fish (IBI scores) and macroinvertebrates (RBA scores), provides a defensible assessment of the functions and habitat values for aquatic mitigation. Since HEP provides a quantitative method for assessing both aquatic and terrestrial cover types, it may be used in planning applications such as the assessment of current and future wildlife habitat, trade-off analyses, or compensation analyses (mitigation).

HEP is used to appraise a study area by quantifying its habitat value, calculated as the product of habitat quantity and habitat quality; this value is expressed in habitat units (HUs). Habitat quantity is simply the total area of habitat available within the study area, usually expressed in number of acres. Habitat quality is expressed in terms of a dimensionless habitat suitability index (HSI), which is determined by comparing the ecological characteristics of the study area to the habitat characteristics that are optimum for evaluation species. The evaluation species are representative wildlife species with known habitat requirements and are selected to provide a basis to assess habitat suitability.

HSI values are based on two components: the habitat characteristics that provide ideal conditions for an evaluation species, and the habitat characteristics existing in the study area. These characteristics are described by a set of measurable habitat variables, such as the height and percent cover of various vegetation types, the distance to water or grain, the availability of perching or nesting sites, or the frequency of flooding. The set of habitat variables needed to determine HSI values are obtained from documented habitat suitability models for each evaluation species. These models describe the species' life requisites (i.e., its habitat requirements for food, cover and reproduction), the relationship between the habitat variables' values and the suitability of the area to meet its life requisites.

The HEP methodology incorporated into this study is recommended by the USFWS as their basic tool for evaluating project impacts and developing mitigation recommendations (USFWS, 1996) and it has been used as a method to evaluate impacts to wildlife habitat for similar projects in Texas. Additionally, Title 30 §297.53 of the Texas Administrative Code (TAC) states that "functions and values for wetland habitats shall be determined on an individual case basis using the most technically appropriate habitat evaluation methodology (e.g., USFWS's Habitat Evaluation Procedures and Wetlands Evaluation Techniques; TPWD's Wildlife Habitat Appraisal Procedure)". An interagency team with representatives from the USFWS, USACE, USEPA, USFS, TPWD, TWDB, TCEQ, NTMWD, and FNI was convened in May 2007 and August 2010 to identify and agree upon the parameters to guide the HEP studies performed at the reservoir (impact) site and at the Riverby Ranch (mitigation site).

7.2.2. Rapid Geomorphic Assessment (RGA)

The RGA method integrates data collected from the field and desktop sources into a quantitative and qualitative description of the features that affect stream stability and the potential for developing aquatic habitat features (Freese and Nichols, 2008). The RGA method is based on a rapid field assessment of stream properties and characteristics at representative sites along stream reaches that are being evaluated. In general, the types of data collected include observations of channel size and location, bank geometry, information describing riparian vegetation and rooting depths, general bank armoring characteristics, as well as conditions of the upper slopes, lower slopes, and channel bed. At each data collection point, six stream characteristics (evidence of bank erosion, bank root zone, vegetative bank cover, bank angle, sediment transport, and channel alteration) are assessed. These data are later scored and then summed to calculate a final RGA score ranging between zero and 60. The RGA scores are then normalized by dividing by 60 producing a Stream Quality Factor (SQF) ranging between zero and one, where zero represents poorest stream conditions and one represents optimum stream conditions. The calculated SQF score for a particular study reach is then multiplied by its length to calculate Stream Quality Units (SQUs) provided by that reach. Based on field observations and stream classifications from the National Hydrography Dataset (NHD), streams were identified as perennial, intermittent, or ephemeral. The calculated SQUs are presented by stream type and mitigation component. This process was utilized at both the proposed reservoir site as well as the proposed mitigation site.

7.3 MITIGATION COMPONENTS

7.3.1. Avoidance and Minimization

This mitigation plan was conceived to compensate for the unavoidable impacts to waters of the U.S. due to the construction of the proposed Lower Bois d'Arc Creek Reservoir project. The NTMWD has followed the USACE required sequencing process whereby (1) impacts to waters of the U.S. were avoided to the extent practicable while addressing the purpose and need for the project, (2) impacts that could not be avoided were minimized to the extent practicable, and (3) mitigation actions were identified in this plan to compensate for the remaining unavoidable but minimized impacts to waters of the U.S.

The NTMWD proposes the following measures to avoid and minimize impacts of the proposed project on the aquatic environment.

1. Avoidance of Wetlands and other Waters of the U.S.

   Reservoir Site. The purpose of the proposed project is to impound water on Bois d'Arc Creek and its tributaries to create a new water supply for the NTMWD. As described in its Section 404 Permit application, the reservoir is one part of the NTMWD's plan to fulfill its obligation to provide water to meet the increasing demands of its service area. Because the reservoir is a water dependent activity designed to optimize the storage and yield of water at the site, avoidance of impacts to waters of the U.S. by inundation within the reservoir footprint is not possible.

Intake Pump Station, Transmission and Treatment Facilities. During the route selection and site layout process for the proposed raw water pipeline, intake pump station, electrical substation, terminal storage reservoir, rail spur, and water treatment plant, all impacts to wetlands were avoided. In addition, all impacts to streams and jurisdictional open waters (ponds, stock tanks, etc.) that would occur as a result of constructing the pipeline would be minimized and considered temporary by restoring pre-construction contours, stabilizing exposed stream banks, and revegetating the area immediately following construction. Consequently, no permanent impacts to waters of the U.S. would occur as a result of constructing these features.

Removal of 14.4 Miles of Proposed Pipeline. The originally proposed project included piping water from Lower Bois d'Arc Creek Reservoir to Pilot Grove Creek upstream of Lake Lavon. NTMWD has since removed 14.4 miles of proposed pipeline and the associated discharge structures proposed to be located on Pilot Grove Creek (Trinity River Basin) from the originally proposed project. This would result in the avoidance of impacts to 23 streams, nine potential wetlands (forested and emergent), and three on-channel ponds (Plummer, 2008). Additionally, this reduces the potential risk of spreading non-native/invasive species from one watershed to another.

2. Minimization of Impacts to Waters of the U.S.

Reservoir Site. The site of the Lower Bois d'Arc Creek dam was selected to minimize impacts to the Caddo National Grasslands, Lake Bonham Dam, and potential flooding in the City of Bonham while maximizing water supply. As part of a 1984 feasibility study for the reservoir (FNI, 1984), different conservation pool elevations were evaluated. The selected conservation pool elevation (534 feet msl) minimizes impacts to waters of the U.S. by establishing the smallest size reservoir that provides optimal water supply at the site.

Land and Flowage Easement Acquisitions at Proposed Reservoir Site. NTMWD is purchasing land from elevation 534 ft. msl. (conservation pool elevation) up to elevation 541 ft. msl., which is the elevation of the emergency spillway (seven feet above the conservation pool). This is approximately 3,324 acres. Flowage easements would be purchased for land from 541 ft. msl. up to elevation 545 ft. msl. Approximately 2,217 acres would be included in the flowage easements. Development restrictions within the flowage easements would help avoid flood damage to habitable structures and minimize the secondary impacts of development (such as degradation of water quality by unauthorized septic systems) adjacent to the reservoir. This would avoid or minimize indirect impacts to approximately 5,541 acres of land contiguous with the conservation pool of the proposed reservoir. NTMWD has not calculated specific credit units for this area or claimed any preservation credits. However, these restrictions would minimize water quality and secondary development impacts.

Water Quality Regulations. NTMWD will cooperate with Fannin County and resource agencies to regulate boating, fishing, hunting and other recreational and commercial activities on and surrounding the proposed Lower Bois d'Arc Creek Reservoir. Legislation was passed in 2011 that allows Fannin County to regulate development in a 5,000-ft buffer area around the lake. NTMWD will cooperate with local agencies and Fannin County to protect water quality through measures addressing erosion, septic tank installations, fuel spills, etc. The County ultimately will be responsible for managing development around the lake, including protection of the lake's water quality.

Instream Flow Regime. The NTMWD proposes to release water from the proposed Lower Bois d'Arc Creek Reservoir for instream flow purposes. These releases would minimize or reduce potential downstream impacts to Bois d'Arc Creek.

7.3.2. Mitigation for Unavoidable Impacts to Waters of the U.S.

Based on the HEP results from the proposed reservoir site, a total of 1,687.5 HUs of forested, shrub, and emergent wetlands would be lost from the construction of Lower Bois d'Arc Creek Reservoir. Additionally, 87 acres of open waters (ponds, stock tanks, etc.) and 229,054 SQUs (651,024 linear feet) of streams would be impacted. Mitigation for impacted waters of the U.S. (i.e., forested wetlands, shrub wetlands, emergent wetlands, streams, and open waters) would be achieved through three primary mitigation components, including (1) the reservoir (on-site mitigation); (2) wetland restoration and enhancement (near-site mitigation); and (3) stream creation, restoration and enhancement (near-site mitigation). A full description of how each mitigation component would provide compensation for unavoidable impacts to waters of the U.S. is presented below, following the discussion of temporal losses.

7.4 TEMPORAL LOSSES

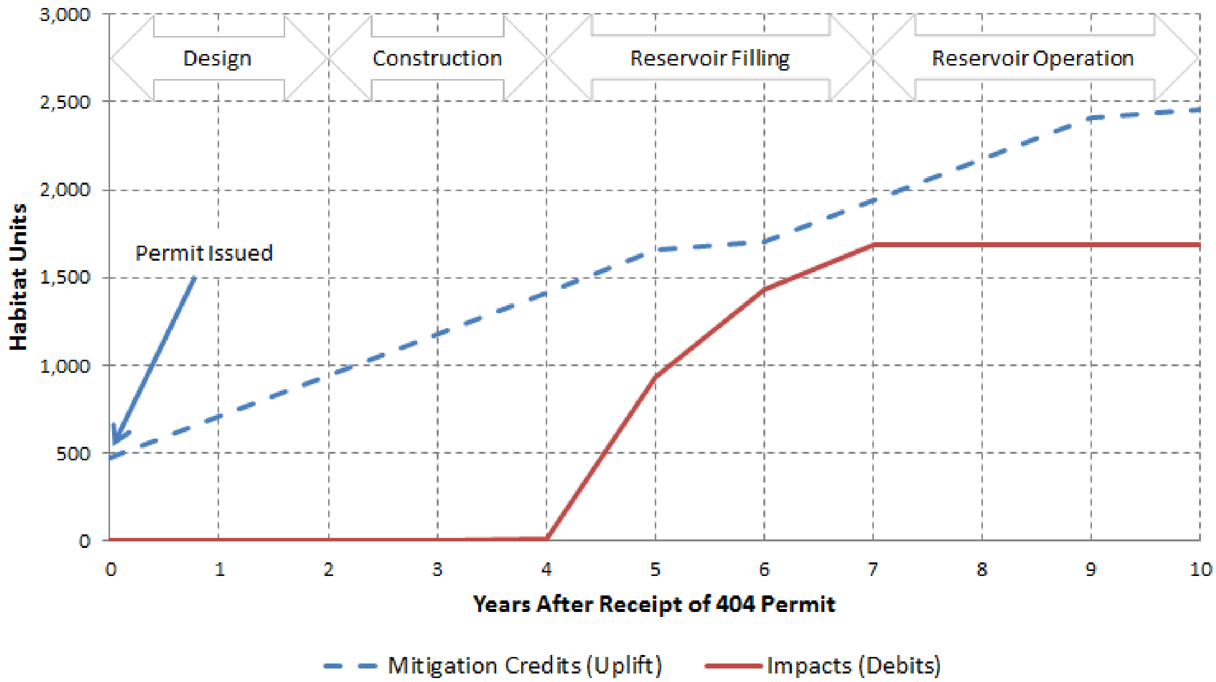
Temporal losses are defined as the time lag between the loss of aquatic resource functions caused by the permitted impacts and the replacement of aquatic resource functions at the compensatory mitigation site. Graphic 2 displays the anticipated impacts to waters of the U.S. in HUs over the first 10 years following issuance of the Section 404 permit versus anticipated uplift from implementing the mitigation plan over the same time period. Table 7-1 shows the anticipated mitigation credits versus impacts over this same time period. To minimize potential temporal losses associated with this project, NTMWD is proposing the following approach.

The NTMWD has already purchased an approximately 15,000-acre mitigation site downstream of the proposed reservoir. Once the Section 404 permit is issued, NTMWD would immediately begin implementing components of the mitigation work plan such as establishing conservation easements, removing cattle, controlling invasive species, grading to establish hydrology, and planting to establish desired vegetation. This would result in immediate uplift and an increase in HUs for emergent, shrub, and forested wetlands at the proposed mitigation site.

Following issuance of the Section 404 permit, NTMWD will have approximately two years during detailed design of the dam and spillways to continue to implement its mitigation work plan. During this time, mitigation measures that have been implemented (i.e., removal of cattle, restored hydrology, planted vegetation, etc.) at the mitigation site will have two years of development and ecological uplift resulting in HU gains prior to any impacts to waters of the U.S. at the proposed reservoir site.

The construction phase of the proposed reservoir project is anticipated to take an additional two years to complete. Construction of the dam and spillways would result in impacts to approximately 12.4 HUs of forested wetlands. These initial impacts would be more than offset through implementation of the mitigation work plan at the proposed mitigation site over this four-year period (two during design and two during construction).

Following construction of the dam and spillways, it is anticipated to take an additional three years for the proposed reservoir to reach its conservation pool elevation of 534 ft. msl. This would result in impacts to the remaining waters of the U.S., but these would be spread out over a three year period based on equal incremental volumes of water being stored each year.



Graphic 2 Anticipated Impacts to Waters of the U.S. vs. Anticipated Uplift.

Table 7-1 Comparison of Mitigation Credits versus Impacts over Time.

Years	0	1	2	3	4	5	6	7	8	9	10
Mitigation Credit (Uplift)	470	707	944	1,181	1,418	1,655	1,703	1,939	2,175	2,411	2,460
Impacts (Debits)	0	0	0	6.2	12.4	934	1,432	1,687	1,687	1,687	1,687

Values are displayed in HUs.

7.5 FORESTED WETLAND MITIGATION

Impacts to forested wetlands at the proposed reservoir site are expected to result in the loss of 1,150.5 HUs. To compensate for these losses, NTMWD is proposing to enhance 452 acres of existing forested wetlands and restore 3,500 acres of existing grassland and cropland sites to their natural state as forested wetlands. The locations of these areas can be seen on Figure 10. Over a 20-year period, the proposed mitigation activities are expected to produce a total of 2,266.1 HUs of forested wetland, resulting in an overall net gain of 1,115.6 HUs above what is expected to be impacted at the proposed reservoir site. The following paragraphs describe the analysis of mitigation benefits.

7.5.1. Habitat Unit Production for Enhancement of Existing Forested Wetlands

Currently, there are 452 acres of existing forested wetlands located at the proposed mitigation site. An analysis of the HEP data collected within this cover type resulted in an overall HSI value of 0.34, which equates to 153.7 HUs (452 ac. X 0.34 HSI = 153.7 HUs) of existing forested wetlands at the mitigation site. This HSI value reflects the current mixture of forested species, maturity, and degradation due to ongoing ranch activities. Through implementing the enhancement actions (i.e., removing cattle, controlling invasives, feral hog control, etc.) and implementing protective measures (i.e., conservation easement) as described in the Mitigation Work Plan section and evaluating the variables contained in the HEP species models, the expected future habitat conditions of the forested wetland cover type were estimated at the 10, 15, and 20-year time intervals. During this evaluation, it was assumed that over time variables such as tree canopy closure, average diameter at breast height (dbh) of trees, number of snags, number of refuge sites, percent of water area covered by logs, trees, limbs or herbaceous vegetation, and basal area of woody stems would generally increase. The results of this analysis indicate that the enhancement of existing forested wetlands at the mitigation site would result in an overall net gain of 131.1 HUs above existing conditions. A summary of this analysis is presented in Table 7-2.

Table 7-2 Habitat Unit Production Expected from the Enhancement of Existing Forested Wetlands.

Year	Acres	Habitat Suitability Index (HSI)	Habitat Units (HUs)	Net Gain (+) of Forested Wetland HUs
Existing Conditions (Year 0)	452	0.34	153.7	0.00
10-Year Future Conditions	452	0.57	257.6	(+)103.9
15-Year Future Conditions	452	0.60	271.2	(+)117.5
20-Year Future Conditions	452	0.63	284.8	(+)131.1

7.5.2. Habitat Unit Production for the Restoration of Forested Wetlands on Existing Cropland and Grassland Sites

Currently, a large portion of the mitigation site is being utilized as cropland and grassland as part of the intensive agricultural operations at the ranch. To maximize use of the property for these operations, many areas have been altered hydrologically, primarily through the practices of ditching and diverting water to drain areas that were historically too wet to farm. This provides opportunities to restore many areas to their original status as forested wetlands.

As part of this mitigation plan, NTMWD is proposing to restore 3,500 acres of existing grassland and cropland back to forested wetlands. The locations of these areas can be seen on Figure 10. This would be accomplished by implementing the mitigation actions described in the Mitigation Work Plan (i.e., conservation easement, restoring hydrology, planting vegetation, controlling invasive species, etc.). The evaluation of HU production for these areas was completed by evaluating the variables contained in the HEP species models and estimating expected future habitat conditions of the restored forested wetland cover type based on the expected growth and survival rates of species identified in the planting plan. During this evaluation, it was assumed that over time variables such as tree canopy closure, average diameter at breast height (dbh) of trees, number of snags, number of refuge sites, percent of water area covered by logs, trees, limbs or herbaceous vegetation, and basal area of woody stems would generally increase. This analysis was conducted for the 10, 15, and 20-year future time intervals. The results of this analysis indicate that restoration of 3,500 acres of existing cropland and grassland cover types to forested wetlands at the mitigation site would result in an overall net gain of 2,135.0 HUs above existing conditions. A summary of this analysis is presented in Table 7-3.

Table 7-3 Habitat Unit Production Expected from Restoring Forested Wetlands on Existing Cropland and Grassland Sites.

Year	Acres	Habitat Suitability Index (HSI)	Habitat Units (HUs)	Net Gain (+) of Forested Wetland HUs
Existing Conditions (Year 0)	3,500	0.00	0.00	0.00
10-Year Future Conditions	3,500	0.11	385.0	(+)385.0
15-Year Future Conditions	3,500	0.37	1,295.0	(+)1,295.0
20-Year Future Conditions	3,500	0.61	2,135.0	(+)2,135.0

In conclusion, the proposed mitigation would more than compensate for impacts to forested wetlands at the proposed reservoir site. Impacts to forested wetlands at the proposed reservoir site were determined to be 1,150.5 HUs. Through enhancement of existing forested wetlands and restoration of cropland and grassland areas to forested wetlands, the mitigation plan would provide 2,266.1 HUs resulting in a net gain of 1,115.6 HUs. A summary of this information is contained in Table 7-4.

Table 7-4 Net Gain in Forested Wetland Habitat Units Resulting from the Proposed Mitigation Activities.

	Future Habitat Units (HUs) Produced by Year (Net)			
Mitigation Activities	Existing Conditions (Year 0)	10-Year Future Conditions	15-Year Future Conditions	20-Year Future Conditions
Enhancement of Existing Forested Wetlands	0.00	(+)103.9	(+)115.0	(+)131.1
Restoration of Forested Wetlands on Cropland and Grassland Sites	0.00	(+)385.0	(+)1,295.0	(+)2,135.0
TOTAL	**0.00**	**(+)488.9**	**(+)1,410.0**	**(+)2,266.1**
Impacts at Proposed Reservoir Site	(-)1,150.5	(-)1,150.5	(-)1,150.5	(-)1,150.5
Net Gain/Loss	**(-)1,150.5**	**(-)661.6**	**(+)259.5**	**(+)1,115.6**

7.6 SHRUB WETLAND MITIGATION

Impacts to shrub wetlands at the proposed reservoir site are expected to result in the loss of 23 HUs. To compensate for these losses, NTMWD is proposing to preserve and protect 98 acres of existing shrub wetlands and restore 325 acres of existing grassland and cropland sites to their natural states as shrub wetlands. The locations of these areas can be seen on Figure 10. The following paragraphs describe the analysis of mitigation benefits.

7.6.1. Habitat Unit Production for the Restoration of Shrub Wetlands on Existing Cropland and Grassland Sites

As previously discussed, a large portion of the mitigation site was hydrologically altered for agricultural purposes. While some of this area is proposed for forested wetland restoration (Section 7.5.2), there are also opportunities to restore existing cropland and grassland sites to their original use as shrub wetlands.

Restoration of shrub wetlands would be accomplished by implementing the mitigation actions described in the Mitigation Work Plan (i.e., conservation easement, restoring hydrology, planting vegetation, controlling invasive species, etc.). The evaluation of HU production for these areas was completed by evaluating the variables contained in the HEP species models and determining expected future habitat conditions of the restored shrub wetland cover type. During this evaluation, it was assumed that over time variables such as percent emergent herbaceous cover in the littoral zone, percent of water area covered by shrub or herbaceous cover, percent shrub crown closure, and number of refuge sites per acre would generally increase. These assumptions are based on standard growth rates and species diversity for species identified in the planting plan. This analysis was conducted for the five year future time interval (the five year analysis period is based on the assumption that shrub wetlands would develop to maturity during this time). The results of this analysis indicate that restoration of 325 acres of existing cropland and grassland cover types to shrub wetlands at the mitigation site would result in an overall net gain of 224.3 HUs above existing conditions. A summary of this analysis is presented in Table 7-5. The overall net gain in shrub wetland HUs is summarized in Table 7-6. (*Note: No HU credits have been included in the overall net gain in shrub wetland HUs for the preservation and protection of the 98 acres of existing shrub wetland at the mitigation site.*)

Table 7-5 Habitat Unit Production Expected from Restoring Shrub Wetlands on Existing Cropland and Grassland Sites.

Year	Acres	Habitat Suitability Index (HSI)	Habitat Units (HUs)	Net Gain (+) of Emergent Wetland HUs
Existing Conditions (Year 0)	325	0.00	0.00	0.00
Five Year Future Conditions	325	0.69	224.3	(+)224.3

Table 7-6 Net Gain in Shrub Wetland Habitat Units Resulting from the Proposed Mitigation Activities.

	Future Habitat Units (HUs) Produced by Year (Net)	
Mitigation Activities	Existing Conditions (Year 0)	Five Year Future Conditions
Restoration of Shrub Wetlands on Cropland and Grassland Sites (near-site)	0.00	(+)224.3
TOTAL	**0.00**	**(+)224.3**
Impacts at Proposed Reservoir Site	(-)23.0	(-)23.0
Net Gain/Loss	**(-)23.0**	**(+)201.3**

7.7 EMERGENT WETLAND MITIGATION

Impacts to emergent wetlands at the proposed reservoir site are expected to result in the loss of 514 HUs. To compensate for these losses, NTMWD is proposing to enhance 1,377 acres of existing emergent wetlands and restore 1,100 acres of emergent wetlands on existing grassland and cropland sites. The locations of these areas can be seen on Figure 10. Over a five year period (five year analysis period is based on the assumption that emergent wetlands develop to maturity during this time), the mitigation plan is expected to produce a total of 715.4 HUs of emergent wetland, resulting in an overall net gain of 201.4 HUs above what is expected to be impacted at the proposed reservoir site.

In addition to the HUs generated from the enhancement and restoration of emergent wetlands at the mitigation site (near-site mitigation), an additional 1,402 acres of littoral wetlands would develop within the proposed reservoir (on-site mitigation) (Figure 3). The littoral wetland areas are expected to develop in locations three feet deep or less (between elevations 531-534 ft. msl.) within the shallow areas of the proposed reservoir as well as cove areas where tributaries enter. Many of the areas where littoral wetlands are expected to develop are currently functioning emergent wetlands and would continue to function as emergent wetlands following impoundment of the reservoir. The existing wetlands would also serve as a seed source for these newly developed littoral wetlands helping to establish vegetation. These littoral wetland areas are expected to provide an additional 560.8 HUs of emergent wetlands assuming a conservative estimate that they would have an HSI value of 0.40 (HSI value based on existing HSI values documented at the proposed reservoir site of 0.42). On-site and near-site mitigation would result in an overall net gain of 762.2 HUs of emergent wetlands. The following paragraphs describe the methods used to reach this conclusion.

7.7.1. Habitat Unit Production for the Enhancement of Existing Emergent Wetlands

Currently, there are 1,377 acres of existing emergent wetlands located at the proposed mitigation site. An analysis of the HEP data collected within this cover type resulted in an overall HSI value of 0.23, which equates to 316.7 HUs (1,377 ac. X 0.23 HSI = 316.7 HUs) of existing emergent wetlands at the mitigation site. Through implementing the enhancement mitigation actions described in the Mitigation Work Plan (i.e., conservation easement, removing cattle, invasive species control, feral hog control, etc.) and evaluating the variables contained in the HEP species models, the expected future habitat conditions of the emergent wetland cover type was estimated at the end of a five year time interval. With these actions, the HSI values of the existing wetlands are expected to attain a similar, if not higher, overall value as the emergent wetlands at the existing reservoir site. The results of this analysis indicate that the enhancement of existing emergent wetlands at the mitigation site would result in a future HSI value of 0.43, resulting in an overall net gain of 275.4 HUs above existing conditions. A summary of this analysis is presented in Table 7-7.

Table 7-7 Habitat Unit Production Expected from Enhancing Existing Emergent Wetlands.

Year	Acres	Habitat Suitability Index (HSI)	Habitat Units (HUs)	Net Gain (+) of Emergent Wetland HUs
Existing Conditions (Year 0)	1,377	0.23	316.7	0.00
Five Year Future Conditions	1,377	0.43	592.1	(+)275.4

7.7.2. Habitat Unit Production for the Restoration of Emergent Wetlands on Existing Cropland and Grassland Sites

Based on the presence of hydric soils and existing emergent wetlands along the lower terraces at the mitigation site, it appears that these areas may have previously been wetlands or have the potential to become wetlands. As part of this mitigation, NTMWD is proposing to restore 1,100 acres of existing grassland and cropland to emergent wetland. This would be accomplished by implementing the mitigation actions described in the Mitigation Work Plan (i.e., conservation easement, restoring hydrology, planting of native emergent wetland vegetation, controlling invasive species, etc.). The evaluation of HU production for these areas was completed by evaluating the variables contained in the HEP species models and determining expected future habitat conditions of the restored emergent wetland cover type. This analysis was conducted at the five year future time interval (expected time for maturity). The results of this analysis indicate that restoration of 1,100 acres of existing cropland and grassland cover types to emergent wetlands at the mitigation site would result in a future HSI value of 0.40, resulting in an overall net gain of 440 HUs above existing conditions. The HSI value of 0.40 is slightly less than the performance goal for the enhancement of existing emergent wetlands. Both of these goals reflect conservative estimates of the potential future HSI values for emergent wetlands at the mitigation site. A summary of this analysis is presented in Table 7-8.

Table 7-8 Habitat Unit Production Expected from Restoring Emergent Wetlands on Existing Cropland and Grassland Sites.

Year	Acres	Habitat Suitability Index (HSI)	Habitat Units (HUs)	Net Gain (+) of Emergent Wetland HUs
Existing Conditions (Year 0)	1,100	0.00	0.00	0.00
Five Year Future Conditions	1,100	0.40	440	(+)440

7.7.3. Habitat Unit Production for the Establishment of Littoral (Emergent) Wetlands at the Proposed Reservoir Site

It was estimated that 1,402 acres of littoral wetlands would develop between elevations 531 to 534 ft. msl. around the proposed reservoir. As discussed previously, data collected and published by TPWD under the Statewide Freshwater Fisheries Monitoring and Management Program indicates the development of littoral zone wetlands along lake margins appears to be common in Northeast Texas. Littoral wetlands provide a number of habitat and water quality functions and comprise a complex of community types that occur in zones that reflect a wide variety of potential water depths, energy regimes, and fluctuation patterns (ERDC/EL TR-10-17, October 2010). The wetland littoral zone of lakes is dominated by rooted emergent, floating, and submersed vascular plants, collectively called macrophytes. Macrophytes are large plants, usually with roots, leaves, and stems, and are only found in shallow water. The littoral zone is characterized by high plant and animal diversity, and is commonly the site where fish reproduction and development occurs. Wetland-littoral communities are also important habitats for waterfowl (Cooke et. al. 1993). These littoral wetland areas are expected to provide an additional 560.8 HUs of emergent wetlands assuming a conservative estimate that they would have an HSI value of 0.40 (HSI value based on existing HSI values documented at the proposed reservoir site of 0.42). The development of these wetlands would provide on-site, in-kind mitigation for impacts to emergent wetlands following construction of the proposed reservoir.

In conclusion, the proposed mitigation activities would more than compensate for impacts to emergent wetlands at the proposed reservoir site. A summary of this information is presented in Table 7-9.

Table 7-9 Net Gain in Emergent Wetland Habitat Units Resulting from the Proposed Mitigation Activities.

	Future Habitat Units (HUs) Produced by Year (Net)	
Mitigation Activities	Existing Conditions (Year 0)	Five Year Future Conditions
Restoration of Existing Emergent Wetlands (near-site)	0.00	(+)275.4
Restoration of Emergent Wetlands on Cropland and Grassland Sites (near-site)	0.00	(+)440.0
Establishment of Emergent/Littoral Wetlands at Proposed Reservoir Site (on-site)	0.00	(+)560.8
TOTAL	**0.00**	**(+)1,276.2**
Impacts at Proposed Reservoir Site	(-)514.0	(-)514.0
Net Gain/Loss	**(-)514.0**	**(+)762.2**

7.8 OPEN WATER (PONDS, STOCK TANKS, SMALL LAKES, ETC.) MITIGATION

Impacts to open waters at the proposed reservoir site are expected to result in the loss of approximately 87 acres of ponds, stock tanks, small lakes, etc. To compensate for these losses, NTMWD is proposing to enhance the existing 34 acres of open waters at the mitigation site by placing them in a conservation easement and removing cattle. Currently, open waters at the mitigation site are primarily utilized as stock tanks, providing a reliable source of water and a place for cattle to "cool off" during higher temperatures (Photograph 7-1 and 7-2). By removing cattle, these areas would develop vegetation along the banks and in the littoral zone which would result in improvements to water quality (i.e., reductions in sediment, bacteria, and nutrient loading) and overall habitat improvement for wildlife species that utilize these areas; specifically waterfowl, wading birds, reptiles, amphibians, and fish. These improvements are also expected to expand into other water bodies (streams, wetlands, etc.) located downstream resulting in enhanced functions and services provided by these waters as well.

In addition to the 34 acres of open waters at the mitigation site, the proposed reservoir would provide an additional 15,239 acres of open waters, excluding the 1,402 acres of littoral wetlands that are expected to develop around the reservoir. It is expected that the proposed reservoir would fully compensate for the inundation of 87 acres of open water within the proposed reservoir footprint. Table 7-10 summarizes how the mitigation plan would offset all impacts to open waters that would result from construction of the proposed reservoir.

Photograph 7-1 Impacts from cattle to open waters on the mitigation site.

Table 7-10 Summary of the Proposed Mitigation Actions to Offset Impacts to Open Waters.

Impacts to Open Waters (acres)	Near-Site Mitigation (acres)	On-Site Mitigation (acres)	Net Gain (+) / Net Loss (-) of Open Waters (acres)
(-)87	(+)34	(+)15,239	(+)15,186

Photograph 7-2 Impacts from cattle to open waters on the mitigation site.

7.9 STREAM MITIGATION

Impacts at the proposed reservoir site are expected to result in the loss of approximately 229,054 SQUs (651,024 linear feet) of streams. Although stream mitigation is considered difficult to accomplish, such mitigation can be successful for improving water quality, habitat creation, species recovery, and recreation. (See Final Mitigation Rule, 73 Fed. Reg. 19,596-97). For successful stream mitigation, compensatory mitigation provided through in-kind preservation, rehabilitation, or enhancement is generally recommended by USACE and USEPA, if practical. To the extent stream mitigation is not available, or deemed infeasible, a watershed approach is undertaken for mitigation, as required by Regulatory Guidance Letter 02-02 (and the Final Mitigation Rule), so as to offset impacts to the overall ecological function of the Bois d'Arc Creek watershed.

To compensate for unavoidable impacts to streams, NTMWD is proposing a multi-faceted stream mitigation approach. The approach includes three main components, including: creation, restoration, and enhancement of streams at the proposed mitigation site (near-site); enhancement of Bois d'Arc Creek downstream of the proposed reservoir (near-site); and protection and enhancement of the streams flowing through the littoral wetlands at the proposed reservoir site (on-site). For streams that NTMWD actively improves and protects through conservation easements, the total of existing SQUs and improved SQUs (i.e., uplift) are proposed as compensatory mitigation. For Bois d'Arc Creek, which will be improved through a natural channel evolution process afforded by NTMWD's implementation of a scientifically based instream flow regime, only the SQU uplift is proposed for mitigation credit. Each component of the proposed stream mitigation and anticipated ecological benefits are discussed below and results are summarized in Section 7.9.4.

7.9.1. Restoration, Enhancement and Creation of Streams at the Proposed Mitigation Site

Currently, many of the streams located at the mitigation site are in poor condition as a result of existing agricultural practices. The practice of cattle grazing has resulted in the destruction of stream bank vegetation, increased erosion, and down-cutting of the channels (Photograph 7-3). Other existing impacts to the streams from historical land practices at the mitigation site includes the straightening of channels and clearing of trees and other vegetation in former riparian areas to open them up for crop production and/or grazing (Photograph 7-4). The NTMWD is proposing to restore and enhance approximately 179,353 linear feet of existing, degraded streams (not including streams located within the Wetlands Reserve Program area) at the mitigation site by placing them in a conservation easement, removing cattle, laying back stream banks, establishing a balanced sediment supply, and establishing riparian corridors and buffers (Figure 9). Additionally, NTMWD is proposing to restore meanders to several first and second-order streams located on the ranch that have been straightened to expedite runoff (Figure 9). Based on field visits to the mitigation site and nearby streams and a desktop analysis using aerial photos and topographic maps, it was determined that a sinuosity ratio of 1.3 is a reasonable ratio for the restored channels. A sinuosity ratio of 1.3 applied to streams appropriate for meander restoration would add (create) approximately 30,084 linear feet of additional stream length to the mitigation site.

Photograph 7-3 Typical cattle impacts to streams at the proposed mitigation site.

Photograph 7-4 Cleared and degraded riparian corridors along streams at the proposed mitigation site.

These activities would result in longer and higher quality streams that would provide a variety of ecological benefits including:

- Decreasing erosion and down-cutting of stream channels and increasing bank stability;
- Reductions in sediment, bacteria, and nutrient loading downstream from currently degraded areas;
- Improvements in water quality from the cessation of farming practices such as the application of fertilizers, pesticides, herbicides, etc., as well as from restoring a vegetated buffer in riparian corridors; and
- Increasing the quality and quantity of available habitat for aquatic and terrestrial wildlife species.

The RGA method was used to evaluate the streams on the Riverby Ranch mitigation site and within Bois d'Arc Creek downstream of the proposed reservoir site as well as streams that are tributaries of littoral wetlands between elevations 534 and 541 ft. msl. The evaluation of future SQU values for these streams was completed by evaluating the variables contained in the RGA method and determining expected future stream conditions at the mitigation site. The RGA method allows the measurement of stream mitigation credit or uplift for both actively restored and passively enhanced streams. Proposed measures or treatments to provide "uplift" of the RGA scores for the Riverby Ranch streams include:

- laying back stream banks to reduce erosion and allow for tree and shrub plantings
- restoration of riparian corridors through tree and shrub plantings
- removal of cattle for protection from livestock grazing and stream bank trampling/erosion
- plugging and/or diverting drainage ditches
- restoring meanders to straightened portions of stream channels
- improving water quality by reducing sediment, pesticides, herbicides, bacteria, etc. from the actions outlined above

Both in-channel and out-of-channel (riparian buffers, for example) treatments would be implemented, depending on baseline conditions for each reach, to increase the SQU scores and thereby provide uplift.

Based on this analysis, this component of the proposed stream mitigation (creation of new stream length and enhancement and restoration of existing stream length) at the Riverby Ranch is expected to generate a total of 158,065 SQUs. Mitigation credit is not being taken for tributaries of Bois d'Arc Creek in the WRP because the NTMWD is not proposing any direct stream mitigation measures within the WRP. Breakdowns of the SQUs for the two mitigation components (stream restoration and creation) on the mitigation property by SQF category and by stream type are shown in Table 7-11 and Table 7-12, respectively.

Table 7-11 Proposed Stream Mitigation at the Mitigation Site

SQF	Riverby Stream Restoration		Riverby Stream Creation	
	Mitigated Length (ft)	SQU Baseline	Mitigated Length (ft)	SQU Baseline
0-.09	0	0	0	0
.1-.19	0	0	0	0
.2-.29	7,562	2,017	0	0
.3-.39	0	0	0	0
.4-.49	1,012	472	0	0
.5-.59	0	0	0	0
.6-.69	29,423	19,378	510	323
.7-.79	96,196	74,879	20,866	16,345
.8-.89	45,160	37,513	8,708	7,138
.9-.99	0	0	0	0
1	0	0	0	0
Total	**179,353**	**134,259**	**30,084**	**23,806**

Table 7-12 Summary of Stream Mitigation Credits at the Mitigation Site in SQUs

Stream Type	Enhancement/ Restoration	Stream Creation	Total
Perennial	15,378	1,064	16,442
Intermittent	36,847	4,172	41,019
Ephemeral	82,034	18,570	100,604
TOTAL	**134,259**	**23,806**	**158,065**

1. *The total of existing and uplift SQUs are reported in this table because these mitigation components will include active restoration and protection by perpetual conservation easement.*

7.9.2. Enhancement of Bois d'Arc Creek Downstream of Proposed Reservoir

Bois d'Arc Creek and many other streams within the Bois d'Arc Creek watershed have been significantly impacted by channelization, which began in the 1920s and continued well into the 1970s. The channelization was probably in response to frequent overbanking events in the watershed. As a result of the channelization, the watershed is no longer in equilibrium. Downcutting and stream bank erosion have increased, and lateral migration of the stream (i.e., meander migration) has slowed. Channelization has most likely increased the "flashy" nature of flows in the watershed, characterized by the rapid rise and fall in flow in response to rainfall events.

If channelization had not occurred in the Bois d'Arc Creek watershed, the stream system would have likely continued to meander, reducing stream velocities and allowing sediment to deposit along the banks and within the floodplain. Old stream remnants show a previous stream depth of two to five feet downstream of the proposed dam location. The expected stream characteristics without channelization would be very different from the current stream system. There would have been greater connectivity to the floodplain, flows would have been slower and the likelihood of connectivity through the stream system would have been greater, resulting possibly in perennial flows.

The NTMWD's proposed instream flow regime is expected to enhance the future condition of Bois d'Arc Creek downstream of the dam by reducing the frequency and magnitude of high flows which contribute to the degrading, ongoing cycle of channel bed erosion, followed by slumping/sloughing of the resulting steepened channel banks and the subsequent erosion and transport of the bank material downstream. Reducing the frequency and magnitude of high flows is expected to allow the existing channel to reach an equilibrium condition with less steep and vegetated banks and a stable meandering low flow channel within the existing deep and incised channel. This equilibrium condition is expected to provide improved habitat downstream of the dam to maintain the healthy biological community.

These anticipated changes to Bois d'Arc Creek are supported through studies of streams downstream of dams. Chin et al. (2002) showed that a reduction of stream power in Yegua Creek downstream of Somerville Dam has caused a 61 percent decrease in channel depth from estimated pre-dam conditions as a result of reduced stream power. Similar changes in channel dimension have been observed on the Platte River in Nebraska (Williams 1978), Rio Grande River in Texas (International Boundary Condition 1959), Canadian River in Texas (Williams and Wolman 1984), and Sandstone Creek in Oklahoma (Bergman and Sullivan 1963). These changes in channel dimensions result from aggradation of sediment when carrying capacity is reduced, and from the establishment of vegetation on channel banks that is no longer removed by high magnitude flows. This situation represents an improvement over current conditions downstream of the proposed reservoir site, which are characterized by ongoing erosion and downcutting in the reach.

Based on the analyses conducted as part of the instream flow study on Bois d'Arc Creek and coordination with state and federal resource agencies, a proposed environmental flow regime was developed with the goal of providing a sound ecological environment downstream of the proposed dam and spillway. Stream flow frequency analysis indicated that Bois d'Arc Creek flow is less than one cubic foot per second (cfs) approximately 29 percent of the time. Recent stream gaging data from the USGS at FM 1396 demonstrate that the creek stops flowing for periods ranging from days to months in some years. Instream flow modeling results indicated that flows between two and three cfs would achieve longitudinal stream connectivity, with modeled pool habitats connected by run-riffle habitats. This connectivity is important for maintaining fish passage, aquatic habitat, and water quality. As such, during normal hydrologic conditions (i.e., when Lower Bois d'Arc Creek Reservoir storage is greater than 40% of its capacity), NTMWD proposed a minimum base flow of three cfs that would be made from reservoir releases with higher base flows (10 cfs) during the spring spawning season. This proposed flow regime for Bois d'Arc Creek downstream of the proposed dam would provide a sound ecological environment by maintaining flow in the creek, maintaining existing aquatic habitat and communities, promoting bank stability, and protecting water quality. The environmental flow criteria also include periodic pulse flows to provide sediment transport and habitat maintenance. The pulse flows are defined by a peak flow trigger, volume, and duration. During subsistence conditions, i.e., when the reservoir is less than 40 percent of its capacity, NTMWD will pass the higher of 1 cfs or the wastewater discharges from the City of Bonham. NTMWD will also pass a small pulse (freshet) every 60 days if such inflows enter the reservoir and a corresponding pulse does not occur naturally at the downstream gage at FM 409. Based on the hydrologic record, subsistence conditions occur approximately 9 percent of the time. Table 7-13 shows the environmental flow criteria for passing reservoir inflows to Bois d'Arc Creek downstream of the dam. Consistent with the requirements in the water right permit, releases of inflows for environmental flow purposes is limited to inflow to the reservoir.

Table 7-13 Environmental Flow Criteria for Bypassing Inflows through the Reservoir

Season	Months	Subsistence	Base	Pulse
Fall-Winter	November - February	1 cfs*	3 cfs	2 per season Trigger: 150 cfs Volume: 1,000 ac-ft Duration: 7 days
Spring	March - June	1 cfs*	10 cfs	2 per season Trigger: 500 cfs Volume: 3,540 ac-ft Duration: 10 days
Summer	July - October	1 cfs*	3 cfs	1 per season Trigger: 100 cfs Volume: 500 ac-ft Duration: 5 days

cfs = cubic feet per second *ac-ft = acre-feet*
**A subsistence period freshet requirement with a trigger level of 20 cfs, a volume of 69 ac-ft, and a duration of 3 days, to occur no more than every 60 days, also applies.*

Based on these proposed releases, an evaluation of SQU production for Bois d'Arc Creek was completed by evaluating the variables contained in the RGA method and determining expected future stream conditions for Bois d'Arc Creek downstream of the proposed reservoir. Benefits from the proposed releases that are expected to occur include lowering erosion rates and decreasing channel degradation. Based on this analysis, this component of the proposed stream mitigation is expected to improve the stream quality of Bois d'Arc Creek and provide approximately 5,973 SQUs of ecological uplift within the 106,077 linear feet of Bois d'Arc Creek downstream of the proposed dam to its confluence with the Red River. All of Bois d'Arc Creek downstream of the dam is considered perennial for purposes of stream mitigation. Table 7-14 shows the existing and expected future SQUs for Bois d'Arc Creek.

Table 7-14 Proposed Stream Mitigation for Bois d'Arc Creek

SQF	Existing Conditions		Future Conditions		Uplift
	Length (ft)	SQU	Length (ft)	SQU	SQU
0 - .09	0	0	0	0	
.1 - .19	0	0	0	0	
.2 - .29	0	0	0	0	
.3 - .39	40,184	14,734	0	0	
.4 - .49	65,893	30,939	40,184	17,413	
.5 - .59	0	0	65,893	34,233	
.6 - .69	0	0	0	0	
.7 - .79	0	0	0	0	
.8 - .89	0	0	0	0	
.9 - .99	0	0	0	0	
1.0	0	0	0	0	
Total	**106,077**	**45,673**	**106,077**	**51,646**	**5,973**

7.9.3. Streams within Littoral Wetlands (On-Site Stream Mitigation)

In an effort to further offset the loss of streams that would result from construction and operation of the proposed Lower Bois d'Arc Creek Reservoir, additional stream mitigation would be provided through protection and enhancement of the contributing streams in the areas where fringe or littoral zone wetlands are expected to develop (Figure 3). The NTMWD is purchasing land up to elevation 541 ft. msl. around the lake to serve as the flood pool. Tributaries to the proposed Lower Bois d'Arc Creek Reservoir that are above the conservation pool but flow within land owned by the NTMWD and through the littoral wetlands would be protected through conservation easements. These streams (Figure 3) would provide ecological uplift by providing fish spawning habitat and other aquatic habitat functions when the reservoir is at or above the normal pool elevation of 534 ft. msl. Additionally, these streams would experience ecological uplift from the termination of agricultural practices (farming, grazing, etc.) and other man-made negative impacts. The termination of agricultural practices and other man-made negative impacts is expected to result in the natural re-stabilization of stream channels by reducing sediment and nutrient contributions and allowing natural re-vegetation of stream banks and riparian buffers. The length of streams benefitting from these protected buffers is approximately 89,465 linear feet.

Based on the benefits described above, an evaluation of SQU production for these streams was conducted by evaluating the variables contained in the RGA method and identifying expected future stream conditions. Based on this analysis, this component of the proposed stream mitigation is expected to generate a total of 29,295 SQUs for the selected contributing streams at the reservoir site following construction. Table 7-15 shows the existing and expected future SQUs for the contributing streams to the littoral wetlands, and Table 7-16 shows a breakdown of mitigation SQUs by stream type.

Table 7-15 Proposed Stream Mitigation for Streams within Littoral Wetlands

SQF	Existing Conditions		Future Conditions	
	Length (ft)	SQU	Length (ft)	SQU
0 - .09	37,717	3,143	0	0
.1 - .19	6,973	813	37,717	6,286
.2 - .29	14,550	3,079	11,372	2,641
.3 - .39	4,363	1,309	14,515	4,718
.4 - .49	10,175	4,455	4,397	2,125
.5 - .59	13,555	7,583	5,779	3,178
.6 - .69	2,131	1,456	13,555	8,713
.7 - .79	0	0	2,131	1,634
.8 - .89	0	0	0	0
.9 - .99	0	0	0	0
1.0	0	0	0	0
Total	**89,465**	**21,840**	**89,465**	**29,295**

1. *The total of existing and uplift SQUs are reported in this table because these mitigation components will include active restoration and protection by perpetual conservation easement.*

Table 7-16 Summary of Stream Mitigation Credits for Streams within Littoral Wetlands

Stream Type	Length (ft)	SQU
Perennial	35,342	7,473
Intermittent	54,123	21,822
TOTAL	**89,465**	**29,295**

1. *The total of existing and uplift SQUs are reported in this table because these mitigation components will include active restoration and protection by perpetual conservation easement.*

7.9.4. Summary of Proposed Stream Mitigation

Table 7-17 shows the total stream quality units of the proposed stream mitigation program by each major mitigation component. This program includes a total of 404,979 linear feet of enhanced, restored or created streams that collectively have an expected future stream quality value of 193,334 SQUs. Table 7-18 shows the proposed stream mitigation by stream type.

Table 7-17 Summary of Proposed Stream Mitigation

Mitigation Location	Mitigation Type	Amount (linear feet)	Stream Quality Units (SQUs)
Riverby Ranch	Restoration/Enhancement	179,353	134,259
Riverby Ranch	Creation	30,084	23,806
Bois d'Arc Creek (downstream of dam)	Enhancement	106,077	5,974*
On-Site Tributaries to Littoral Wetlands	Enhancement	89,465	29,295
TOTAL		**404,979**	**193,334**

** This value represents only the uplift expected to occur within Bois d'Arc Creek following implementation of the proposed releases downstream of the proposed dam. The other values represent the total stream quality units associated with actively enhanced, restored, and created streams and/or protections of streams.*

Table 7-18 Summary of Proposed Stream Mitigation by Stream Type.

Stream Type	Amount (linear feet)	Stream Quality Units (SQUs)
Perennial	167,953	29,889
Intermittent	106,898	62,841
Ephemeral	130,128	100,604
TOTAL	**404,979**	**193,334**

7.10 SUMMARY OF PROPOSED MITIGATION CREDITS

Construction of the proposed Lower Bois d'Arc Creek Reservoir would result in unavoidable impacts to waters of the U.S. including 1,150.5 HUs of forested wetlands, 514 HUs of emergent wetlands, 23 HUs of shrub wetland, 87 acres of open waters (ponds, stock tanks, etc.), and 229,054 SQUs of streams. This mitigation plan provides both on-site and near-site compensatory mitigation for these anticipated impacts. The mitigation plan, if implemented, would meet the federal "no net loss of wetlands" goal. It would also provide protection, in perpetuity, to thousands of acres of existing and restored wetlands, riparian areas, and open waters through conservation easements. They would be protected from future development, grazing, and other non-compatible uses. The mitigation plan would also provide compensatory mitigation for impacts to streams through creation, restoration, and enhancement activities. While the NTMWD has endeavored to maximize opportunities to create, restore, and enhance streams to compensate for the identified impacts, a shortfall remains based on length and SQUs. The proposed compensation to impact ratio based solely on length is just over 1/2 to 1 (specifically 0.62), while factoring existing and future stream quality into the analysis (i.e., SQUs) results in nearly a 1 to 1 ratio (specifically 0.84). While there is not a stated federal goal of no net loss related to streams, the proposed stream mitigation nearly accomplishes such.

A summary of impacts to waters of the U.S. that could result from the construction of the proposed reservoir and proposed mitigation is summarized in Table 7-19. Table 7-20 summarizes existing cover type acreages and HUs at the Riverby Ranch compared to expected cover type acreages and HUs following implementation of the mitigation plan.

Table 7-19 Summary of Impacts to Waters of the U.S. and Proposed Mitigation.

Type of Water of the U.S.	Amount Impacted		Amount of Mitigation		Net Gain(+) / Net Loss(-)	
	Acres	HUs	Acres	HUs	Acres	HUs
Forested Wetland	(-)4,602	(-)1,150.5	(+)3,952	(+)2,261.1	(-)650	(+)1,115.6
Emergent Wetland	(-)1,223	(-)514	(+)3,879	(+)1,276.2	(+)2,656	(+)762.2
Shrub Wetland	(-)49	23	(+)373	(+)224.3	(+)324	(+)201.3
Open Waters	(-)87	N/A	(+)15,273	N/A	(+)15,186	N/A
	Linear Feet	**SQUs**	**Linear Feet**	**SQUs**	**Linear Feet**	**SQUs**
Streams	(-)651,024	(-)229,054	(+)404,979	(+)193,334	(-)246,045	(-)35,720
Perennial	262,944	89,887	167,953	29,889	(-)94,990	(-)59,998
Intermittent	388,080*	139,167	106,898	62,841	(-)281,182	(-)76,326
Ephemeral	N/A**	N/A	130,128	100,604	(+)130,128	(+)100,604

** Intermittent stream length includes both ephemeral and intermittent streams.*

*** Ephemeral streams were not differentiated from, and are included in the total of, intermittent streams at the reservior site.*

Table 7-20 Types and Amounts of Waters of the U.S. at the Proposed Mitigation Site (Riverby Ranch): Existing vs. Proposed.

Type of Water of the U.S.	Existing		Proposed	
	Acres	HUs	Acres	HUs
Forested Wetland	452	153.7	3,952	2,266.1
Emergent Wetland	1,377	316.7	2,477	715.4
Shrub Wetland	98	--	423	224
Open Waters	34	--	34	--
	Linear Feet	**SQUs**	**Linear Feet**	**SQUs**
Streams	179,353	64,140	209,437	158,065

**Table does not include littoral zone wetlands, linear feet of streams protected and enhanced on-site, linear feet of Bois d'Arc Creek downstream of proposed dam site, or streams within the WRP area of the ranch.*

8.0 MAINTENANCE PLAN

Proposed mitigation would be, to the maximum extent practicable, planned and designed to become self-sustaining over time. However, it is anticipated that some active management and maintenance activities would need to occur to maintain the long-term viability and sustainability of the proposed mitigation project.

Once initial construction is completed, the mitigation site would be monitored as provided in the Monitoring Requirements and Performance Standards sections of this plan. In addition to corrective actions, as may be required, maintenance of the property would likely include the following activities:

- protection from encroachment by neighboring landowners;
- protection from timber thefts;
- maintaining boundary markings;
- maintaining necessary fence lines;
- maintaining access roads;
- providing for compatible uses such as hiking, bird watching, hunting, camping, etc., which do not interfere with achieving and maintaining mitigation goals and objectives and meeting performance standards;
- remedial vegetation planting to achieve survival and ground cover rates;
- protection of newly planted mitigation sites;
- conducting prescribed burns;
- maintaining water control structures;
- conducting easement enforcement;
- controlling invasive plant and animal species; and
- taking such other actions, as may be necessary, under the Adaptive Management Plan.

Many of the above maintenance activities would occur on an as needed and/or as identified basis. It is anticipated that more effort would be required at the mitigation site during the early phases of the mitigation project for routine, day-to-day maintenance activities and that the effort would diminish over time as mitigation goals and objectives are achieved. This effort would improve the likelihood of achieving a successful mitigation project. The funding associated with maintenance activities would be provided by NTMWD and would be included in the cost for operating and maintaining the proposed Lower Bois d'Arc Creek Reservoir. NTMWD would continue to monitor and maintain the site until the mitigation project has met its stated goals and objectives as confirmed by the USACE. It is anticipated that once the goals and objectives have been met, the mitigation site would be a self-sustaining system.

9.0 PERFORMANCE STANDARDS

Three conditions would be used to evaluate the performance of the restored and enhanced wetland mitigation sites (including littoral wetlands):

- wetland hydrology;
- wetland vegetative cover; and
- wildlife habitat

These conditions would need to be established and evaluated in a step-wise fashion to improve the chances of mitigation success. In other words, the successful establishment of wetland hydrology would improve the likelihood for the successful establishment and survival of wetland vegetation and, over time, improvement in wildlife habitat value. The purpose of this approach is to be proactive during the early stages of the mitigation implementation process when "nudging" one habitat type in the direction of another habitat type is critical. Each performance standard to be evaluated is discussed below.

9.1 HYDROLOGY

The USACE 1987 Wetlands Delineation Manual defines wetland hydrology as "the sum total of wetness characteristics in areas that are inundated or have saturated soils for a sufficient duration to support hydrophytic vegetation." And, as mentioned previously, hydrology would be the foundation of this mitigation plan. Although a variety of methods would be used to restore wetland hydrology as part of this plan, the USACE has developed a simple method to determine if it exists on a particular site by observing whether certain hydrology indicators are present or absent. These indicators are identified and have been taken directly from the March 2010 *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Great Plains Region (Version 2.0)* (ERDC/EL TR-10-1). The same indicators and presence or absence test identified in this manual would be used as the performance standard to determine successful establishment of wetland hydrology (e.g., one primary or two secondary indicators exist on the site). The indicators are summarized in Table 9-1.

Table 9-1 Primary and Secondary Indicators of Wetland Hydrology.

Primary Indicators	Secondary Indicators
• Surface Water • High Water Table • Saturation • Water Marks • Sediment Deposits • Drift Deposits • Algal Mat or Crust • Iron Deposits • Inundation Visible on Aerial Imagery • Water-Stained Leaves • Salt Crust • Aquatic Invertebrates • Hydrogen Sulfide Odor • Dry-Season Water Table • Oxidized Rhizospheres on Living Roots (**where not tilled**) • Presence of Reduced Iron • Thin Muck Surface • Other	• Surface Soil Cracks • Sparsely Vegetated Concave Surface • Drainage Patterns • Oxidized Rhizospheres on Living Roots (**where tilled**) • Crayfish Burrows • Saturation Visible on Aerial Imagery • Geomorphic Position • FAC-Neutral Test

Note: One primary or two secondary wetland hydrology indicators must be identified to conclude wetland hydrology is present.

During routine monitoring events, field data would be collected and analyzed to determine if hydrology performance standards are being met. This information would also be utilized to determine if adaptive management strategies would need to be implemented.

9.2 VEGETATIVE COVER

No vegetative performance standards are being proposed for the existing wetland mitigation areas. These areas already have established vegetative cover and would have performance standards based on habitat value that would be assessed with the use of Habitat Evaluation Procedures (HEP), discussed below.

Vegetative performance standards would vary depending on the type of wetland (forested or emergent) being restored. For example, a restored forested wetland site could have vegetative performance standards based on measurements or averages of stems per acre while a restored emergent wetland site could have performance standards based on achieving a percent ground cover of desirable wetland plant species. The proposed vegetative performance standards for this mitigation plan are summarized in Table 9-2.

Table 9-2 Proposed Vegetative Performance Standards for Restored Wetland Mitigation Sites.

Habitat Type	Vegetative Performance Standards
Restored Forested and Shrub Wetlands	• achieve a survival rate of desirable trees and shrubs ≥ 50 percent of the planted number after three years • species diversity of plantings and volunteer recruitment with no single species constituting > 50 percent of the individuals at the end of the monitoring term
Restored Emergent Wetland (includes littoral zone wetlands)	• achieve a percent ground cover (or water surface) rate with desirable wetland or aquatic plant species ≥ 50 percent at three years

The proposed survival rate of 50 percent for trees and shrubs within the forested wetland and riparian areas are based upon what is expected to produce the highest gains in habitat units over a 20-year analysis period. Although the Tulsa District's Mitigation and Monitoring Guidelines suggest achieving a survival rate of installed trees and shrubs exceeding 75 percent after three years, our analysis does not indicate that this will produce the highest gains in HUs over the analysis period. Examples of this can be seen in the HSI models for the fox squirrel and barred owl. For the barred owl, achieving a percent canopy cover of 60 percent or greater yields an HSI value of 1.0 (1.0 is the highest possible value) for this particular variable. For the fox squirrel, achieving a percent canopy closure of hard mast producing trees between 40 to 60 percent yields an HSI value of 1.0 and a percent tree canopy closure (of all species) between 20 to 60 percent also yields an HSI value of 1.0. Based on these variables, the ideal riparian woodland/forested wetland would have a percent canopy cover/closure of 60 percent that would be comprised of hard mast producing trees. As proposed, the planting plan calls for planting 370 hard and soft mast producing trees/acre (80% bare root seedlings/20% 5-gallon containerized) with a 50 percent survival rate after three years. This equates to 185 trees/acre, or 15 ft.

x 15 ft. spacing per tree after three years. Considering that many of the tree species identified in the tree species list can achieve a canopy spread of 30 to 40-feet at maturity, a nearly 100 percent canopy cover could be attained with as few as 35-62 trees/acre (if uniformly spaced). This would equate to a mortality rate of up to 80 percent of the remaining 185 trees. On the contrary, if the mitigation site were to be planted at a rate of 435 bare root seedlings per acre requiring 75 percent survival after three years, there would be approximately 326 trees/acre, or 12 ft. x 12 ft. spacing per tree. Based on this analysis, a canopy cover percentage could be achieved that would produce higher HSI values and a greater number of HUs with the proposed planting plan and performance standards compared to having 75 percent survival after three years, as suggested by Tulsa District's Mitigation and Monitoring Guidelines. *(Note: these estimates have not factored in native, volunteer species which are likely to colonize the mitigation areas.)*

Similarly, the proposed percent ground cover rate with desirable wetland or aquatic plant species of "≥ 50 percent" within the restored emergent wetland areas is based upon what is expected to produce the highest gains in habitat units over a five year analysis period. This can be seen when evaluating the variables contained in the HSI models for the green heron and wood duck. For the green heron, achieving a percent emergent/herbaceous cover in the littoral zone of between 45 and 80 percent and a 50 to 80 percent water area covered by logs, tree limbs, shrub cover, or herbaceous vegetation (live or dead and overhanging within one meter of the water surface) during summer conditions yields an HSI value of 1.0 (1.0 is the highest possible value) for these particular variables. For the wood duck, achieving a 50 to 80 percent water area covered by logs, tree limbs, shrub cover, or herbaceous vegetation (live or dead and overhanging within one meter of the water surface) during summer conditions yields and HSI value of 1.0. Based on these variables, the ideal emergent wetland habitat (for both evaluation species) would have an herbaceous vegetation cover of between 50 and 80 percent.

During routine monitoring events, field data would be collected and analyzed to determine if vegetative performance standards are being met. Guidance on vegetation sampling and analysis outlined in the Great Plains Regional Supplement would be used during data collection. This information would also be utilized to determine if any adaptive management strategies would need to be implemented.

9.3 WILDLIFE HABITAT

Performance standards for wildlife habitat would be based on the USFWS Habitat Evaluation Procedures (HEP). A discussion of the HEP methodology is presented in Chapter 7. The method is designed to describe wildlife habitat values at baseline and future conditions to allow for comparisons of the relative values of different areas at the same point in time or of the same area at different points in time. Because HEP provides a quantitative method for such comparisons, it may be used in planning applications such as the assessment of current and future wildlife habitat, trade-off analyses, or compensation analyses.

The use of HEP to evaluate performance standards would allow for the objective evaluation of the proposed mitigation site to determine if it is achieving its objectives and to determine if it is developing into the desired resource type (i.e., forested wetland, emergent wetland, etc.). The proposed HEP based performance standards for this mitigation plan are summarized in Table 9-3.

Monitoring events would include periodic field inspections and performance assessments using HEP. The frequency of the different monitoring events and specific activities are described in the subsequent section (Chapter 10). Monitoring reports will be submitted annually for the first five years following completion of initial plantings and subsequently in years ten and fifteen. During the HEP monitoring events, a team composed of qualified professionals from NTMWD, its consultants, and the state and federal resource agencies that participated in the baseline HEP studies, would collect HEP data from the different mitigation areas (cover types). The data would then be evaluated using the HEP methodology and compared to the performance standards to determine if the mitigation plan is accomplishing its desired outcome or if adaptive management strategies would need to be implemented.

Table 9-3 HEP Based Performance Standards for Proposed Mitigation by Habitat Type.

Habitat Type	Mitigation Strategy	Year 0 Existing Conditions (HUs)	5-year Performance Goal (HUs)	10-year Performance Goal (HUs)	15-year Performance Goal (HUs)	20-year Performance Goal (HUs)
Existing Forested Wetland	Enhancement	0	N/A	(+)103.9	(+)117.5	(+)131.1
Forested Wetland	Restoration	0	N/A	(+)385.0	(+)1,295.0	(+)2,135.0
Shrub Wetland	Restoration	0	(+)224.3	N/A	N/A	N/A
Existing Emergent Wetland	Enhancement	0	(+)275.4	N/A	N/A	N/A
Emergent Wetland	Restoration	0	(+)440	N/A	N/A	N/A
Littoral Wetland	Restoration	0	(+)560.8	N/A	N/A	N/A

**Five year performance goals for forested wetlands are not included because these areas are not expected to develop into forests within five years. Emergent and shrub wetlands are expected to fully develop at five years.*

9.4 PERFORMANCE STANDARDS FOR BOIS D'ARC CREEK

Performance standards for Bois d'Arc Creek downstream of the dam would be based on fish Index of Biotic Integrity (IBI) and macroinvertebrate Rapid Bioassessment (RBA) scores. Results obtained during the instream flow study on Bois d'Arc Creek in 2010 showed that integrity scores for fish community structure were intermediate to high (mean: 43.83). Main stem site scores ranged from 33 (limited) to 49 (high). It was found that overall biological integrity of Bois d'Arc Creek's macroinvertebrate community was intermediate (mean: 28.93). Main stem sampling site scores ranged from 22 (intermediate) to 37 (high). The goal or performance standard for Bois d'Arc Creek downstream of the proposed dam site would be no degradation of the aquatic community from the baseline metrics (based on IBI and RBA scores). This would be done by comparing RBA and IBI scores from the mitigation monitoring with baseline data collected during the 2010 instream flow study. In the event that the aquatic life use does not meet the water quality standards for Segment 0202A, the potential causes would be identified and remedial management strategies would be implemented to meet the designated aquatic life use.

In addition to using the IBI and RBA performance standards for Bois d'Arc Creek downstream of the proposed dam, the RGA methodology will also be used to determine if stream conditions are improving as a result of the hydrologic stability inherent in the proposed environmental flow regime. A discussion of the RGA methodology is in FNI's (2014) *Proposed Mitigation for Stream Impacts of the Proposed Lower Bois d'Arc Creek Reservoir – Rapid Geomorphic Assessment*. The proposed RGA based performance standards for Bois d'Arc Creek are summarized in Table 9-4.

Monitoring events would include periodic field inspections and performance assessments using the RGA methodology. The frequency of the different monitoring events and specific activities are described in Chapter 10. During the RGA monitoring events, a team composed of qualified professionals from NTMWD and its consultants would collect RGA data at the same sampling locations used to establish baseline RGA conditions for Bois d'Arc Creek downstream of the dam. The data would then be evaluated using the RGA methodology and compared to the performance standards to determine if the mitigation plan is accomplishing its desired outcome or if adaptive management strategies would need to be implemented.

Table 9-4 RGA Based Performance Standards for Bois d'Arc Creek.

Mitigation Strategy	Year 0 Existing Conditions (SQUs)	5-year Performance Goal (SQUs)	10-year Performance Goal (SQUs)	20-year Performance Goal (SQUs)
Enhancement	45,673	47,167 (1,494 SQU uplift)	48,659 (2,987 SQU uplift)	51,646 (5,974 SQU uplift)

9.5 PERFORMANCE STANDARDS FOR RESTORED STREAMS ON RIVERBY RANCH AND ON-SITE STREAMS IN LITTORAL ZONE WETLANDS

Performance standards for streams targeted for creation, restoration, and enhancement on Riverby Ranch and on-site streams within littoral zone wetlands would also be based on the RGA methodology. The proposed stream creation, restoration, and enhancement activities would restore and/or enhance approximately 209,437 linear feet of streams on Riverby Ranch. An additional 89,465 linear feet of streams would be protected and enhanced on-site within the littoral wetlands expected to develop at the proposed reservoir site. During the RGA monitoring events, a team composed of qualified professionals from NTMWD and its consultants would collect RGA data at the same sampling locations used to establish baseline RGA conditions for streams on Riverby Ranch. New RGA sampling locations for the on-site streams would be identified and data would be collected following the same RGA methodology used to establish baseline stream conditions. The data would then be evaluated using the RGA methodology and compared to the performance standards to determine if the mitigation plan is accomplishing its desired outcome or if adaptive management strategies would need to be implemented. The proposed RGA based performance standards for these streams by mitigation strategy are summarized in Table 9-5.

The stream performance standards are an aggregate SQU score for the combined stream types rather than a separate score for ephemeral, intermittent and perennial streams. Implementation of the proposed mitigation measures at Riverby Ranch are expected to cause a general increase in soil moisture and groundwater recharge by restoring wetlands and meandering streams. This expected increase in water retention over much of the ranch could lead to the conversion of some streams from ephemeral to intermittent, and possibly from intermittent to perennial wherever the water table rises above stream channels. While it is plausible that such conversion might occur, predicting which streams, if any, might undergo such a conversion is not possible. Combining the stream performance goals into a single score, rather than partitioning the goal by stream type, avoids a potential future performance standard accounting issue if streams undergo a conversion during the monitoring period.

Table 9-5 RGA Based Performance Standards for Streams on Riverby Ranch and Streams within Littoral Zone Wetlands.

Mitigation Strategy	Year 0 Existing Conditions (SQUs)	5-year Performance Goal (SQUs)	10-year Performance Goal (SQUs)	20-year Performance Goal (SQUs)
Restoration and Enhancement on Riverby Ranch (existing streams)	64,140	90,435	116,729	134,259
Stream Creation on Riverby Ranch	0	8,927	17,854	23,806
Protection and Enhancement of Littoral Streams	21,840	24,636	27,431	29,295

In summary, the performance standards identified for this mitigation plan would help determine if the project is achieving its overall objectives. These standards are based on attributes that are objective and verifiable by field measurements and analysis. Additionally, data collection and analysis would be based on methods established by both the USACE and USFWS to determine if the performance standards are being met. If it is determined that performance standards are not being met, adaptive management strategies would be identified in consultation with the USACE and TCEQ and a plan would be developed and implemented (see Chapter 17). Such measures may include additional plantings, removal of invasive species, predator or pest control measures, selectively cutting trees, hydrologic manipulation, and, if available and necessary, the purchase of mitigation bank credits to supplement the permittee-responsible mitigation actions. This approach would help improve the chances of mitigation success.

10.0 MONITORING REQUIREMENTS

10.1 GENERAL

The purpose of monitoring the proposed mitigation sites is to determine if the compensatory mitigation project is on track to meet performance standards and to determine if adaptive management is needed. Monitoring requirements for this mitigation plan would be based on guidance provided in the following:

- Aquatic Resource Mitigation and Monitoring Guidelines, Department of the Army Regulatory Program, Tulsa District U.S. Army Corps of Engineers, October 2004.
- Compensatory Mitigation for Losses of Aquatic Resources; Final Rule (33 CFR Part 332 and 40 CFR Part 230, 73 Fed. Reg. 19,593, April 10, 2008) (Final Mitigation Rule).

Performance standards for wetlands on Riverby Ranch and within the littoral zone wetlands would be based on three parameters: wetland hydrology, wetland vegetative cover (i.e., survival rates, species diversity, and percent ground cover) and wildlife habitat value (i.e., HSI scores). As such, monitoring events would be focused on assessing the development of these variables through time to determine if the proposed mitigation project is meeting its objectives. Monitoring of the wetlands will include visual inspections and field measurements using HEP methodologies. As with the baseline HEP study, the USACE, TCEQ, and other state and federal resource agencies would be invited to participate in HEP field data collection. It is anticipated that the monitoring sites within the enhanced mitigation areas would be similar in number and location as the baseline HEP sites. New sites would be identified in areas proposed for wetland restoration. Table 10-1 shows the schedule of proposed monitoring events for the wetland mitigation sites. Data collection during monitoring events would be conducted using the methodologies described in the Performance Standards section of this mitigation plan.

Table 10-1 Proposed Wetland Mitigation Monitoring Events.

Monitoring Year (Season)	Wetland Types	Protocol	Activities		
1 (Spring, Summer)	Emergent, Forested, Shrub		Field inspection*		Photographs
1 (Fall)	Emergent, Shrub	HEP	Field measurements		Photographs
2 (Spring, Summer)	Emergent, Forested, Shrub		Field inspection		Photographs
2 (Fall)	Emergent, Shrub	HEP	Field measurements		Photographs
3 (Spring, Summer)	Emergent, Forested, Shrub		Field inspection		Photographs
3 (Fall)	Emergent, Shrub	HEP	Field measurements		Photographs
4	Emergent, Shrub	HEP	Field measurements		Photographs
4	Forested		Field inspection		Photographs
5	Emergent, Forested, Shrub	HEP	Field measurements	Species diversity	Photographs
6	Forested		Field inspection		Photographs
7	Forested		Field inspection		Photographs
8	Forested		Field inspection		Photographs
9	Forested		Field inspection		Photographs
10	Forested	HEP	Field measurements	Species diversity	Photographs
15	Forested	HEP	Field measurements	Species diversity	Photographs
20	Forested	HEP	Field measurements	Species diversity	Photographs

** Field inspection includes visual assessment of survival and overall health. The field inspection will identify if there are potential issues that may impact mitigation success and identify corrective measures if needed.*

Performance standards for Bois d'Arc Creek downstream of the dam will be assessed by comparing RBA and IBI scores from the mitigation monitoring with baseline data collected during the 2010 instream flow study. Biological monitoring would be performed twice per year in years one, three, and five following deliberate impoundment in the reservoir and again at year 10. Monitoring events will be conducted and the data will be collected and analyzed in accordance with the TCEQ approved *Surface Water Quality Monitoring Procedures Volume 2: Methods for Collecting and Analyzing Biological Community and Habitat Data*. Field sampling will be conducted at the FM 409 and downstream of FM 100 instream flow study reaches established during the 2010 instream flow study.

Water quality measurements will be continuously monitored at the USGS gage at FM 409 beginning upon deliberate impoundment in the reservoir. A grab sample also will be collected at each biological monitoring site during each monitoring event to be analyzed for total dissolved solids, chlorides, sulfates, total suspended solids, total nitrogen and total phosphorus.

In the event that the monitoring results indicate that aquatic life use is not meeting the water quality standards for Segment 0202A, the potential causes will be identified, including a review of the required flow regime, and a remedial management strategy will be identified and implemented in consultation with and under the approval of the TCEQ Executive Director. If the metrics indicate no degradation of the aquatic community and the annual diversions from the reservoir have exceeded 100,000 acre-feet during at least one year of operation prior to the year 5 monitoring, then monitoring will end after 10 years. If diversions have not reached 100,000 acre-feet prior to the fifth year following deliberate impoundment, instream biological monitoring and water quality sampling will continue to be performed every fifth year thereafter until monitoring has been conducted during two years following the diversion of 100,000 acre-feet in a given year.

In addition to biological monitoring, Bois d'Arc Creek will also be monitored utilizing the RGA methodology. Monitoring would be performed annually, in years one, three, five and ten following deliberate impoundment in the reservoir and again at year 20. The same sampling locations utilized during the 2014 RGA study to establish existing baseline conditions would be used for these proposed monitoring events. Data collected during monitoring would be compared to the baseline data to determine if RGA performance standards are being met. If it appears that performance standards are not being met, the potential causes will be identified and a remedial management strategy will be implemented to rectify the issue(s). Table 10-2 shows the proposed monitoring events for Bois d'Arc Creek.

Table 10-2 Proposed Bois d'Arc Creek Monitoring Events.

Monitoring Event (Year)	Protocol	Activities			
1	IBI, RBA, RGA	Seining, electroshock Macroinvertebrate sampling	Measure representative stream x-sections	RGA data collection	Photographs
3	IBI, RBA, RGA	Seining, electroshock Macroinvertebrate sampling	Measure representative stream x-sections	RGA data collection	Photographs
5	IBI, RBA, RGA	Seining, electroshock Macroinvertebrate sampling	Measure representative stream x-sections	RGA data collection	Photographs
10	IBI, RBA, RGA	Seining, electroshock Macroinvertebrate sampling	Measure representative stream x-sections	RGA data collection	Photographs
20	RGA	-	Measure representative stream x-sections	RGA data collection	Photographs

1. *If additional monitoring is required after year 10 because the annual diversions from the reservoir have not exceeded 100,000 acre-feet, then the monitoring activities identified for year 10 will continue every 5 years until there are two monitoring years following the diversion of 100,000 acre-feet or more.*

Performance standards for streams within Riverby Ranch and streams within the littoral wetlands will also be based on the RGA methodology. The proposed stream mitigation activities will enhance, restore, and/or create approximately 209,437 linear feet of streams on Riverby Ranch and 89,465 linear feet of streams within the littoral zone wetlands. As discussed in Chapter 9, the RGA data would be collected at the same monitoring locations used to establish baseline RGA conditions for streams on Riverby Ranch. RGA monitoring locations for the on-site streams within the littoral wetlands would be identified and data would be collected following the same RGA methodology used to establish baseline stream conditions. Monitoring of these streams will occur annually in years 1, 3, 5, 10 and 20 following implementation of the initial hydrological modifications and plantings. For the streams at the reservoir, the monitoring period will begin when the water surface elevation in the reservoir reaches 534 ft. msl. Monitoring activities for stream mitigation on Riverby Ranch and on-site streams within the littoral zone wetland areas will include stream cross-sections, RGA data collection and photographs.

All monitoring events would be conducted by qualified, professional biologists/scientists that are retained by the NTMWD. Additionally, state, federal, tribal, and local resource agencies that are involved in this mitigation project would be invited to participate in these events.

10.2 MONITORING PERIOD

The proposed mitigation plan contains different types of mitigation with varying times to reach maturity or to become established. As such, the length of the monitoring periods for the different types of mitigation would vary depending on the anticipated times to reach maturity or to become established. As proposed, emergent (including littoral zone wetlands) and shrub wetland mitigation areas would be monitored for five years, stream mitigation sites on Riverby Ranch, within littoral zone wetland areas, and on Bois d'Arc Creek downstream of the proposed dam and spillways would be monitored for a minimum of 10 years, and forested wetland mitigation sites would be monitored for 20 years. Monitoring of the littoral zone wetlands would begin the first year following reservoir filling (i.e., water level reaching 534 ft. msl.) During the early phases of the mitigation project, monitoring events would be conducted more frequently to identify potential concerns or threats to the success of the mitigation project and to determine if adaptive management or other corrective actions are needed. If adaptive measures are determined to be needed and implemented, monitoring may be extended to ensure that the mitigation goals are being met.

10.3 MONITORING REPORTS

For years one through five, ten, fifteen, and twenty, a monitoring report would be prepared and submitted to the USACE Tulsa District Engineer. Findings from the periodic monitoring events would be summarized in the report. The monitoring reports would reflect the activities proposed in the mitigation plan, including the specific field activities in Tables 10-1 and 10-2 and monitoring activities associated with stream mitigation at the Riverby Ranch mitigation site and littoral wetlands at the reservoir site. An annual report documenting the environmental flow releases would be prepared and submitted with the monitoring report. The monitoring report would likely include the following elements, as applicable:

1. Project name and permit number
2. Project location, map, site drawings, photograph station locations
3. Permittee's name, address, phone

4. Report preparer's name, address, phone
5. Purpose and goals for mitigation site
6. Brief summary of mitigation strategy/actions
7. Date mitigation action commenced
8. Dates of site inspections
9. Dates of maintenance activities
10. Summary of observations and measurements
11. Assessment of success toward the performance standards or success criteria
12. Report any observed problems (adverse water levels, failure, underperformance, vandalism, erosion, invasive plants, storm damage, etc.)
13. Implemented or recommended solutions to identified problems or deficiencies
14. Documentation of completed corrective actions taken at the mitigation site
15. Photos from each of the site inspections by photographic station location and date

PART 2 MITIGATION PLAN FOR IMPACTS TO TERRESTRIAL RESOURCES

This Part of the mitigation plan addresses impacts to and proposed mitigation for terrestrial resources that could be impacted following construction of the proposed Lower Bois d'Arc Creek Reservoir and associated treatment and transmission facilities, and was developed to support and meet the permitting and mitigation requirements associated with the State of Texas water right permit application for the Lower Bois d'Arc Creek Reservoir submitted by NTMWD to the TCEQ on December 29, 2006. During the development of this section of the mitigation plan, specific consideration was given to 30 TAC §297.53, which addresses habitat mitigation associated with water rights permitting.

All proposed terrestrial compensatory mitigation for potential terrestrial impacts would be provided through in-kind mitigation that would occur through near-site mitigation strategies. Both the proposed aquatic and terrestrial mitigation (excluding on-site aquatic mitigation) would occur on one large, contiguous tract of land (approximately 15,000 acres) located downstream of the proposed reservoir site (Riverby Ranch) (Figures 1 and 5). Having both terrestrial and aquatic mitigation sites located adjacent to one another will provide synergistic ecological uplift to both ecosystems and avoid fragmentation of habitat.

11.0 IMPACTS TO TERRESTRIAL RESOURCES

The impacts of the proposed project have been evaluated by the NTMWD with participation of state and federal resource agencies, including the TCEQ, over the past several years. Reports documenting these studies and the findings have been submitted to the TCEQ in support of the water right permit application. A listing of these reports is presented below.

- Report Supporting an Application for a Texas Water Right for Lower Bois d'Arc Creek Reservoir, 2 volumes, submitted to TCEQ on December 29, 2006.
- Section 404 Permit Application and Jurisdictional Determination Report, submitted to TCEQ water rights permitting section on October 8, 2008.
- Environmental Report, Supporting an Application for a 404 Permit for Lower Bois d'Arc Creek Reservoir, submitted to TCEQ water rights permitting section on October 8, 2008.
- Instream Flow Study Report for the Proposed Lower Bois d'Arc Creek Reservoir, May 2010. Submitted to USACE and Cooperating agencies on May 27, 2010. Submitted to TCEQ on June 1, 2010.
- Instream Flow Study Supplemental Data, September 2010, Submitted to USACE and cooperating agencies on September 17, 2010. Submitted to TCEQ on September 23, 2010.

A synopsis of the impacts of the proposed project on terrestrial and aquatic habitats was provided to the TCEQ in the response to a Request for Information, dated May 13, 2011. A copy of this response is included in Appendix C of this mitigation plan. Impacts to waters of the U.S., including wetlands, are summarized in Part 1 of this mitigation plan. A brief summary of the project's potential terrestrial impacts is presented below.

11.1 DIRECT IMPACTS

The proposed Lower Bois d'Arc Creek Reservoir will directly impact 17,068 acres associated with the construction of the dam and spillway and subsequent filling of the reservoir to the conservation pool elevation of 534 ft. msl. An additional 354 acres would be impacted as a result of constructing the proposed transmission and treatment facilities. Impacts within the proposed reservoir project site were assessed with an interagency team using HEP, developed by the USFWS. A supplemental HEP analysis to document existing conditions was completed for the associated transmission and treatment facilities in

October and November of 2013 following the selection of the raw water pipeline route and locations of the water treatment plant and terminal storage reservoir (FNI, 2013). The HEP methodology is recommended by the USFWS as their basic tool for evaluating a project's impacts and developing mitigation recommendations. It is also a recommended methodology by the TCEQ for habitat evaluations (30 TAC 297.53).

The Lower Bois d'Arc Creek Reservoir study area, including the associated transmission and treatment facilities, was subdivided into the following nine cover types: Upland Deciduous Forest, Evergreen Forest, Tree Savanna, Shrubland, Cropland, Grassland / Old Field, Riparian Woodland / Bottomland Hardwood, Shrub Wetland, and Emergent / Herbaceous Wetland. The habitat quality within each delineated cover type was evaluated in relation to the habitat requirements of one or more of sixteen evaluation species selected based on their ecological significance and the availability of applicable HSI models.

The acreages and baseline HUs for each terrestrial cover type within the Lower Bois d'Arc Creek Reservoir project site are presented in Table 11-1. (Note: Areas of riparian woodland / bottomland hardwood that were delineated as forested wetlands are discussed in Part 1. Table 11-1 addresses only non-wetland cover types.)

Table 11-1 Baseline Habitat Units by Terrestrial Cover Type at the Proposed Lower Bois d'Arc Creek Reservoir Site.

Cover Type	Average HSI Values	Area (acres)	Habitat Units (HUs)
Upland Deciduous Forest	0.47	2,226	**1,046**
Riparian Woodland / Bottomland Hardwood	0.25	1,731	**433**
Shrubland	0.57	64	**36**
Grassland / Old Field	0.60	4,810	**2,886**
Cropland	0.72	2,045	**1,472**
Tree Savanna	0.73	132	**96**
Evergreen Forest	0.35	231	**81**
TOTAL		**11,239**	**6,050**

Source: Table 12, Appendix D, "Habitat Evaluation Procedures (HEP) Report for the Lower Bois d'Arc Creek Reservoir," Environmental Report Supporting an Application for a Section 404 Permit, FNI, 2008.

11.2 INDIRECT IMPACTS

Indirect impacts include associated actions of the project that potentially impact habitat upstream, adjoining, and downstream of the project site. These impacts are discussed in Appendix C of this plan and in Appendix C of the Instream Flow Study Report (FNI, May 2010).

While changes in terrestrial habitats may have occurred without the project, construction of the reservoir may impact the timing of these changes. Impacts to the habitats downstream of the reservoir are expected to be minimal due to several factors:

(1) the existing community is not dependent upon overbank flow for reproduction and overall success and many of the species along Bois d'Arc Creek riparian corridor are equally likely to occur in uplands;

(2) the local site conditions (e.g., rainfall, soil type, and land cover) contribute to floodplain inundation;

(3) the proposed release of base flows should increase channel-groundwater connectivity and promote growth of stream bank vegetation;

(4) the reduction in highly erosive flows would allow the stream to aggrade over time increasing the potential for floodplain connectivity; and

(5) downstream hydrology will continue to contribute to instream flow and supplement floodplain connectivity and certain aspects of the riparian corridor may even be improved as a result of the dam, including increased stream bank stabilization, vegetation growth, and gain of hard mast producing woody trees.

12.0 MITIGATION OBJECTIVES

The purpose of this Part of the mitigation plan is to identify and describe in detail the mitigation measures proposed by NTMWD to compensate for impacts to terrestrial habitats that could result following construction of the proposed Lower Bois d'Arc Creek Reservoir and associated transmission and treatment facilities. Specific plan objectives are to mitigate, to the extent practicable, for the 433 habitat units of riparian woodland / bottomland hardwoods (bottomland hardwoods that were delineated as forested wetlands are addressed in Part 1), 1,046 habitat units of upland deciduous forest, 2,886 habitat units of grassland / old field cover types, and 64 acres of shrubland. Terrestrial mitigation efforts will focus on the restoration, enhancement, and/or preservation of these habitat types at the proposed mitigation site.

Mitigation for the habitats units associated with cropland, evergreen forest, and tree savanna cover types are not an objective of this mitigation plan. These cover types are either man-induced/created habitat types, consist largely of invasive species, or are transitional habitats that would require extensive ongoing management activities to maintain.

13.0 MITIGATION SITE SELECTION AND BASELINE CONDITIONS

13.1 SITE SELECTION PROCESS

The NTMWD has acquired the Riverby Ranch specifically because of its unique characteristics and qualities to provide mitigation for potential impacts from the proposed project. A map showing the location of the mitigation site and existing cover types is shown on Figure 7. A detailed description of the mitigation site selection process to identify the proposed mitigation site is described in Part 1 of this mitigation plan.

13.2 TERRESTRIAL BASELINE CONDITIONS OF THE PROPOSED MITIGATION SITE

Descriptions of the following existing conditions on the Riverby Ranch are described in Part 1 of this mitigation plan:

- Overall project site description;
- Existing hydrology;
- Existing soils;
- Existing wetland vegetation;
- Existing wetland wildlife use; and
- Existing wildlife habitat value for wetland cover types, including a description of the HEP methodology and how it was applied at the proposed mitigation site.

13.2.1. Existing Terrestrial Cover Types

The location and distribution of all existing vegetative cover types within the proposed mitigation site are depicted in Figure 7. The following provides descriptions of the terrestrial cover types that were identified and evaluated using the HEP methodology at the proposed mitigation site.

<u>Upland Deciduous Forest</u>

Upland forests are defined as non-wetland areas dominated by trees of at least five meters in height with a minimum tree canopy closure of 25 percent. In upland deciduous forests, at least 50 percent of that canopy is composed of deciduous species, or those that completely shed their foliage during part of the year (USFWS 1980c).

Grassland / Old Field

The grassland / old field cover type consists of upland areas with at least a 25 percent canopy cover of predominantly non-woody vegetation in which grasses, whether native or introduced, are dominant. This cover type includes mostly prairies and rangeland (USFWS 1980c).

Riparian Woodland / Bottomland Hardwood (non-wetland)

The riparian woodland / bottomland hardwood cover type includes wetland areas dominated by woody vegetation at least six meters tall, with a total vegetation cover of more than 30 percent; this designation is synonymous with the Forested Wetland cover type described in Ecological Services Manual (ESM) 103 (USFWS 1980c).

Shrubland

Shrublands are defined as upland areas that are dominated by a shrub layer, which may be composed of shrub species and/or small trees shorter than five meters. This cover type should have a shrub canopy cover of at least 25 percent (USFWS 1980c).

Cropland

Croplands are defined as agricultural uplands which are planted and harvested annually with agricultural crops; pasture and hayland are excluded from this cover type (USFWS 1980c).

13.2.2. Existing Wildlife Habitat Value

The wildlife habitat value of the approximately 15,000-acre area that would become the mitigation site for the proposed Lower Bois d'Arc Creek Reservoir project was estimated using the HEP procedures. The HEP analysis was conducted by personnel from FNI and the same state and federal resource agencies that participated in the HEP study completed at the proposed reservoir site. Additionally, the same HEP species models were used within the same cover types to estimate habitat value. Using the same procedures to estimate wildlife habitat value for the impact site and mitigation site allows for a more consistent comparison of impacts to mitigation as well as a more accurate assessment of potential ecological uplift that could occur at the mitigation site.

During an interagency HEP meeting (August 2010) held prior to collecting HEP data at the mitigation site, it was proposed and agreed to that preservation of the shrubland areas would likely be the best mitigation alternative. This conclusion was reached based on the fact that the shrubland areas at the proposed mitigation site are located adjacent to the Red River and are susceptible to overbanking conditions. Because of these factors, implementing mitigation actions such as shrub plantings, control of invasive species, etc. would have a very low likelihood of success. As such, it was concluded that collecting HEP data within this cover type would not be beneficial or necessary.

Baseline HUs were calculated for each cover type at the proposed mitigation site by multiplying the average cover type HSI values by the acres in each cover type, as presented in Table 13-1.

Table 13-1 Baseline Habitat Units for Terrestrial Cover Types at the Mitigation Site.

Cover Type	Average HSI Values	Area (acres)	Habitat Units (HUs)
Upland Deciduous Forest	0.58	78	**46**
Grassland / Old Field	0.41	5,413	**2,220**
Riparian Woodland / Bottomland Hardwood	0.38	840	**319**
Shrubland	N/A	41	**N/A**
Cropland	0.44	3,858	**1,697**
TOTAL		**10,230**	**4,282**

14.0 TERRESTRIAL MITIGATION PLAN

14.1 AVOIDANCE AND MINIMIZATION

Part 1 of this mitigation plan was developed to compensate for the unavoidable impacts to waters of the U.S. due to the construction of the proposed Lower Bois d'Arc Creek Reservoir. Impacts were avoided to the extent practicable while addressing the purpose and need of the project, and those impacts that could not be avoided were minimized to the extent practicable. The mitigation actions identified in Part 2 of this plan are designed to compensate for the remaining unavoidable, but minimized, impacts to terrestrial habitats.

The measures proposed by NTMWD to avoid and/or minimize impacts to aquatic resources are described in Part 1 of this mitigation plan. Some of these actions will also avoid and/or minimize impacts to terrestrial resources. NTMWD proposes the following measures to avoid and minimize impacts of the proposed project:

1. <u>Avoidance of Wetlands and Minimization of Impacts to other Waters of the U.S.</u> During the route selection and site layout process for the proposed raw water pipeline, intake pump station, electrical substation, terminal storage reservoir, rail spur, and water treatment plant, all impacts to wetlands were avoided. In addition, all impacts to streams and jurisdictional open waters (ponds, stock tanks, etc.) that would occur as a result of constructing the pipeline would be minimized and considered temporary by restoring pre-construction contours, stabilizing exposed stream banks, and revegetating the area immediately following construction. Consequently, no permanent impacts to waters of the U.S. would occur as a result of constructing these features.
2. <u>Removal of 14.4 Miles of Proposed Pipeline</u>. NTMWD has removed 14.4 miles of proposed pipeline and the associated discharge structures proposed to be located on Pilot Grove Creek from the originally proposed project. This would result in the avoidance and minimization of impacts to both aquatic and terrestrial resources. While the impacts to terrestrial resources associated with the construction of a pipeline are generally temporary, there would likely have been maintenance activities within the permanent right-of-way that would prevent the regrowth of forested habitat types. Removal of the pipeline would avoid and minimize impacts to these resources.

3. Land and Flowage Easement Acquisitions. NTMWD is purchasing land in fee simple from elevation 534 ft. msl. up to elevation 541 ft. msl. This is approximately 3,324 acres. Flowage easements would be purchased for land from elevation 541 ft. msl. up to elevation 545 ft. msl. Approximately 2,217 acres would be included in the flowage easements. No development would be permitted below elevation 541 ft. msl. and development would be restricted to non-habitable structures within the flowage easements. This would avoid or minimize direct and indirect impacts to approximately 5,541 acres of land contiguous with the conservation pool.

4. Instream Flow Regime. The NTMWD proposes to release water from the proposed Lower Bois d'Arc Creek Reservoir for instream flow purposes. The proposed instream flow regime would minimize impacts to the downstream riparian corridor, and is expected to enhance existing stream and riparian conditions due to reductions in erosive flows and aggradation within the channel. This is discussed in more detail in Part 1 of this mitigation plan.

14.2 TERRESTRIAL MITIGATION APPROACH

The proposed Riverby Ranch mitigation site will be used to meet the compensatory mitigation requirements for terrestrial resources. The approximate 15,000-acre mitigation site offers the opportunity to restore terrestrial resources that would complement the proposed aquatic resource mitigation areas on the ranch. Additionally, permanently protected lands (i.e., Pintail Farms WRP, Riverby Ranch WRP, and Caddo National Grasslands) adjacent to the proposed mitigation site would provide synergistic ecological uplift (Figure 6).

The proposed approach to terrestrial mitigation would include the restoration of forested riparian buffer zones along stream channels, restoring native grassland, restoring and enhancing upland deciduous forests, and preserving shrublands.

14.3 MITIGATION FOR IMPACTS

Potential impacts at the proposed reservoir site could result in the loss of 433 HUs of riparian woodland / bottomland hardwood, 1,046 HUs of upland deciduous forest, 2,886 HUs of grassland / old field, and 64 acres of shrubland. To compensate for these losses, NTMWD is proposing to restore and enhance riparian woodland / bottomland hardwoods, native grasslands, upland deciduous forest, and preserve shrublands on the Riverby Ranch. Currently, there are approximately 4,307 acres on the ranch that are not being utilized as part of the aquatic resources mitigation plan that could be utilized to offset these potential impacts. Additionally, the aquatic resources mitigation plan is proposing to restore and enhance approximately 1,375 acres of riparian woodland / bottomland hardwood to create riparian corridors/buffers. All proposed mitigation areas are identified in Figure 10. The following paragraphs describe the analysis and mitigation benefits associated with this plan.

14.3.1. Habitat Unit (Credit) Determination

Upland Deciduous Forest

The plant species selected to restore vegetation within upland deciduous forest areas associated with this mitigation plan were derived from two primary sources - the NRCS 2001 Soil Survey of Fannin County, Texas and the USFWS's *National List of Plant Species That Occur in Wetlands: South Plains (Region 6)*. The following list of species would be used as a guide for the selection of species based upon site conditions, soils, hydrology, etc. (as they would likely vary from site-to-site) as well as commercial availability. Tree species identified in Table 14-1 are hard mast producing trees native to this area of Texas. Soft mast producing tree species with lighter seeds such as cedar elm, eastern cottonwood, and American sycamore as well as fruit bearing tree species such as red mulberry, sugarberry, and black cherry are expected to establish in restoration areas on their own from natural sources. This mixture of hard mast, soft mast, and fruit bearing tree species is expected to provide food, shelter, and nesting habitat for a variety of wildlife species, thus providing ecological uplift.

The suggested planting density or planting rate for the tree species identified in Table 14-1 would be 435 bare root seedlings per acre with no single species constituting greater than 50 percent of the individuals being planted and a minimum of five different species per acre.

Through implementing mitigation actions (i.e., establishing a conservation easement, removing cattle and controlling feral hogs, invasive species control, and hard mast plantings and evaluating the variables contained in the HEP species models), the expected future habitat conditions of the upland deciduous forest cover type was estimated at a 20-year time interval for existing and newly restored upland deciduous forest areas. During this evaluation, it was assumed that over time variables such as tree canopy closure, number of hard mast producing trees, average diameter at breast height (dbh) and height of trees, number of snags, overall number of trees, and basal area of woody stems would generally increase. The results of this analysis are presented in Table 14-2.

Table 14-1 Tree Species List for Upland Deciduous Forest Restoration.

Common Name	Scientific Name
White Oak	*Quercus alba*
Black Oak	*Quercus velutina*
Bur Oak	*Quercus macrocarpa*
Southern Red Oak	*Quercus falcata*
Shumard Oak	*Quercus shumardii*
Chinkapin Oak	*Quercus muhlenbergii*
Pecan	*Carya illinoensis*
Black Hickory	*Carya texana*
Black Walnut	*Juglans nigra*

Table 14-2 Habitat Unit Production Expected from the Restoration and Enhancement of Upland Deciduous Forest.

Mitigation Type	Acres	20- Year Habitat Suitability Index (HSI)	20-Year Habitat Unit (HU) Production
Enhancement of Existing Upland Deciduous Forest	78	0.76	(+) 59
Restoration of Upland Deciduous Forest	1,027.5	0.59	(+) 606
		TOTAL	**(+) 665**
		IMPACTS	**(-) 1,046**
		NET GAIN / LOSS	**(-) 381**

Grassland / Old Field

The plant species selected to restore vegetation within grassland areas associated with this mitigation plan were derived from private vendors that specialize in the establishment and restoration of native grasslands and prairies. The species within Table 14-3 would be used as a guide for the selection of species based upon site conditions (as they would likely vary from site-to-site) as well as commercial availability. Species within this table would be planted as a mixture and would be expected to provide food, shelter, and nesting habitat for a variety of wildlife species, thus providing ecological uplift.

Table 14-3 Grass and Forb Species list for Grassland / Old Field Restoration.

Common Name	Scientific Name
Bushy Bluestem	*Andropogon glomeratus*
Eastern Gamagrass	*Tripsacum dactyloides*
Broomsedge Bluestem	*Andropogon virginicus*
Indiangrass	*Sorghastrum nutans*
Little Bluestem	*Schizachyrium scoparium*
Prairie Wildrye	*Elymus canadensis*
Virginia Wildrye	*Elymus virginicus*
Sideoats Grama	*Bouteloua curtipendula*
Switchgrass	*Panicum virgatum*
Purpletop	*Tridens flavus*
Sand Dropseed	*Sporobolus cryptandrus*
Sand Lovegrass	*Eragrostis trichodes*
Clasping Coneflower	*Rudbeckia amplexicaulis*
Lemon Mint	*Monarda citriodora*
Indian Blanket	*Gaillardia pulchella*
Partridge Pea	*Chamaechrista fasciculata*
Plains Coreopsis	*Coreopsis tinctoria*
Black-Eyed Susan	*Rudbeckia hirta*
Drummond Phlox	*Phlox drummondii*
Illinois Bundleflower	*Desmanthus illinoensis*
Pink Evening Primrose	*Oenothera speciosa*
Lazy Daisy	*Aphanostephus skirrhobasis*

Through implementing mitigation actions (i.e., establishing a conservation easement, removing cattle and controlling feral hogs, invasive species control, and native grassland plantings and evaluating the variables contained in the HEP species models), the expected future habitat conditions of the grassland / old field cover type was estimated at a five year time interval (it was assumed that restored grassland areas would reach maturity within five years) within restored areas. The results of this analysis are presented in Table 14-4.

Table 14-4 Habitat Unit Production Expected from the Restoration of Grassland / Old Field Habitat.

Mitigation Type	Acres	5-Year Habitat Suitability Index (HSI)	5-Year Habitat Unit (HU) Production
Restoration of Grassland / Old Field	3,277.5	0.73	(+) 2,393
		TOTAL	**(+) 2,393**
		IMPACTS	**(-) 2,886**
		NET GAIN / LOSS	**(-) 493**

Riparian Woodland / Bottomland Hardwood (non-wetland)

The proposed approach to riparian woodland / bottomland hardwood restoration and enhancement is discussed in Part 1 of this mitigation plan (see Section 6.4). Through implementing mitigation actions such as establishing a conservation easement, removing cattle and controlling feral hogs, invasive species control, and hard and soft mast plantings and evaluating the variables contained in the HEP species models, the expected future habitat conditions of the riparian woodland / bottomland hardwood cover type was estimated at a 20-year time interval for existing and newly restored mitigation areas. During this evaluation, it was assumed that over time, variables such as tree canopy closure, average dbh of trees, number of snags, number of refuge sites, and basal area of woody stems would generally increase. The results of this analysis are presented in Table 14-5.

Table 14-5 Habitat Unit Production Expected from the Restoration and Enhancement of Riparian Woodland / Bottomland Hardwoods (non-wetland).

Mitigation Type	Acres	20- Year Habitat Suitability Index (HSI)	20-Year Habitat Unit (HU) Production
Enhancement of Riparian Woodland / Bottomland Hardwood	840	0.63	(+) 529
Restoration of Riparian Woodland / Bottomland Hardwood	535	0.61	(+) 855
		TOTAL	**(+) 855**
		IMPACTS	**(-) 433**
		NET GAIN / LOSS	**(+) 422**

<u>Shrubland</u>

During an interagency HEP meeting (August 2010) held prior to collecting HEP data at the mitigation site, it was proposed and agreed to that preservation of the shrubland areas would likely be the best mitigation alternative. This conclusion was reached based on the fact that the shrubland areas at the proposed mitigation site are located adjacent to the Red River and are susceptible to disturbances from overbanking conditions (i.e., plants are uprooted and easily disturbed) and long-term survivability is low. Because of these factors, plant diversity is low. Implementing mitigation actions such as shrub plantings, control of invasive species, etc. would have a very low likelihood of success. As such, NTMWD is proposing to preserve 41 acres of existing shrubland habitat at the mitigation site to offset 64 acres of potential impacts at the proposed reservoir site.

As proposed, this mitigation plan would provide, to the extent practicable, compensatory mitigation for impacts to terrestrial resources. A summary of impacts to terrestrial resources that could result from the construction of the proposed reservoir and proposed mitigation is summarized in Table 14-6.

Table 14-6 Summary of Impacts to Terrestrial Resources and Proposed Mitigation.

Terrestrial Resource Type	Amount Impacted	Amount of Mitigation	Net Gain (+) / Net Loss (-)
Upland Deciduous Forest (HU)	(-) 1,046	(+) 665	(-) 381
Riparian Woodland / Bottomland Hardwood (HU)	(-) 433	(+) 855	(+) 422
Grassland / Old Field (HU)	(-) 2,886	(+) 2,393	(-) 493
Shrubland (acre)	(-) 64	(+) 41	(-) 23

14.3.2. Mitigation Work Plan

The mitigation activities associated with the terrestrial resources would be conducted in conjunction with the mitigation activities for the aquatic resources. These activities would occur on the same property at Riverby Ranch. Descriptions of the timing of restoration activities, invasive and non-native species control, construction methods, grading plan, soil preparation and management, and erosion control are discussed in Part 1 of this mitigation plan. Planting species and rates for upland plantings are discussed in the previous section.

14.3.3. Monitoring and Success Criteria

Monitoring of the terrestrial mitigation sites will be conducted in conjunction with the monitoring of the aquatic mitigation areas during monitoring events as described in Part 1 of this mitigation plan. Restored upland deciduous forest areas will be monitored to determine the success rate of tree plantings. The proposed vegetative performance standards for this mitigation plan are summarized in Table 14-7. This information will be included as a brief section within the monitoring reports and would be sent to the TCEQ. If a site is not performing as expected, the problem will be identified (i.e., herbivory, invasive species, etc.) and corrective actions will be implemented and monitoring will continue until the mitigation areas are on target to meet the performance standards. Table 14-8 shows the schedule of proposed monitoring events for the wetland mitigation sites.

Table 14-7 Proposed Vegetative Performance Standards for Restored Upland Deciduous Forest Sites.

Habitat Type	Vegetative Performance Standards
Restored Upland Deciduous Forest	• achieve a survival rate of desirable trees exceeding 50 percent of the planted number after three years. • species diversity of plantings and volunteer recruitment with no single species constituting greater than 50 percent of the individuals at the end of the monitoring term.

Table 14-8 Proposed Terrestrial Mitigation Monitoring Events.

Monitoring Year (Season)	Terrestrial Cover Types	Protocol	Activities		
1 (Spring, Summer)	Upland Deciduous Forest, Riparian Woodland/Bottomland Hardwood, Grassland/Old Field		Field inspection*		Photographs
1 (Fall)	Grassland/Old Field	HEP	Field measurements		Photographs
2 (Spring, Summer)	Upland Deciduous Forest, Riparian Woodland/Bottomland Hardwood, Grassland/Old Field		Field inspection		Photographs
2 (Fall)	Grassland/Old Field	HEP	Field measurements		Photographs
3 (Spring, Summer)	Upland Deciduous Forest, Riparian Woodland/Bottomland Hardwood, Grassland/Old Field		Field inspection		Photographs
3 (Fall)	Grassland/Old Field	HEP	Field measurements		Photographs
4	Grassland/Old Field	HEP	Field measurements		Photographs
4	Upland Deciduous Forest, Riparian Woodland/Bottomland Hardwood		Field inspection		Photographs
5	Upland Deciduous Forest, Riparian	HEP	Field measurements	Species diversity	Photographs

Monitoring Year (Season)	Terrestrial Cover Types	Protocol	Activities		
	Woodland/Bottomland Hardwood, Grassland/Old Field				
6	Upland Deciduous Forest, Riparian Woodland/Bottomland Hardwood		Field inspection		Photographs
7	Upland Deciduous Forest, Riparian Woodland/Bottomland Hardwood		Field inspection		Photographs
8	Upland Deciduous Forest, Riparian Woodland/Bottomland Hardwood		Field inspection		Photographs
9	Upland Deciduous Forest, Riparian Woodland/Bottomland Hardwood		Field inspection		Photographs
10	Upland Deciduous Forest, Riparian Woodland/Bottomland Hardwood	HEP	Field measurements	Species diversity	Photographs
15	Upland Deciduous Forest, Riparian Woodland/Bottomland Hardwood	HEP	Field measurements	Species diversity	Photographs
20	Upland Deciduous Forest, Riparian Woodland/Bottomland Hardwood	HEP	Field measurements	Species diversity	Photographs

** Field inspection includes visual assessment of survival and overall health. The field inspection will identify if there are potential issues that may impact mitigation success and identify corrective measures if needed.*

PART 3 SITE PROTECTION, MANAGEMENT AND FINANCIAL ASSURANCES

15.0 SITE PROTECTION INSTRUMENT

This compensatory mitigation project will provide long-term protection through a USACE-approved conservation easement(s) created pursuant to the Texas Uniform Conservation Easement Act of 1983, Chapter 183 of the Texas Natural Resource Code.

> **<u>CONSERVATION EASEMENTS</u>**
>
> "A conservation easement is a restriction placed on a piece of property to protect its ecological or open space values. It is a voluntary, legally binding agreement that limits certain types of uses or prevents development from taking place now and in the future."
>
> "Conservation easements are one of the most powerful, effective tools available for the conservation of private lands. Their use has successfully protected millions of acres of wildlife habitat and open space in the United States and in many countries."
>
> ***http://www.nature.org/aboutus/privatelandsconservation/conservationea***

The NTMWD shall record the USACE-approved conservation easement(s) with each of the Fannin and Lamar County clerks and provide a copy of the recorded conservation easement(s) to the USACE Tulsa District. The conservation easement(s) will allow for the implementation of the compensatory mitigation plan, and, to the extent practicable, specifically prohibit incompatible uses (e.g., clear cutting or land surface disturbance for mineral extraction) that might otherwise jeopardize the objectives of the compensatory mitigation project. In addition, the conservation easement(s) will contain a provision requiring 60-day advance notification to the District Engineer before any action is taken to void or modify the instrument, management plan, or long-term protection mechanism, including transfer of title to, or establishment of any other legal claims over, the compensatory mitigation site.

16.0 LONG-TERM MANAGEMENT PLAN

All sites proposed as part of this mitigation plan would be managed long-term as compensatory mitigation areas associated with impacts to waters of the U.S. resulting from construction of the Lower Bois d'Arc Creek Reservoir. In general, long-term management of the mitigation lands would include planting in designated areas, maintenance of topographical features, control of invasive species, prescribed burns, monitoring natural progression, and responding to occurrences that may be detrimental to the success of the mitigation project. The long-term management of the mitigation site would be provided by the NTMWD until the USACE has determined that the mitigation project is meeting its goals and objectives.

Once the USACE determines the mitigation project is fulfilling the compensatory mitigation requirements, and the mitigation site is self-sustaining, NTMWD may seek to convey the mitigation site and long-term management to an appropriate third-party. The third-party would have a background in the field of natural resources management and possess the expertise and ability to manage wetlands and other aquatic resources. A USACE-approved memorandum of understanding (MOU), or other similar agreement between the NTMWD and third-party will establish a framework for obligations and expectations. If such a conveyance were to occur, the third-party would provide for the long-term management of the site once the conveyance is final. With approval of the USACE, the site may be conveyed to the third-party prior to the achievement of all goals and objectives. If this occurs, NTMWD would continue to provide the monitoring and corrective actions as necessary to achieve all goals and objectives. Financial instruments between consenting parties would be developed at the time of conveyance.

17.0 ADAPTIVE MANAGEMENT PLAN

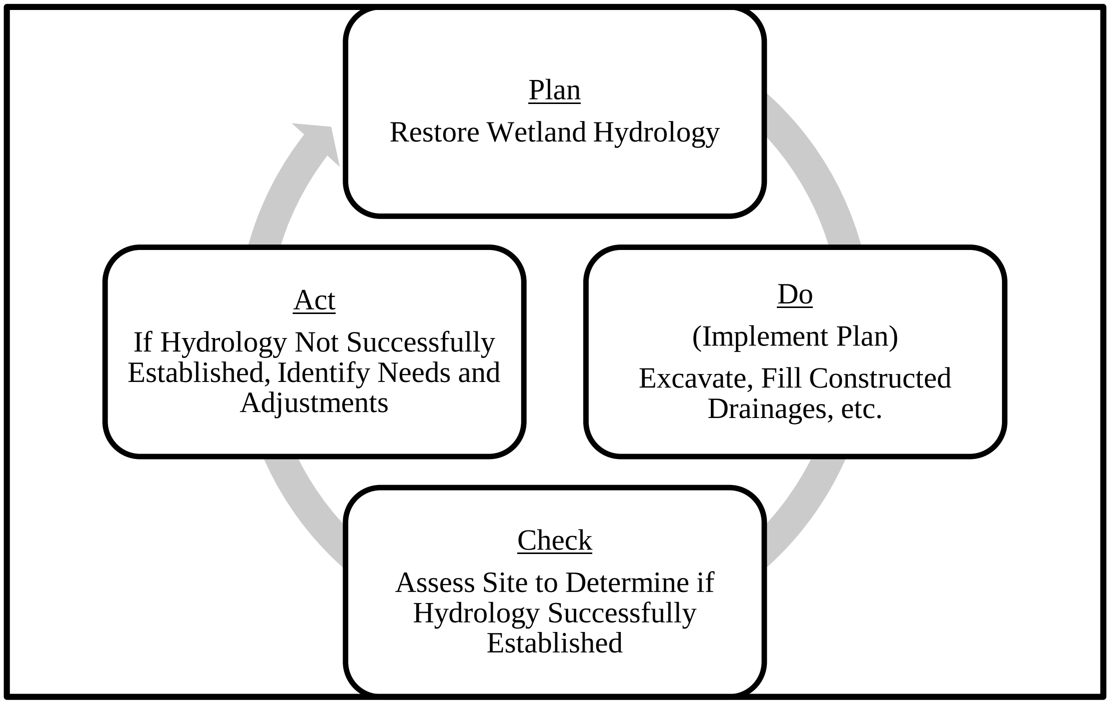
The Final Mitigation Rule defines an adaptive management plan as "a management strategy to address unforeseen changes in site conditions or other components of the compensatory mitigation project, including the party or parties responsible for implementing adaptive management measures." The adaptive management plan's purpose is to "guide decisions for revising compensatory mitigation plans and implementing measures to address both foreseeable and unforeseen circumstances that adversely affect compensatory mitigation success." For the current project, the indicator of the need to develop an adaptive management plan would come from monitoring of wetland and stream mitigation performance standards as described in this mitigation plan. If monitoring reports comparing mitigation progress to performance standards indicate that mitigation progress is falling short of such standards, consultation with the USACE and TCEQ would be initiated regarding the need for adaptive management.

To meet the purpose of the adaptive management plan, NTMWD proposes to implement a method known as the "Plan-Do-Check-Act" cycle. This model was developed for use when implementing change, developing a new product, or starting a new improvement project and it acts as a model for continuous improvement through repetition. Incorporating this model into the adaptive management plan for this mitigation project will increase the likelihood of meeting performance standards and overall mitigation goals and objectives. An example of how this process can be applied is depicted in Graphic 3.

The following features would be monitored and evaluated during monitoring events to determine whether any corrective actions need to be implemented utilizing the "Plan-Do-Check-Act" concept.

17.1 HYDROLOGY

If baseline hydrological conditions, or modified conditions, created as part of the mitigation plan are not supporting the conditions needed for a functioning forested, shrub, or emergent wetland, then the problem will be assessed using hydrological/hydraulic modeling, on the ground surveys, etc. to provide solutions. The creation of beaver dams or other natural events modifying hydrology will not be considered a problem unless the event is detrimental to the overall functioning of the site.



Graphic 3 Example of Utilizing the "Plan-Do-Check-Act" Cycle.

If the stream monitoring indicates that the operations are not meeting stream performance standards for geomorphic, water quality, or biological indices, NTMWD will make an initial assessment of possible causes and identify them in its monitoring report. Such report would trigger consultation with the USACE and/or TCEQ to determine the need to begin an adaptive management initiative. If needed, the initiative would assess the root cause of the problem and identify remedial actions to implement to address the problem.

17.2 VEGETATION

Areas that have been planted as part of this mitigation plan would be monitored to determine survival rates, species composition, and canopy or ground cover percentages. If these areas fail to show progress toward meeting the identified performance standards, attempts would be made to rectify the identified problems. Such measures may include additional plantings, removal of invasive species, predator or pest control measures, selectively cutting trees, etc.

17.3 WILDLIFE HABITAT VALUE

The habitat value of the mitigation sites would be monitored using the USFWS Habitat Evaluation Procedures (HEP). If a site is not performing as expected, then the results of the HEP sampling can be used to identify variables in the species models that need to be modified or improved. The HEP sampling results would be the basis upon which any additional habitat treatments would be identified.

18.0 FINANCIAL ASSURANCES

The NTMWD is a conservation and reclamation district and political subdivision of the State of Texas, created and functioning under Article XVI, Section 59, of the Texas Constitution, pursuant to Chapter 62, Acts of 1951, 52nd Legislature of Texas, Regular Session, as amended (the ACT). As an entity of the state, the district is committed to providing all necessary funding to satisfy compensatory mitigation requirements associated with the Lower Bois d'Arc Creek Reservoir project. As a sign of this commitment, the NTMWD has already purchased approximately 15,000 acres of land (Riverby Ranch) that would be used as a compensatory mitigation site. Additional assurances or financial instruments will be approved by the USACE prior to issuance of the Section 404 permit or as a condition of the permit.

19.0 REFERENCES

Alan Plummer Associates, Inc. (March 2008). Preliminary Jurisdictional Evaluation of Waters of the United States: Proposed Preliminary Raw Water Transmission Pipeline Associated with the Lower Bois d'Arc Creek Reservoir.

Allen, A. W. 1982a. Habitat Suitability Index Models: Fox Squirrel. U.S. Department of Interior, Fish and Wildlife Service. FWS/OBS-82/10.18. 11p.

Allen, A. W. 1984. Habitat Suitability Index Models: Eastern Cottontail. U.S. Department of Interior, Fish and Wildlife Service. FWS/OBS-82/10.66. 23 pp.

Allen, A. W. 1985. Habitat Suitability Index Models: Swamp Rabbit. U.S. Department of Interior, Fish and Wildlife Service. FWS/OBS-82/107. 20p.

Allen, A.W. 1987. Habitat Suitability Models: Barred Owl. U.S. Department of Interior, Fish and Wildlife Service. FWS/OBS-82/10.143. 17 pp.

Author Unknown. 1980a. Habitat Suitability Index Models: American Kestrel (Review Copy; p. 174-184). U.S. Department of Interior, Fish and Wildlife Service. 11 pp.

Author Unknown. 1980b. Habitat Suitability Index Models: Carolina Chickadee (Review Copy; p.233-239). U.S. Department of Interior, Fish and Wildlife Service. 7 pp.

Author Unknown. 1980c. Habitat Suitability Index Models: Green Heron (Review Copy; p.138- 146). U.S. Department of Interior, Fish and Wildlife Service. 9 pp.

Author Unknown. 1980d. Habitat Suitability Index Models: Raccoon (Review Copy; p.99-108). U.S. Department of Interior, Fish and Wildlife Service. 10 pp.

Author Unknown. 1980e. Habitat Suitability Index Models: Racer (Review Copy; p.259-264). U.S. Department of Interior, Fish and Wildlife Service. 6 pp.

Author Unknown. 1980f. Habitat Suitability Index Models: Scissor-tailed Flycatcher (Review Copy; p.227-232). U.S. Department of Interior, Fish and Wildlife Service. 6 pp.

Aquatic Resource Mitigation and Monitoring Guidelines. Department of the Army Regulatory Program. U.S. Army Corps of Engineers, Tulsa District (Oct. 2004).

Cade, B. S. 1986. Habitat Suitability Index Models: Brown Thrasher. U.S. Department of Interior, Fish and Wildlife Service. FWS/OBS-82/10.118. 14 pp.

Compensatory Mitigation for Losses of Aquatic Resources, 73 Fed. Reg. 19,593 (Apr. 10, 2008).

Cooke et al., 1993. Restoration and management of Lakes and Reservoirs (2nd ed.). Ann Arbor: Lewis Publishers.

Freese and Nichols, Inc. (January 1984). Report on New Bonham Reservoir. Prepared for North Texas Municipal Water District.

Freese and Nichols, Inc. (December 2006). Report Supporting an Application for a Texas Water Right for Lower Bois d'Arc Creek Reservoir, 2 volumes.

Freese and Nichols, Inc. (June 2008). Section 404 Permit Application and Jurisdictional Determination Report.

Freese and Nichols, Inc. (June 2008). Environmental Report Supporting an Application for a 404 Permit for Lower Bois d'Arc Creek Reservoir.

Freese and Nichols, Inc. (May 2010a). Instream Flow Study Report for the Proposed Lower Bois d'Arc Creek Reservoir.

Freese and Nichols, Inc. (September 2010b). Instream Flow Study Supplemental Data.

Freese and Nichols, Inc. (July 2011). Draft Jurisdictional Determination Report: Riverby Land and Cattle Company.

Freese and Nichols, Inc. (December 2013). Supplemental Data Supporting an Application for a 404 Permit for Lower Bois d'Arc Creek Reservoir.

Freese and Nichols, Inc. (November 2014). Proposed Mitigation for Stream Impacts of the Proposed Lower Bois d'Arc Creek Reservoir – Rapid Geomorphic Assessment.

Gould, F.W., Hoffman, G.O. and Rechenthin, C.A. 1960. Vegetational areas of Texas, Texas A&M University. Texas Agricultural Experiment Station, Leaflet No. 492 modified by the Texas Parks and Wildlife Department.

Goerdel, A.R. 2001. Soil Survey of Fannin County, Texas. United States Department of Agriculture, Natural Resources Conservation Service in cooperation with the Texas Agricultural Experiment Station, the U.S. Forest Service, and the Texas State Soil and Water Conservation Board.

Guidance on Compensatory Mitigation Projects for Aquatic Resource Impacts Under the Corps Regulatory Program Pursuant to Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act of 1899, Regulatory Guidance Letter (RGL) No. 02-2 [December 24, 2002].

Habberfield, Michael W.*,* Stacey Sloan Blersch*,* Sean J. Bennett*, and* Joseph F. Atkinson*,* 2014*.* Rapid Geomorphic and Habitat Stream Assessment Techniques Inform Restoration Differently Based on Levels of Stream Disturbance*.* Journal of the American Water Resources Association (JAWRA) 50*(*4*):* 1051-1062.

Heeren, D. M., A. R. Mittelstet, G. A. Fox, D. E. Storm, A. T. Al-Madhhachi, T. L. Midgley, A. F. Stringer, K. B. Stunkel, R. D. Tejral. 2012. USING RAPID GEOMORPHIC ASSESSMENTS TO ASSESS STREAMBANK STABILITY IN OKLAHOMA OZARK STREAMS. American Society of Agricultural and Biological Engineers Vol. 55(3): 957-968.

Kline, et al., 2007. Vermont Stream Geomorphic Assessment Phase 2 Handbook Rapid Stream Assessment Field Protocols.

Metropolitan Council of Governments 1992. Montgomery County Rapid Stream Assessment Technique (RSAT).

Schroeder, R. L. 1983. Habitat Suitability Index Models: Downy Woodpecker. U.S. Department of Interior, Fish and Wildlife Service. FWS/OBS-82/10.38. 10 pp.

Schroeder, R. L. 1985. Habitat Suitability Index Models: Eastern Turkey. U.S. Department of Interior, Fish and Wildlife Service. FWS/OBS-82/10.106. 33 pp.

Schroeder, R. L., and P. J. Sousa. 1982. Habitat Suitability Index Models: Eastern Meadowlark. U.S. Department of Interior, Fish and Wildlife Service. FWS/OBS-82/10.29. 9 pp.

Sousa, P. J. 1983. Habitat Suitability Index Models: Field Sparrow. U.S. Department of Interior, Fish and Wildlife Service. FWS/OBS-82/10.62. 14 pp.

Sousa, P. J., and A. H. Farmer. 1983. Habitat Suitability Index Models: Wood Duck. U.S. Department of Interior, Fish and Wildlife Service. FWS/OBS-82/10.43. 27 pp.

Templin, E.H., J.W. Huckabee, Jr., I.C. Mowery, M.H. Layton, T.W. Glassey, and W.J. Moran. 1946. Soil Survey of Fannin County Texas. United States Department of Agriculture in Cooperation with the Texas Agricultural Experiment Station.

Texas Parks and Wildlife Department (TPWD). 2007. Post Oak Savannah and Blackland Prairie Wildlife Management. http://www.tpwd.state.tx.us/landwater/land/habitats/post_oak/

Texas Parks and Wildlife Department. http://www.tpwd.state.tx.us/publications/pwdpubs/lake_survey/index.phtml

U.S. Fish and Wildlife Service (USFWS). 1980a. Habitat as a Basis for Environmental Assessment. Ecological Services Manual (ESM) 101. Division of Ecological Services, U.S. Fish and Wildlife Service, Department of the Interior. Washington, D.C.

U.S. Fish and Wildlife Service (USFWS). 1980b. Habitat Evaluation Procedures (HEP). Ecological Services Manual (ESM) 102. Division of Ecological Services, U.S. Fish and Wildlife Service, Department of the Interior. Washington, D.C.

U.S. Fish and Wildlife Service (USFWS). 1980c. Standards for the Development of Habitat Suitability Index Models. Ecological Services Manual (ESM) 103. Division of Ecological Services, U.S. Fish and Wildlife Service, Department of the Interior. Washington, D.C.

U.S. Fish and Wildlife Service (USFWS). 1996. Population and Habitat Evaluation Methods, Part 870: Habitat Assessment. Division of Habitat Conservation.

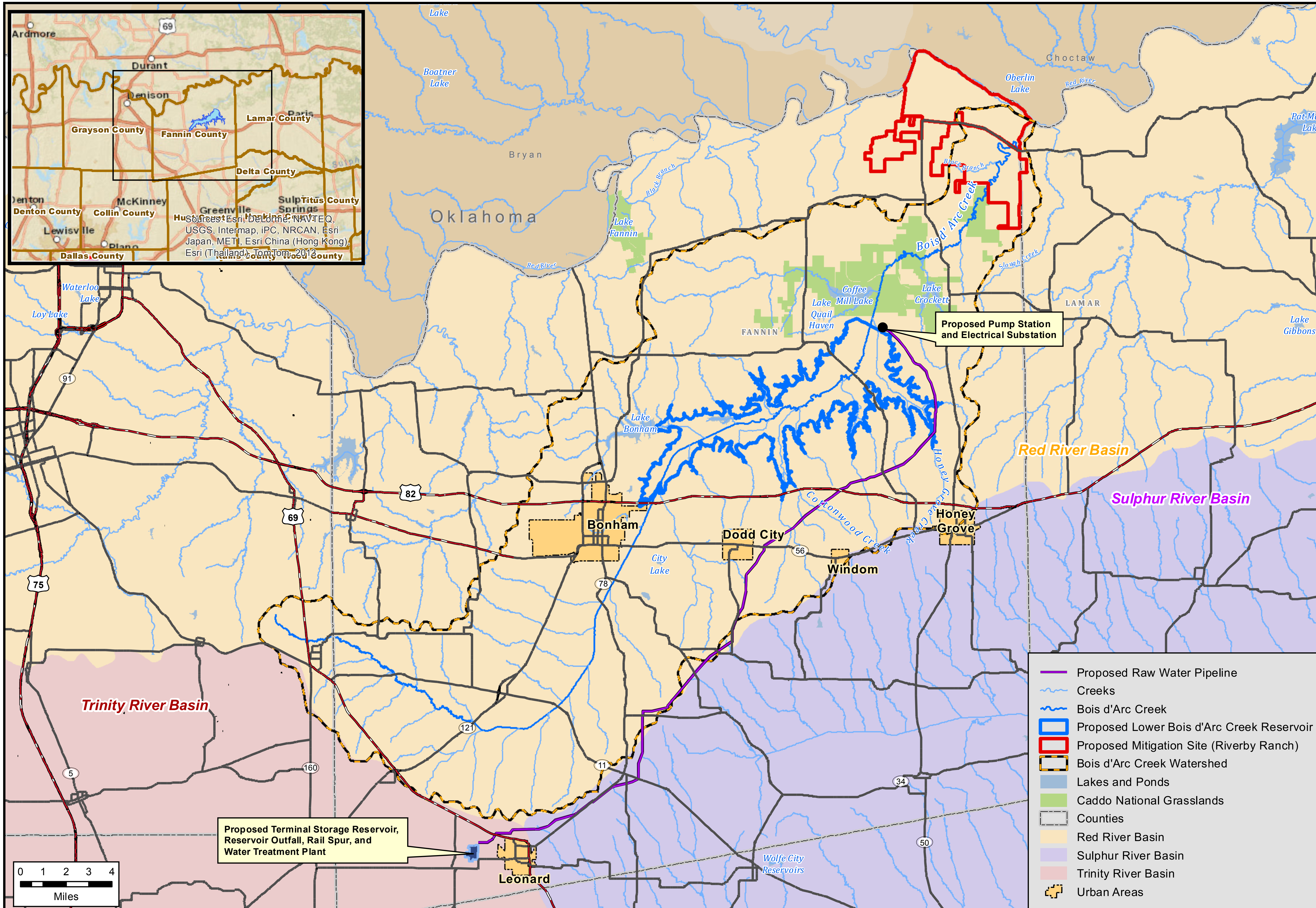
Vermont Stream Geomorphic Assessment Protocols (2004), publications of the Vermont

Agency of Natural Resources — < http://www.anr.state.vt.us/dec/waterq/rivers/htm/ rv_geoassess.htm >.

Watershed Assessment of River Stability & Sediment Supply (WARSSS). (n.d.). Retrieved November 11, 2014. <http://water.epa.gov/scitech/datait/tools/warsss/>.

Appendix A

Figures



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North Texas Municipal Water District

General Location Map - Proposed Reservoir Project Site and the Proposed Mitigation Site

N W E S

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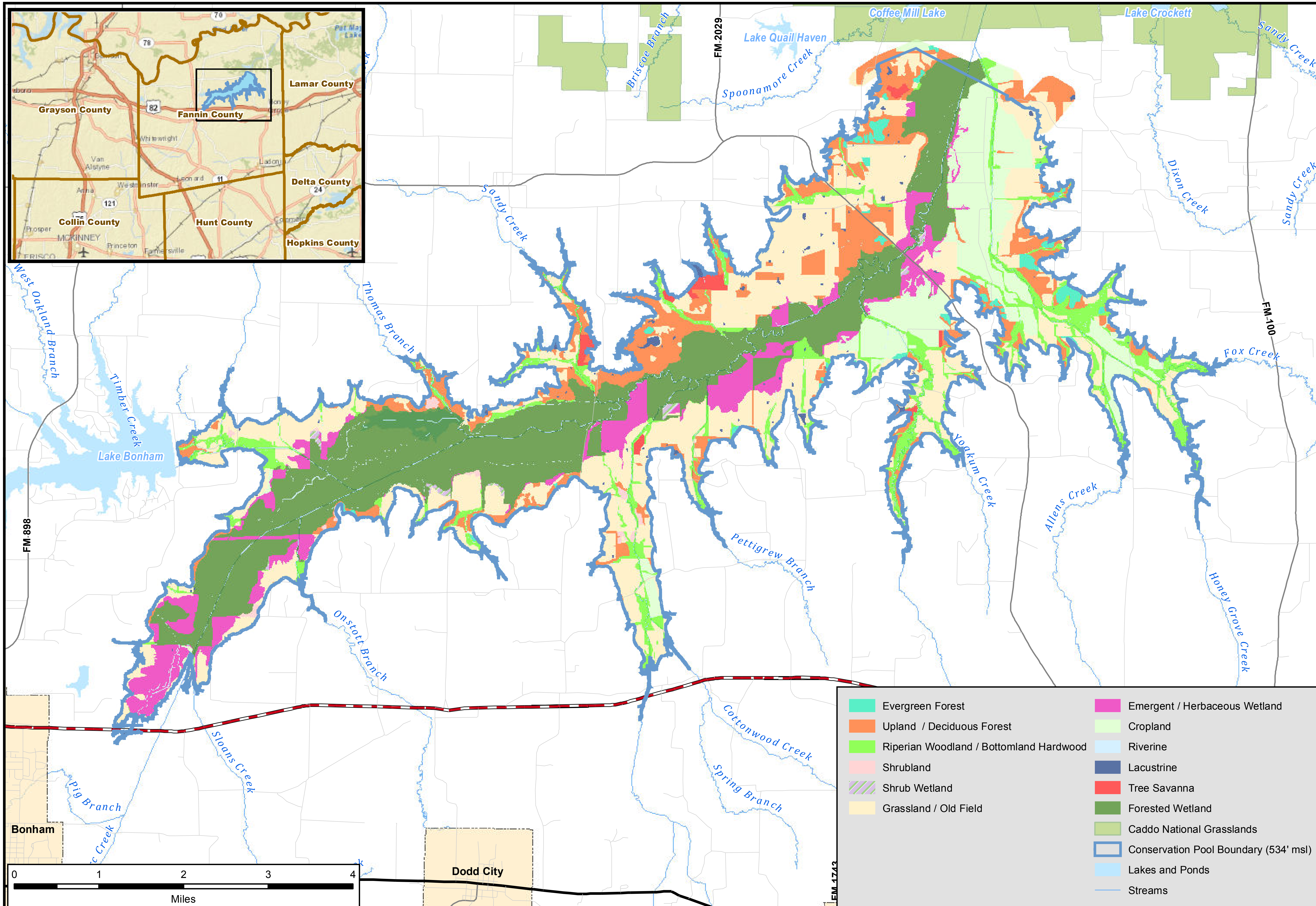
1

FIGURE



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North Texas Municipal Water District

Existing Cover Types
Proposed Lower Bois d'Arc Creek Reservoir Site

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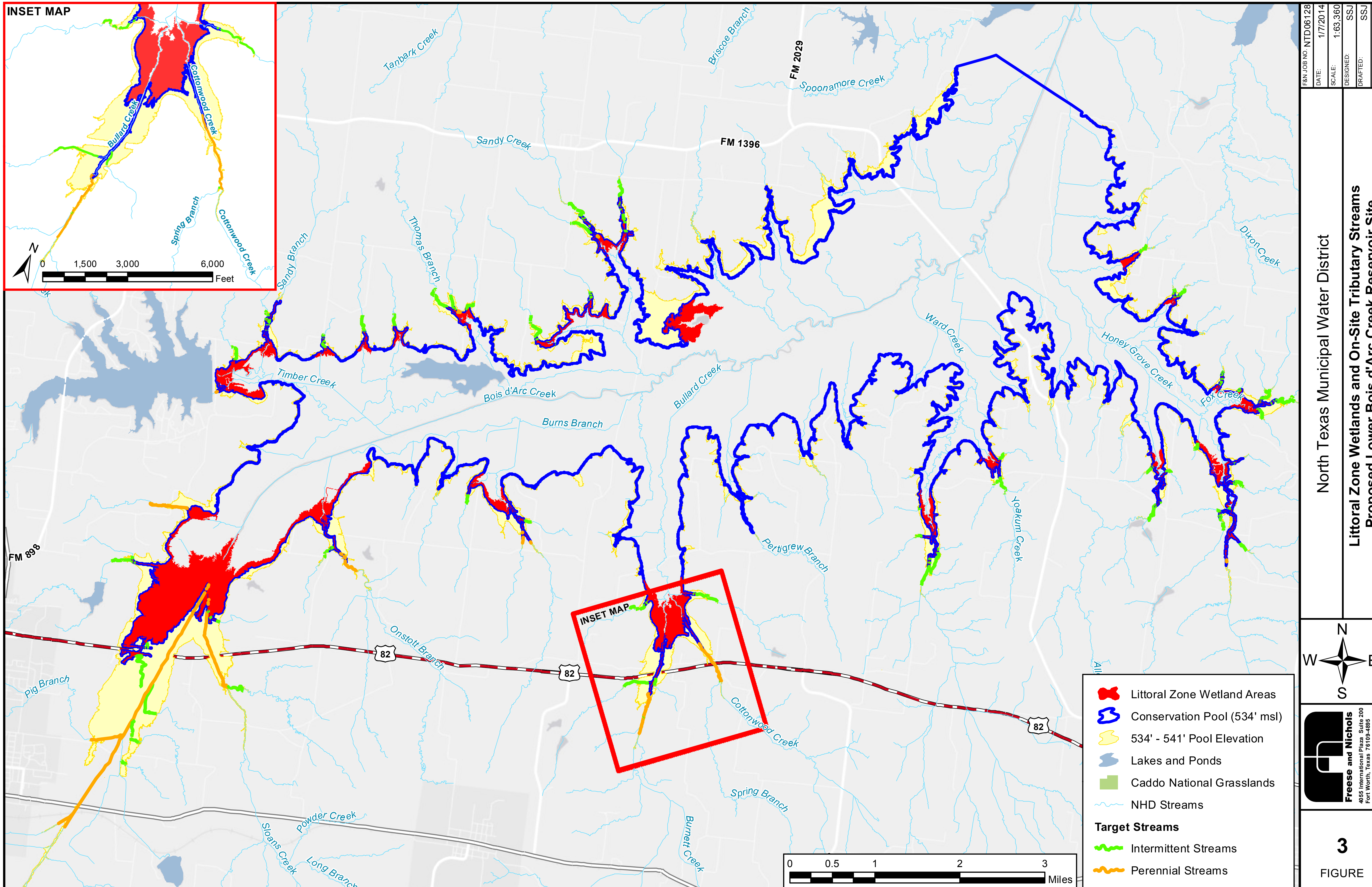
FIGURE 2



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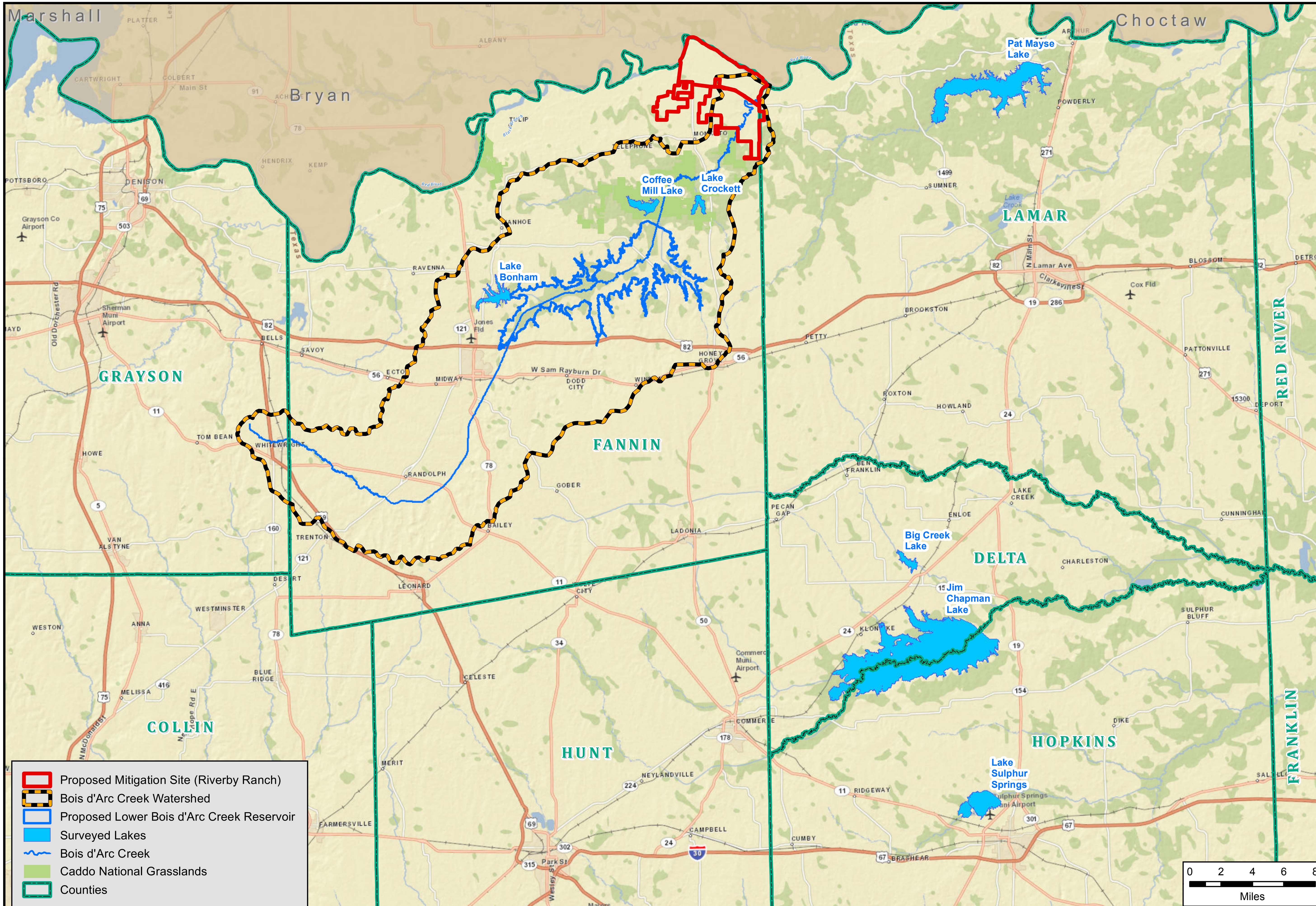

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Location of Area Reservoirs Surveyed by the Texas Parks and Wildlife Department

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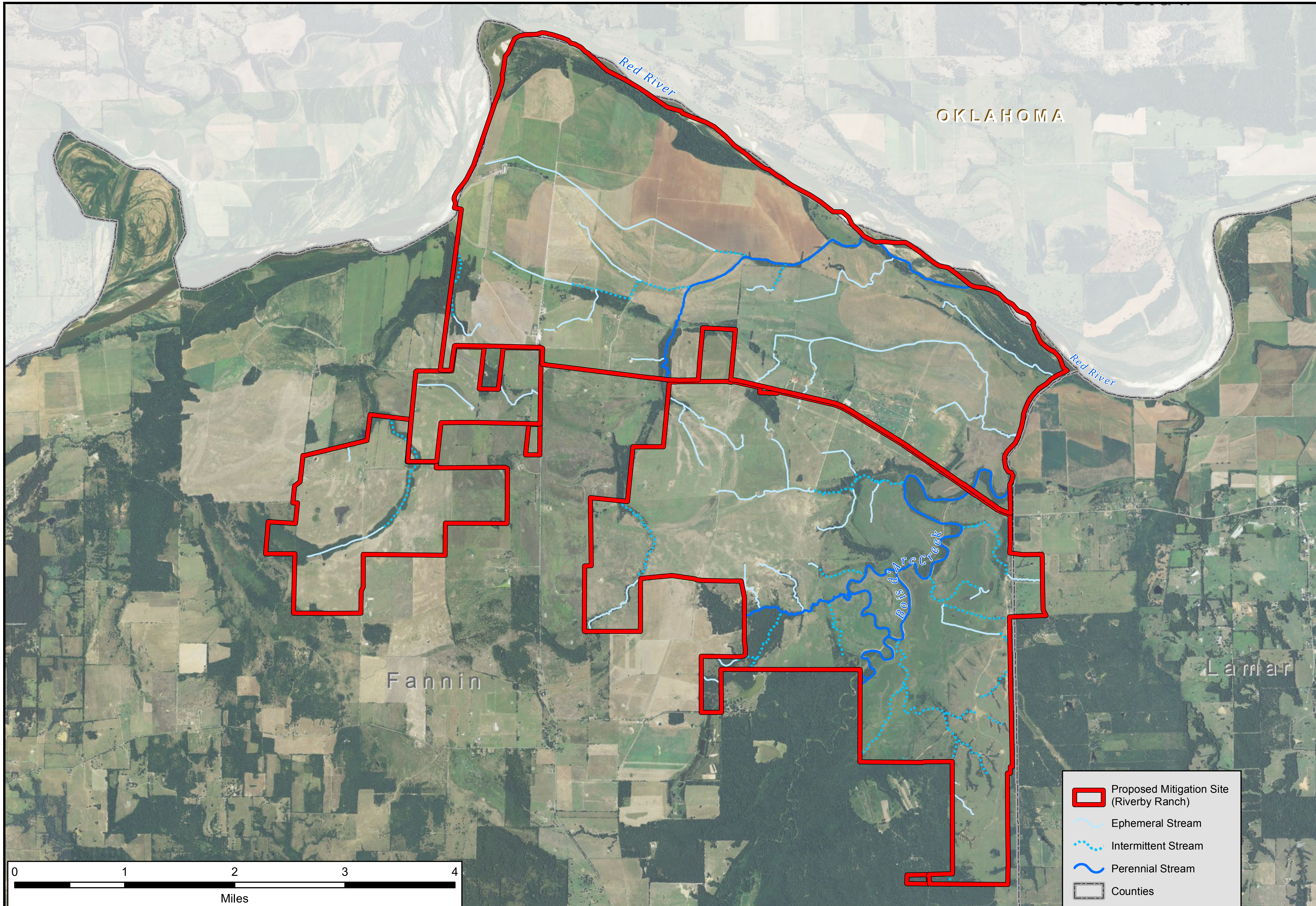
4

FIGURE



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North Texas Municipal Water District

Riverby Ranch Aerial Imagery

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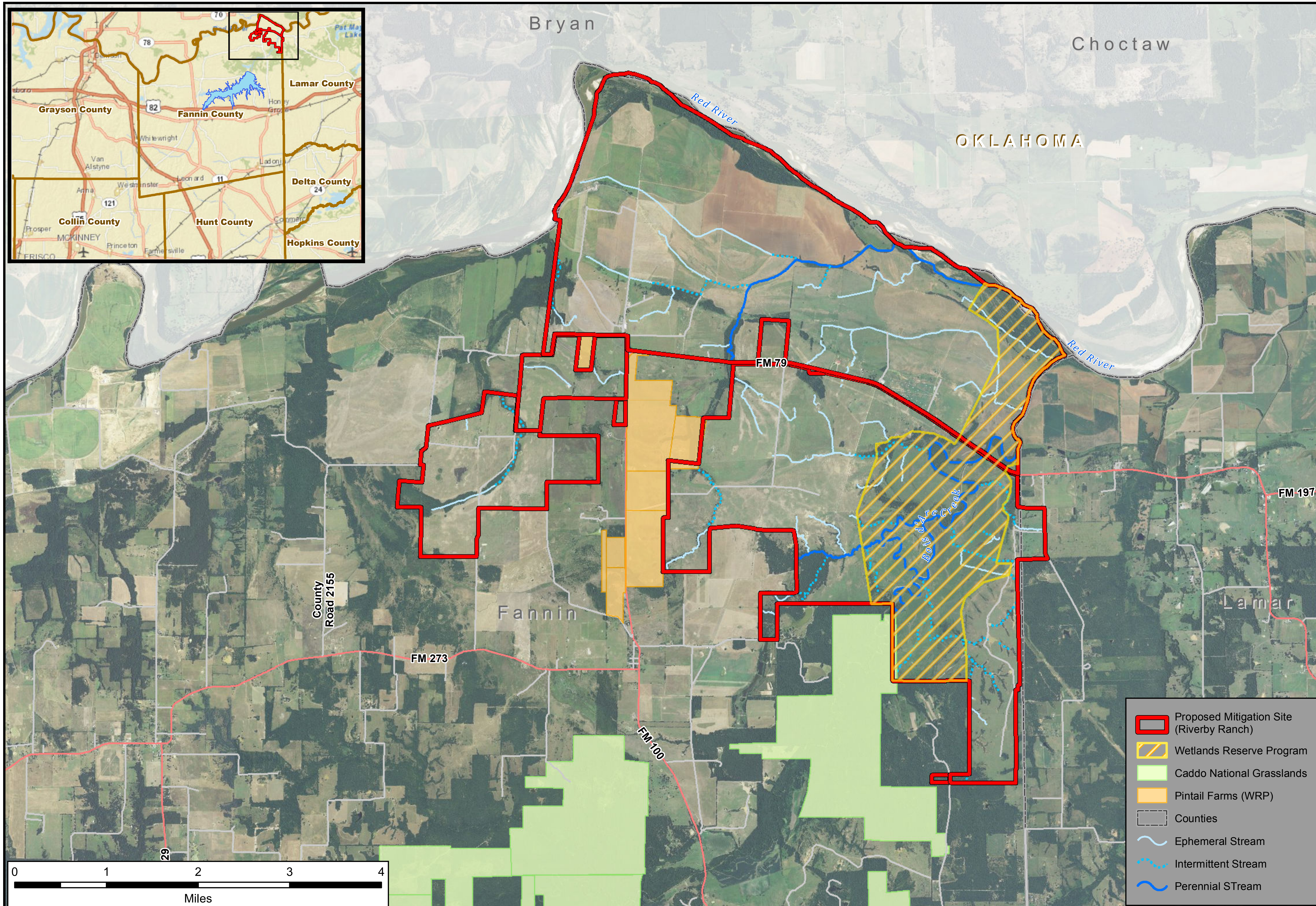
5
FIGURE



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Riverby Ranch Vicinity Map

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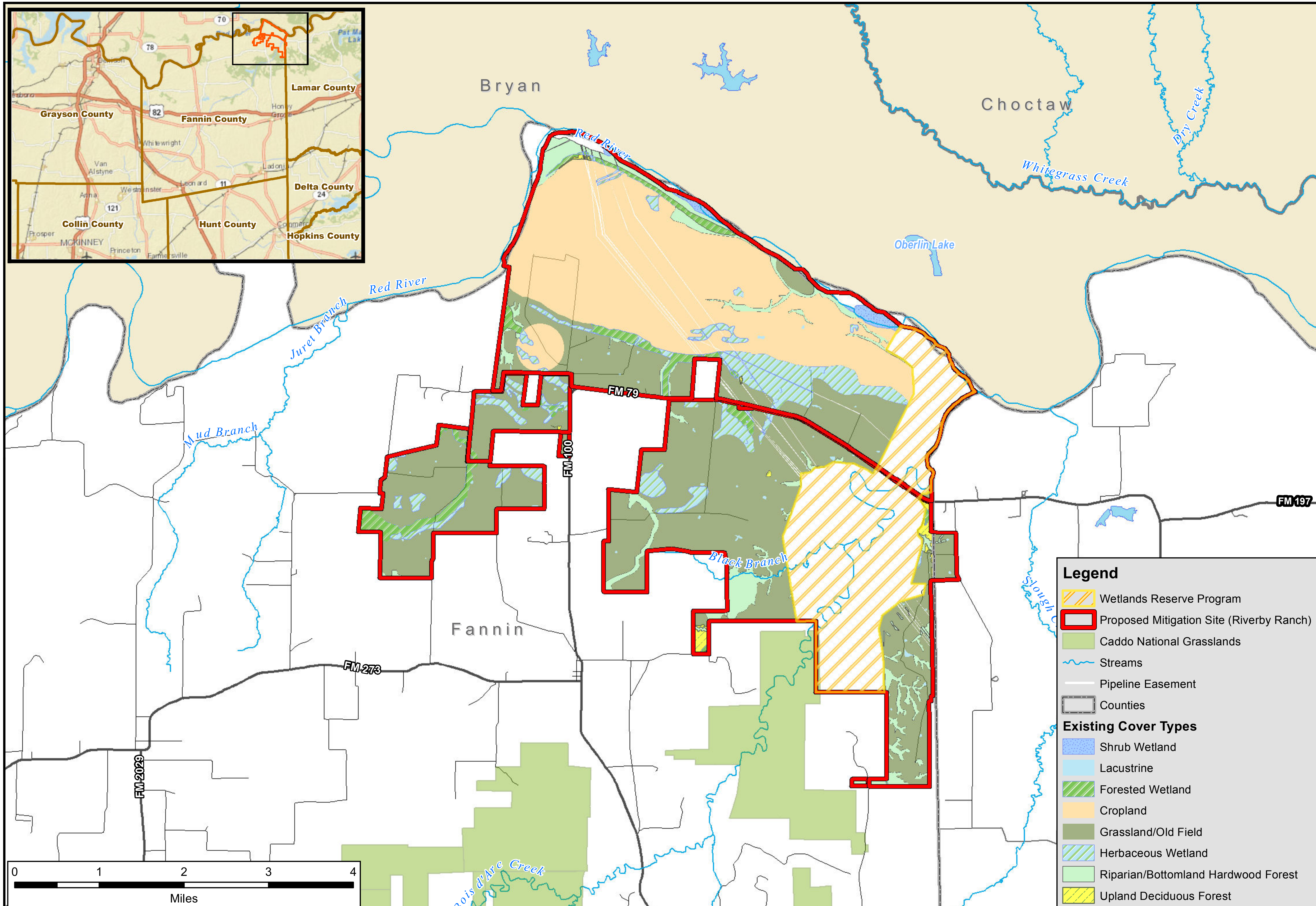
6

FIGURE



F&N JOB NO. NTD06128
DATE: May 2011
SCALE: 1:65,000
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North Texas Municipal Water District

Existing Cover Types at Proposed Mitigation Site

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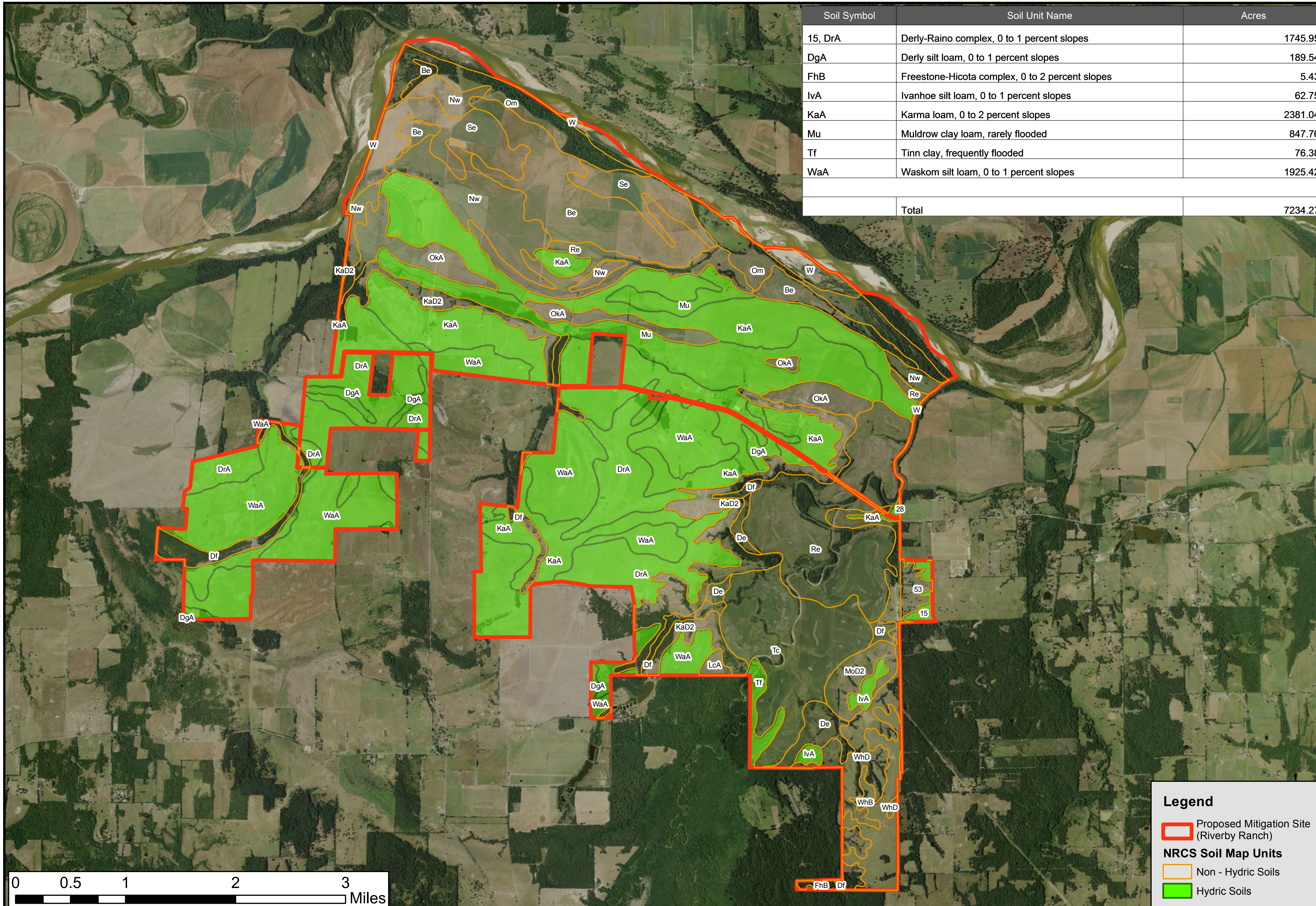
7
FIGURE



Soil Symbol	Soil Unit Name	Acres
15, DrA	Derly-Raino complex, 0 to 1 percent slopes	1745.95
DgA	Derly silt loam, 0 to 1 percent slopes	189.54
FhB	Freestone-Hicota complex, 0 to 2 percent slopes	5.43
IvA	Ivanhoe silt loam, 0 to 1 percent slopes	62.75
KaA	Karma loam, 0 to 2 percent slopes	2381.04
Mu	Muldrow clay loam, rarely flooded	847.76
Tf	Tinn clay, frequently flooded	76.38
WaA	Waskom silt loam, 0 to 1 percent slopes	1925.42
	Total	7234.27

F&N JOB NO. NTD06128
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North Texas Municipal Water District

Location of Hydric Soils at the Proposed Mitigation Site

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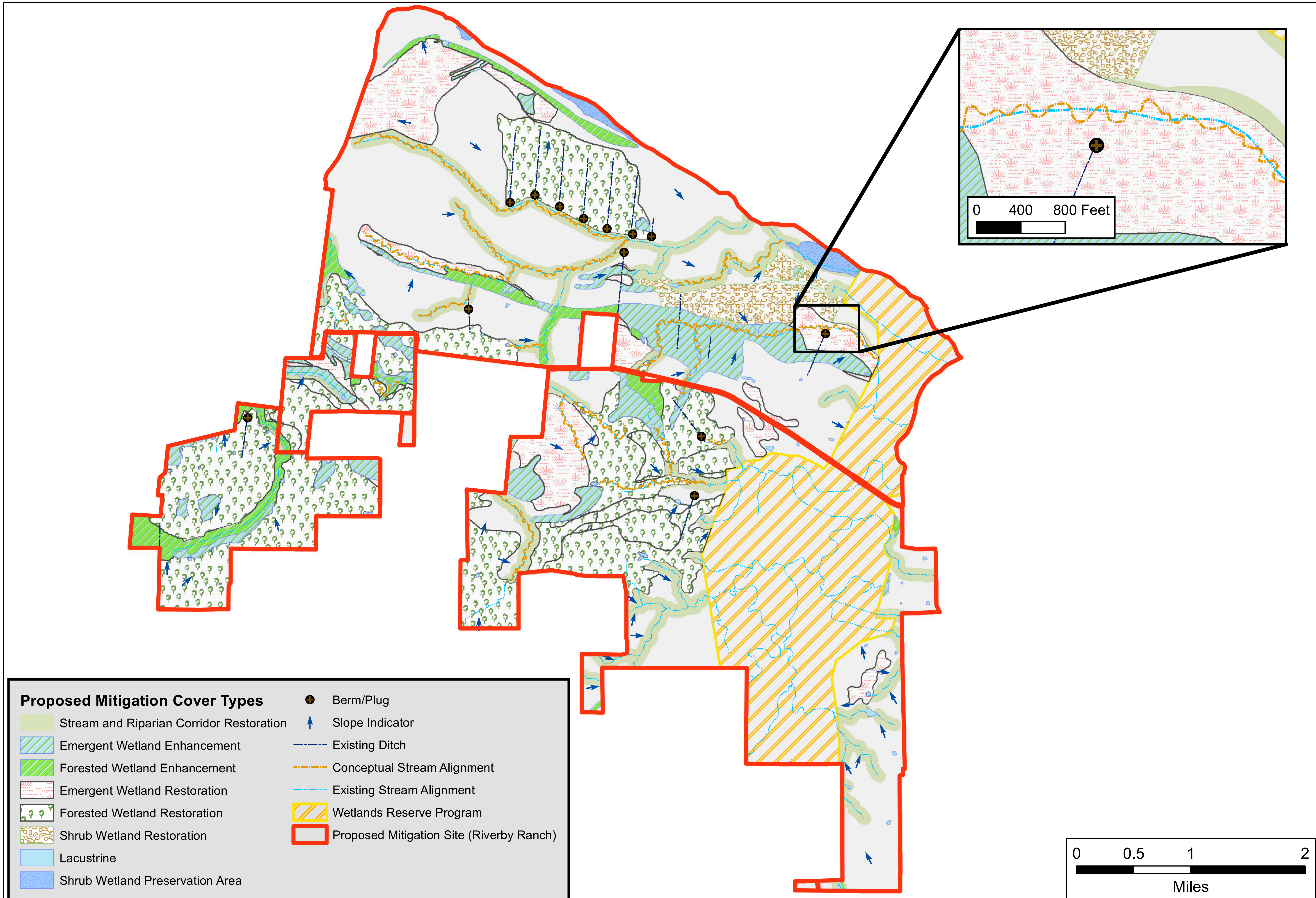
8
FIGURE



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North Texas Municipal Water District

Conceptual Plan For Stream and Hydrology Restoration

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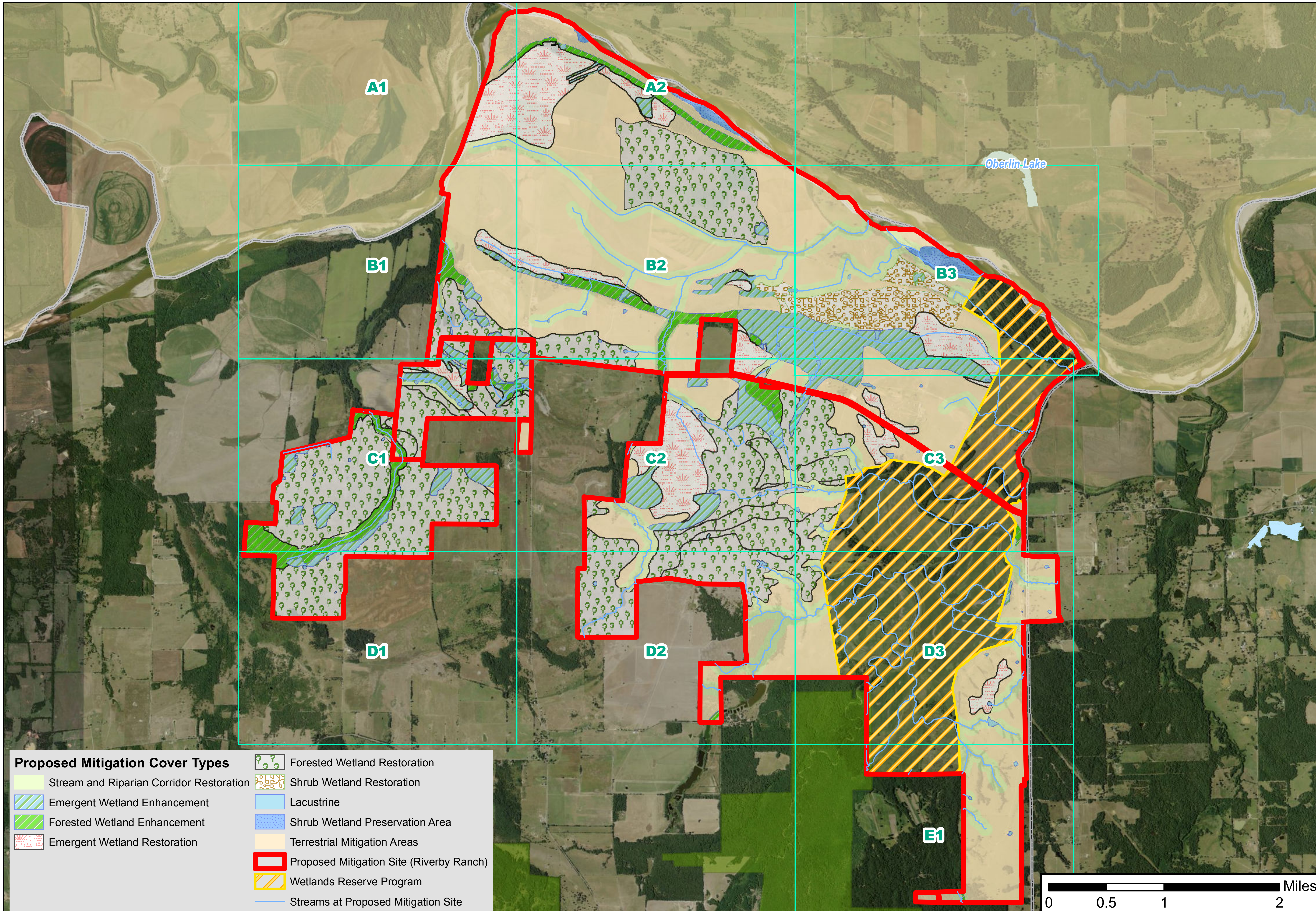
9

FIGURE



F&N JOB NO. NTD06128

DATE: May, 2011

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North Texas Municipal Water District

Index for Aquatic and Terrestrial Mitigation Area Maps

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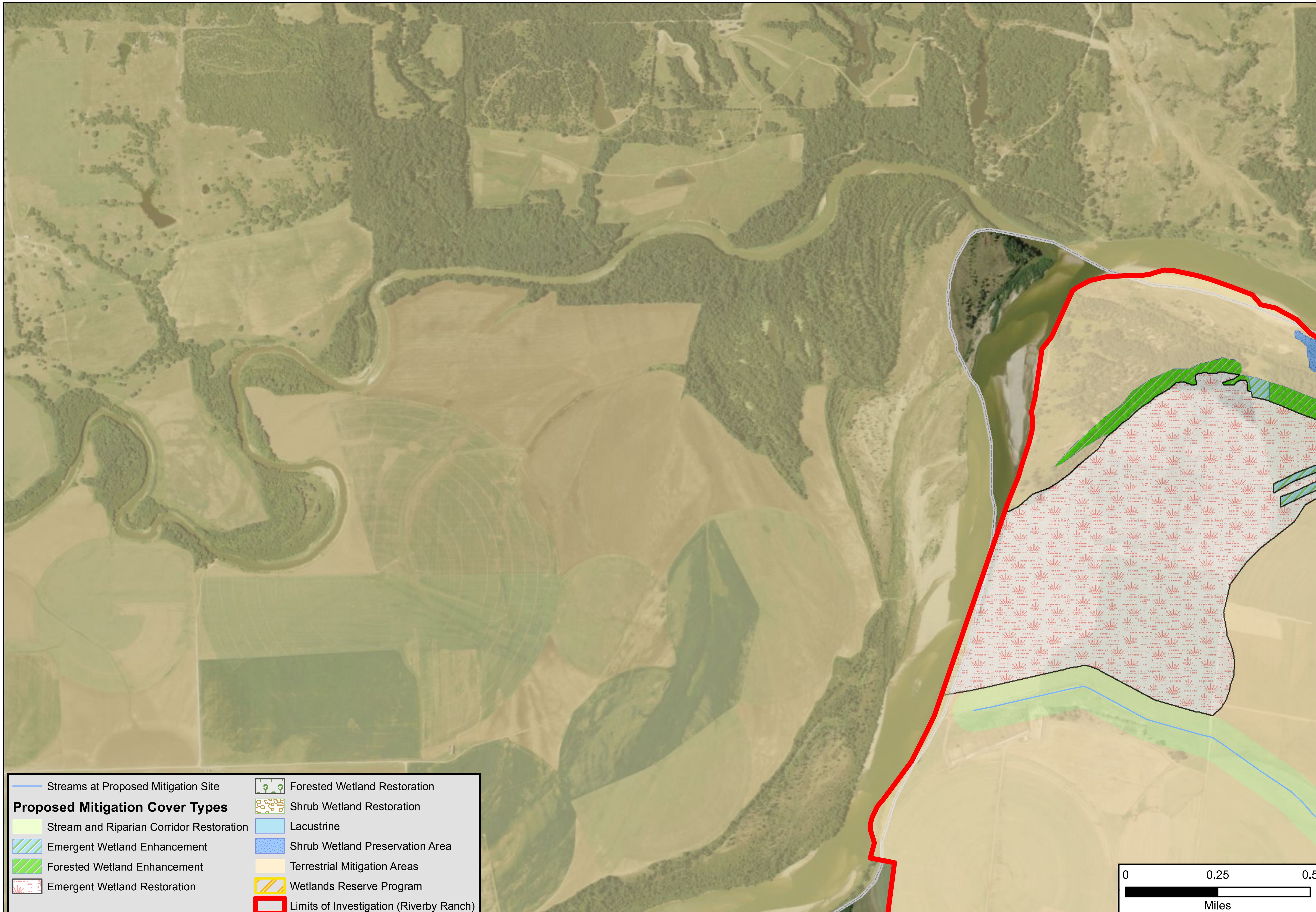
FIGURE 10



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Aquatic and Terrestrial Mitigation Area Maps

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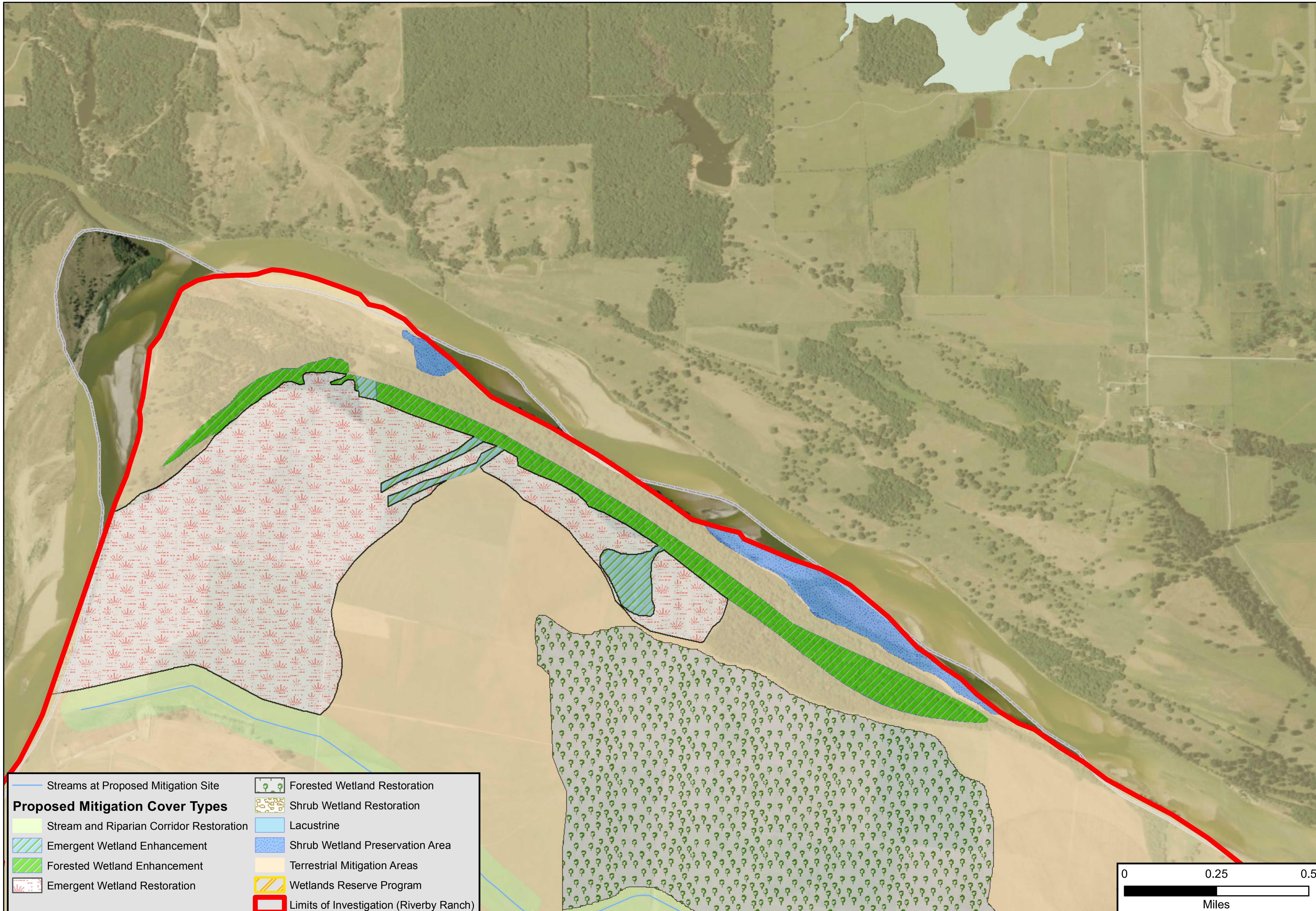
10A-1

FIGURE



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Aquatic and Terrestrial Mitigation Area Maps

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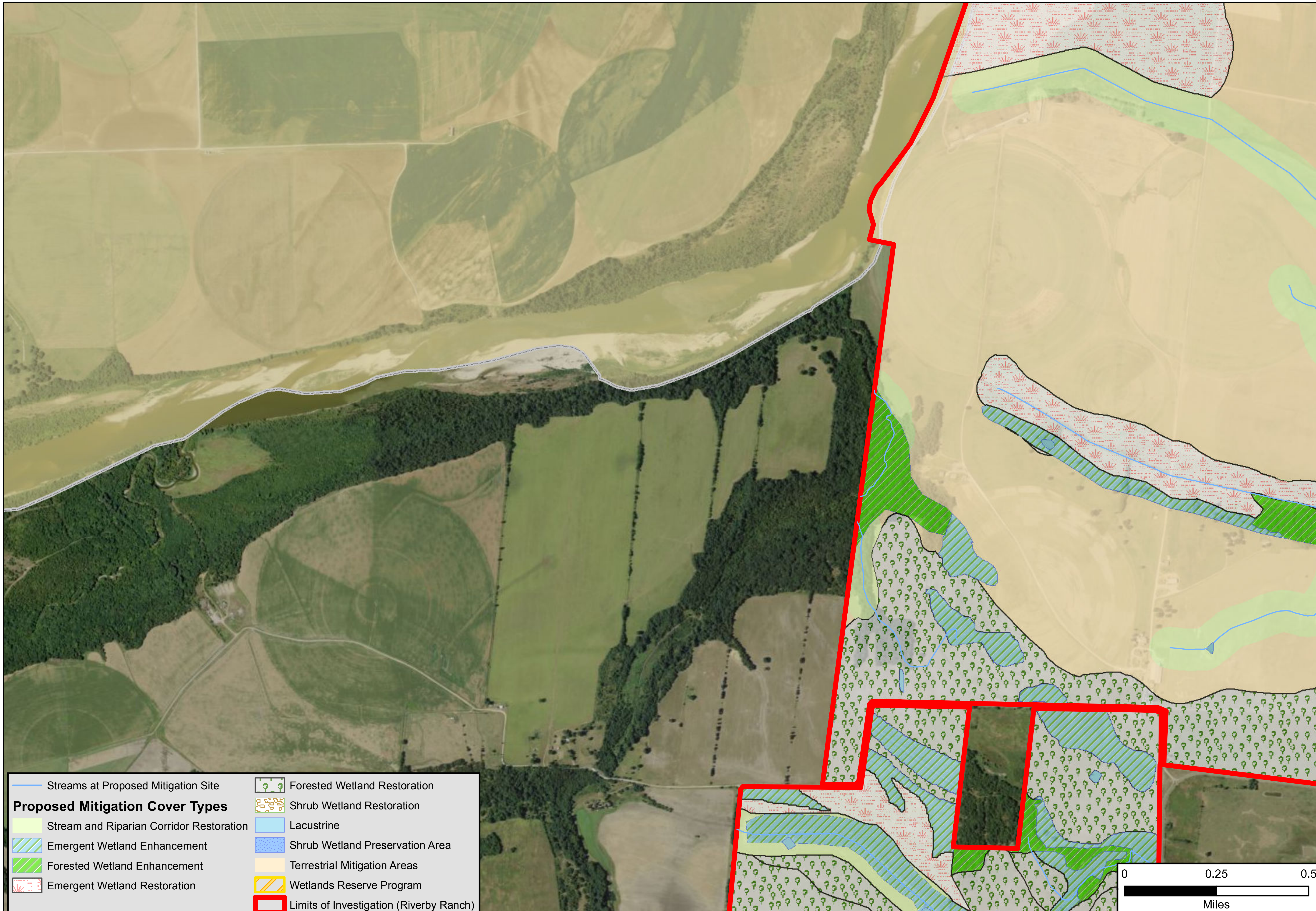
10A-2

FIGURE



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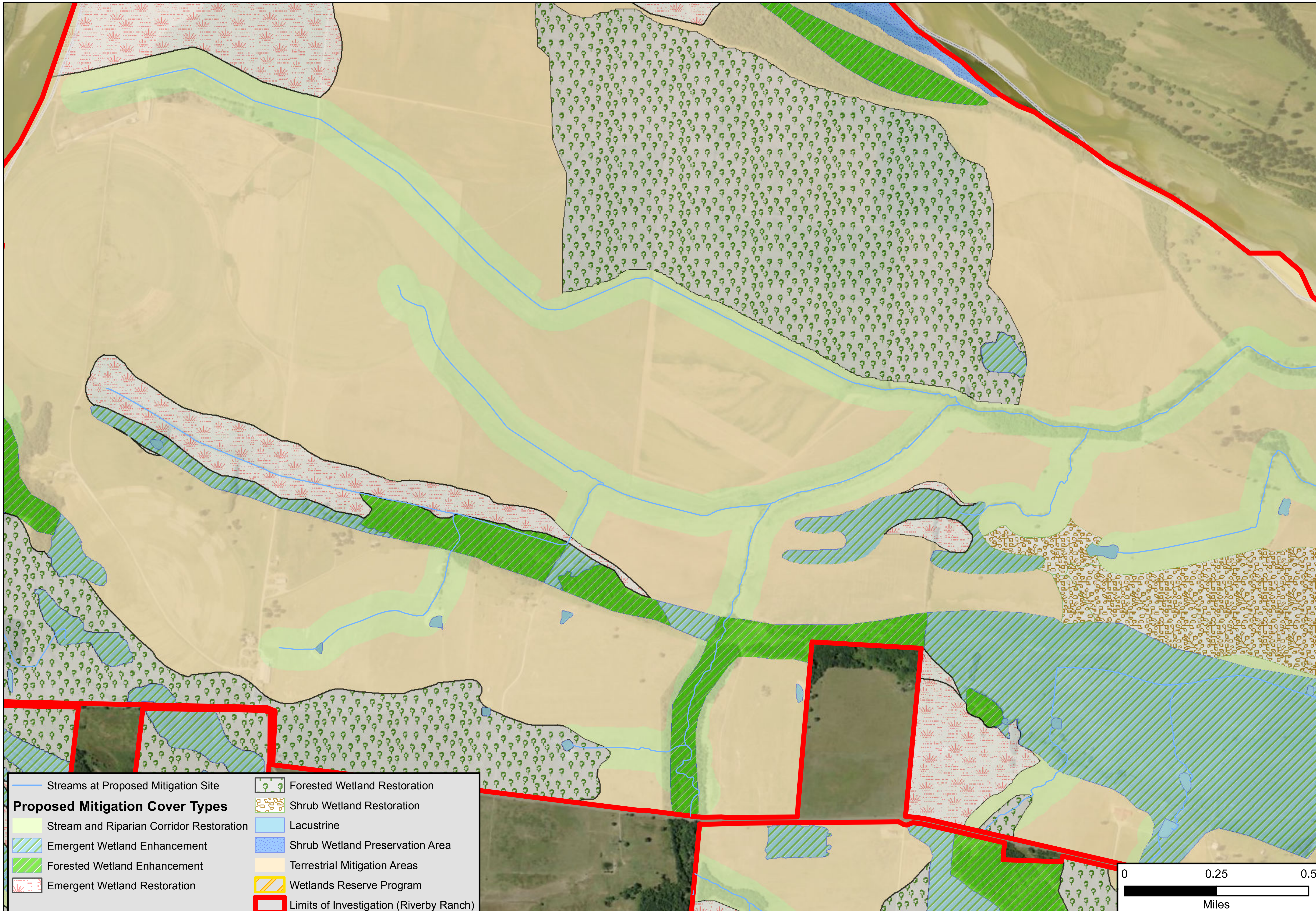
10B-1

FIGURE



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DATE: May, 2011
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DRAFTED: BME

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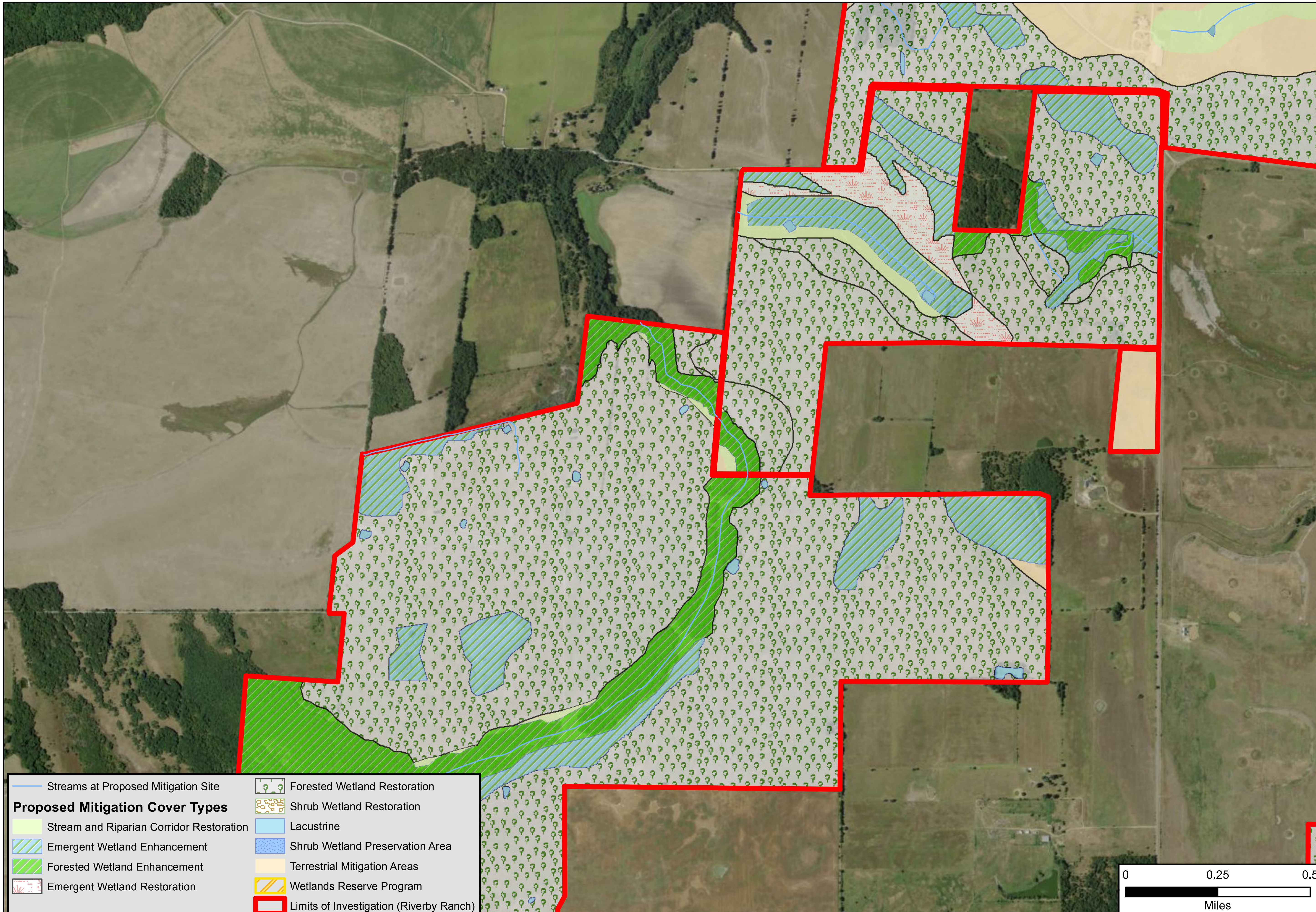
FIGURE 10B-2



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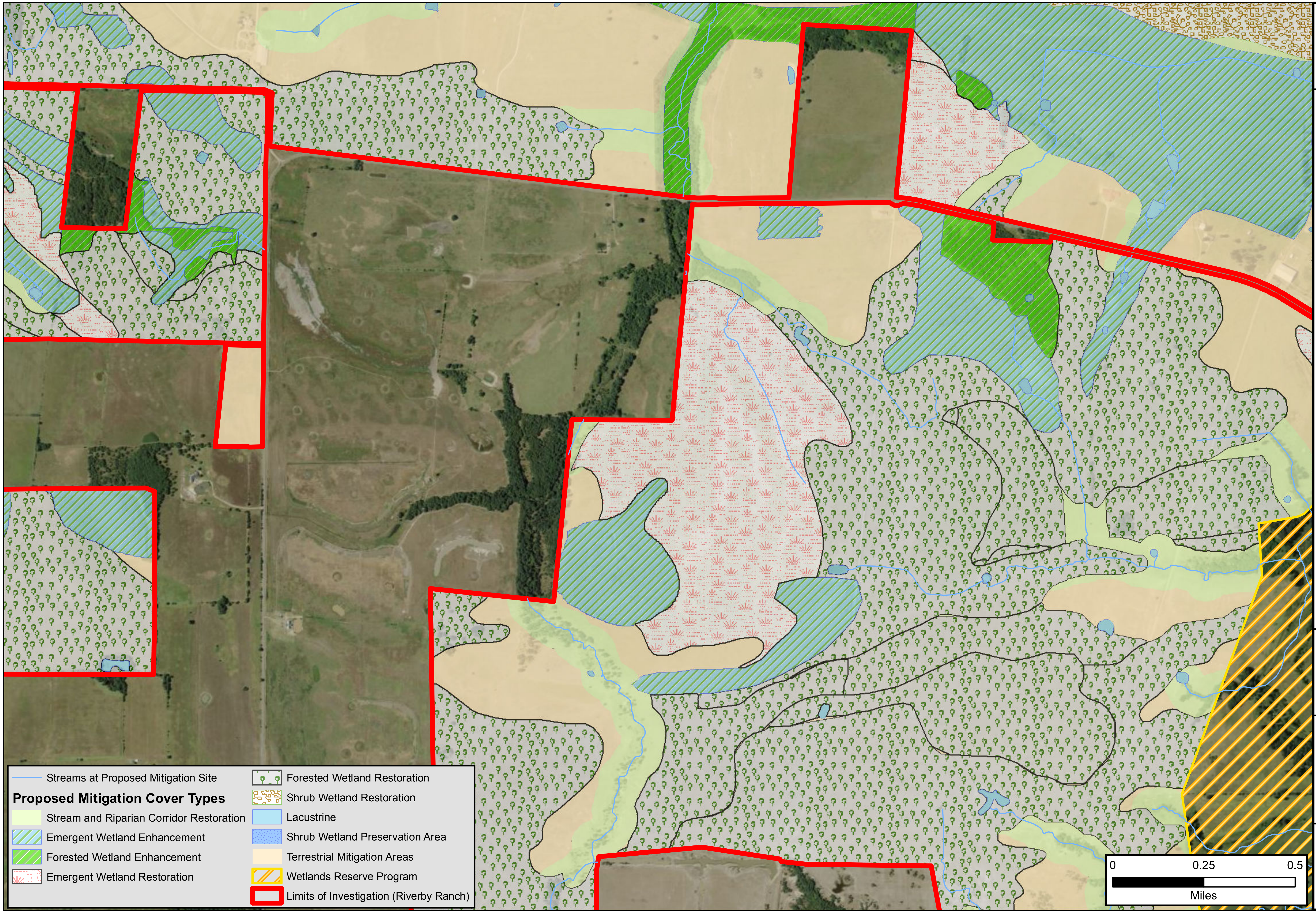
10C-1

FIGURE



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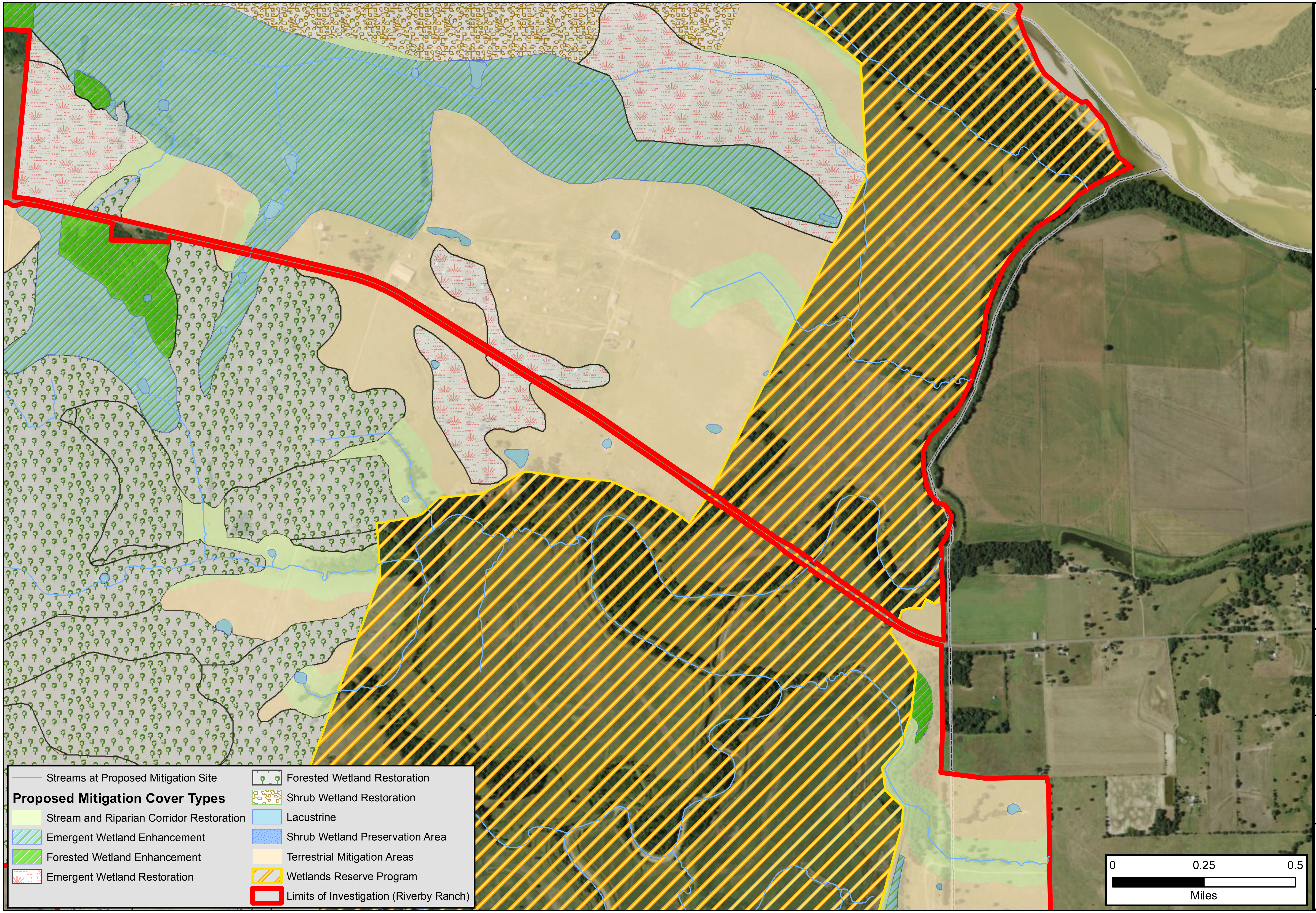
10C-2

FIGURE



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Aquatic and Terrestrial Mitigation Area Maps

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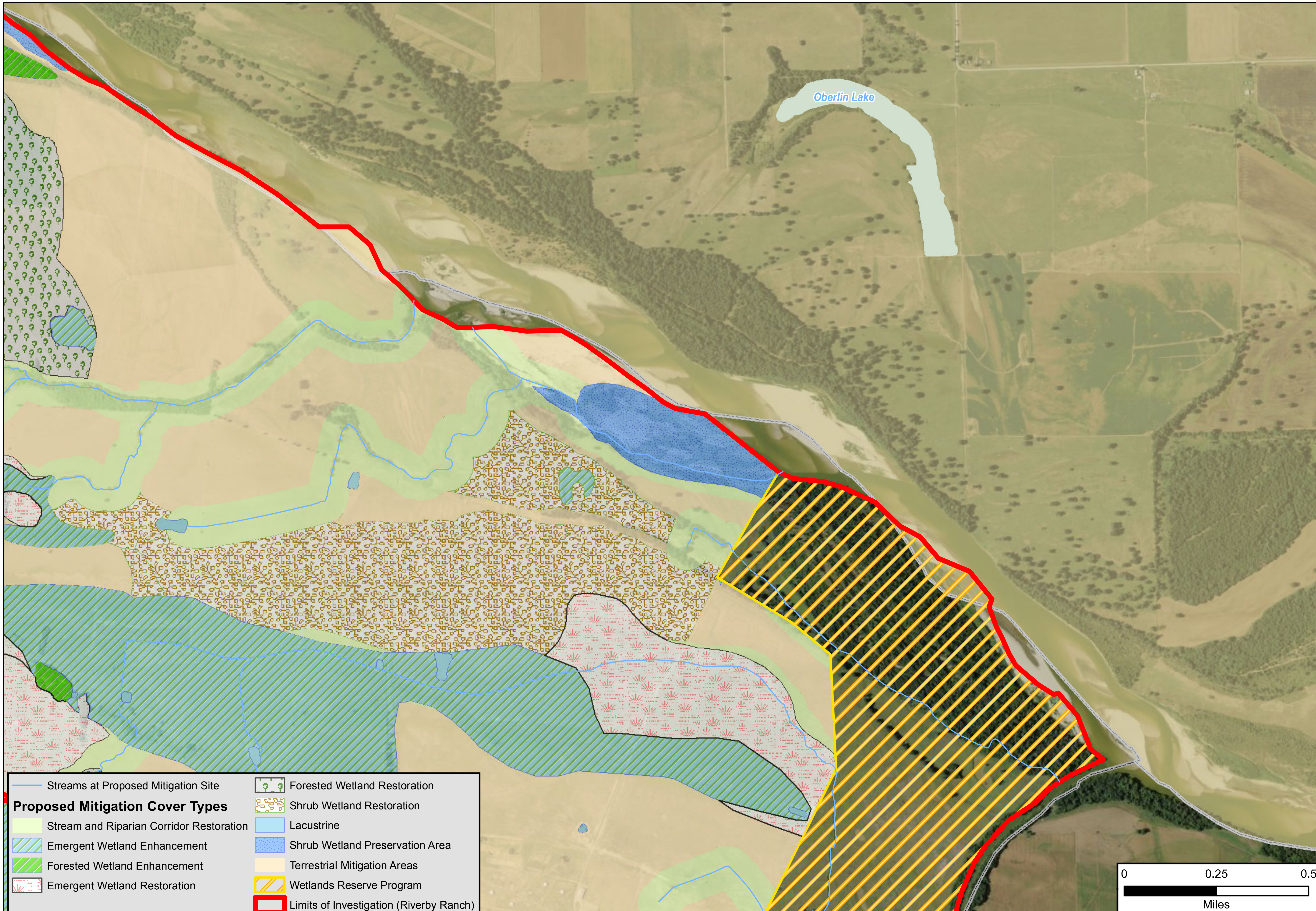
10C-3

FIGURE



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Aquatic and Terrestrial Mitigation Area Maps

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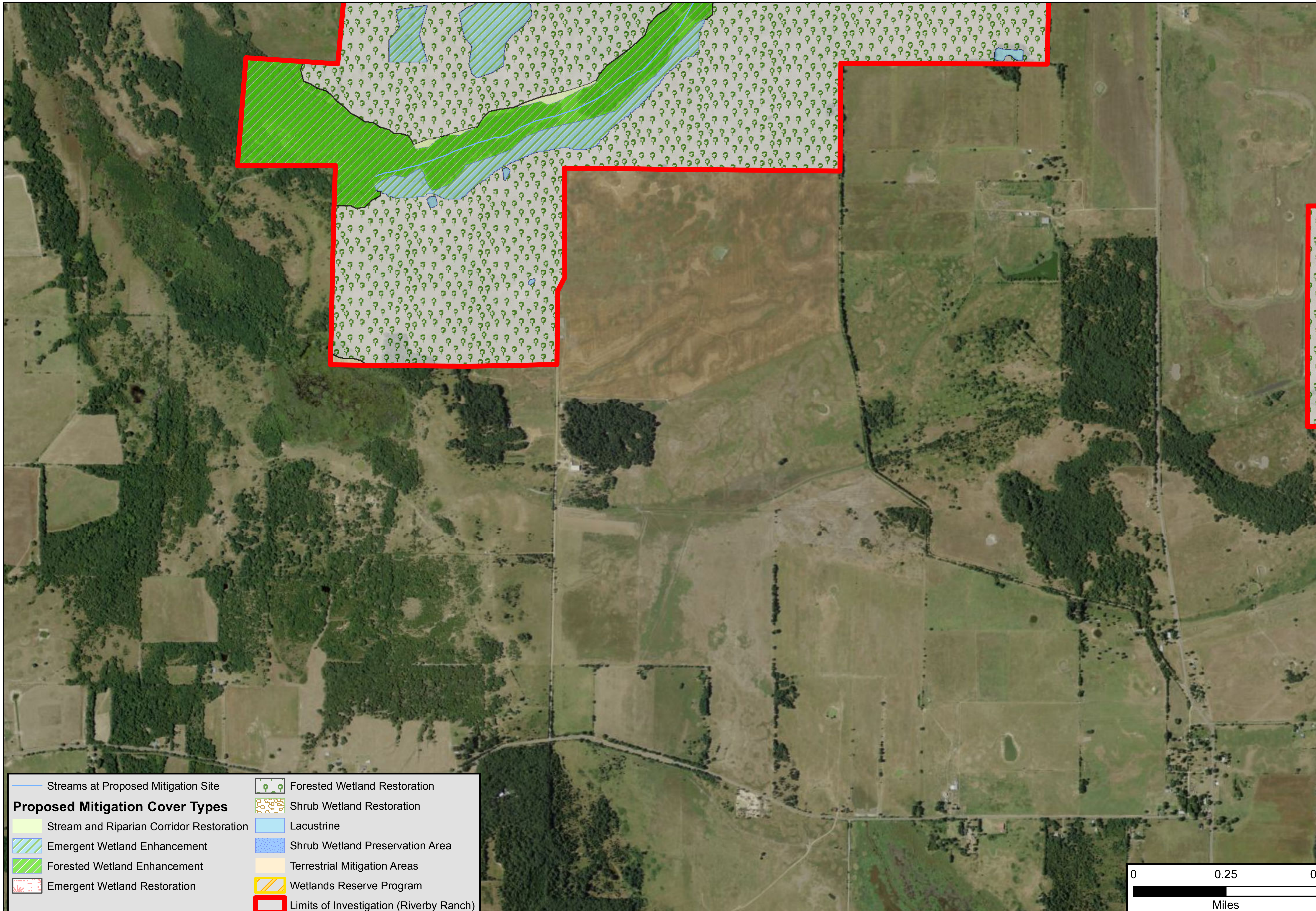
10B-3

FIGURE



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North Texas Municipal Water District

Aquatic and Terrestrial Mitigation Area Maps

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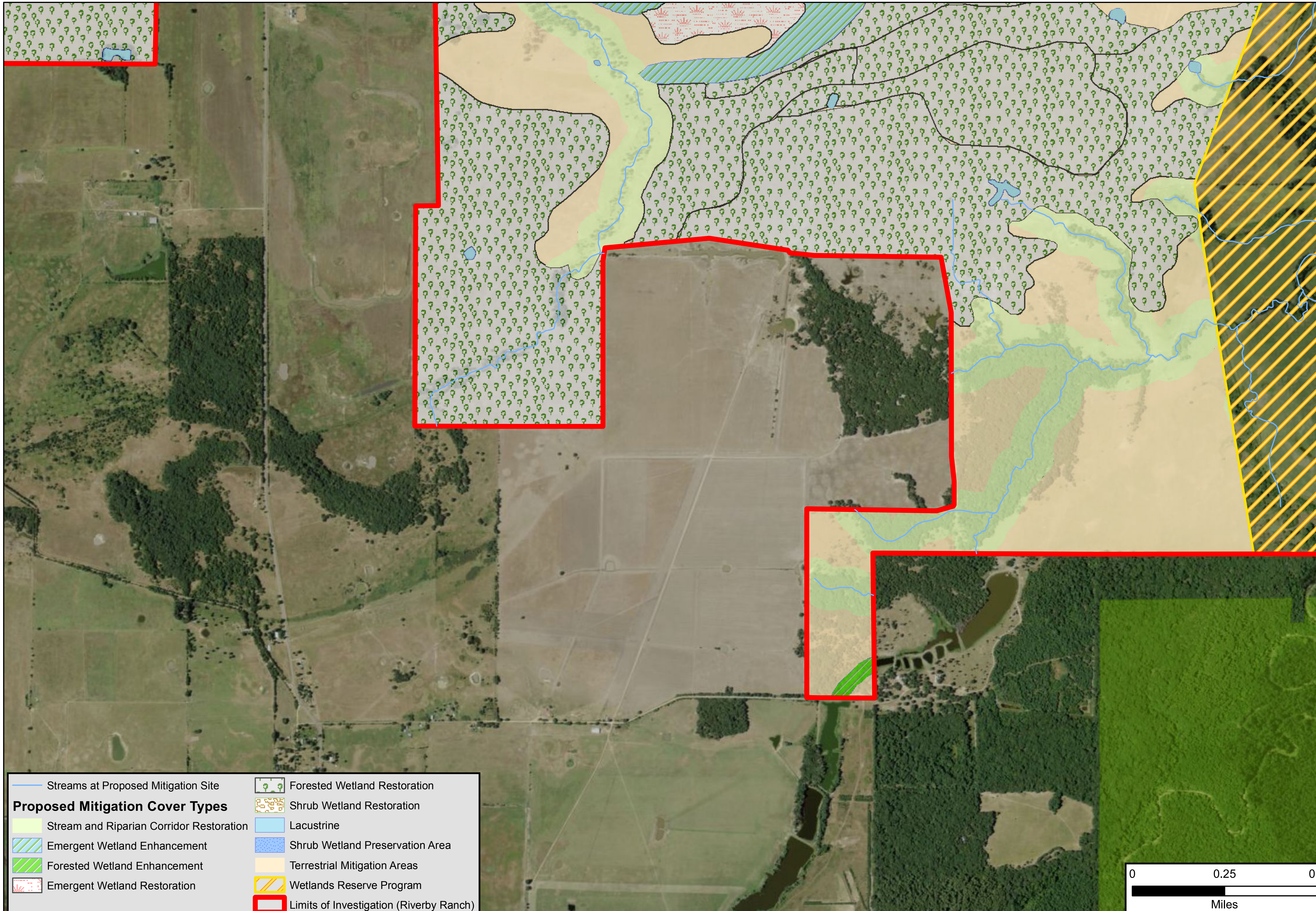
10D-1

FIGURE



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North Texas Municipal Water District

Aquatic and Terrestrial Mitigation Area Maps

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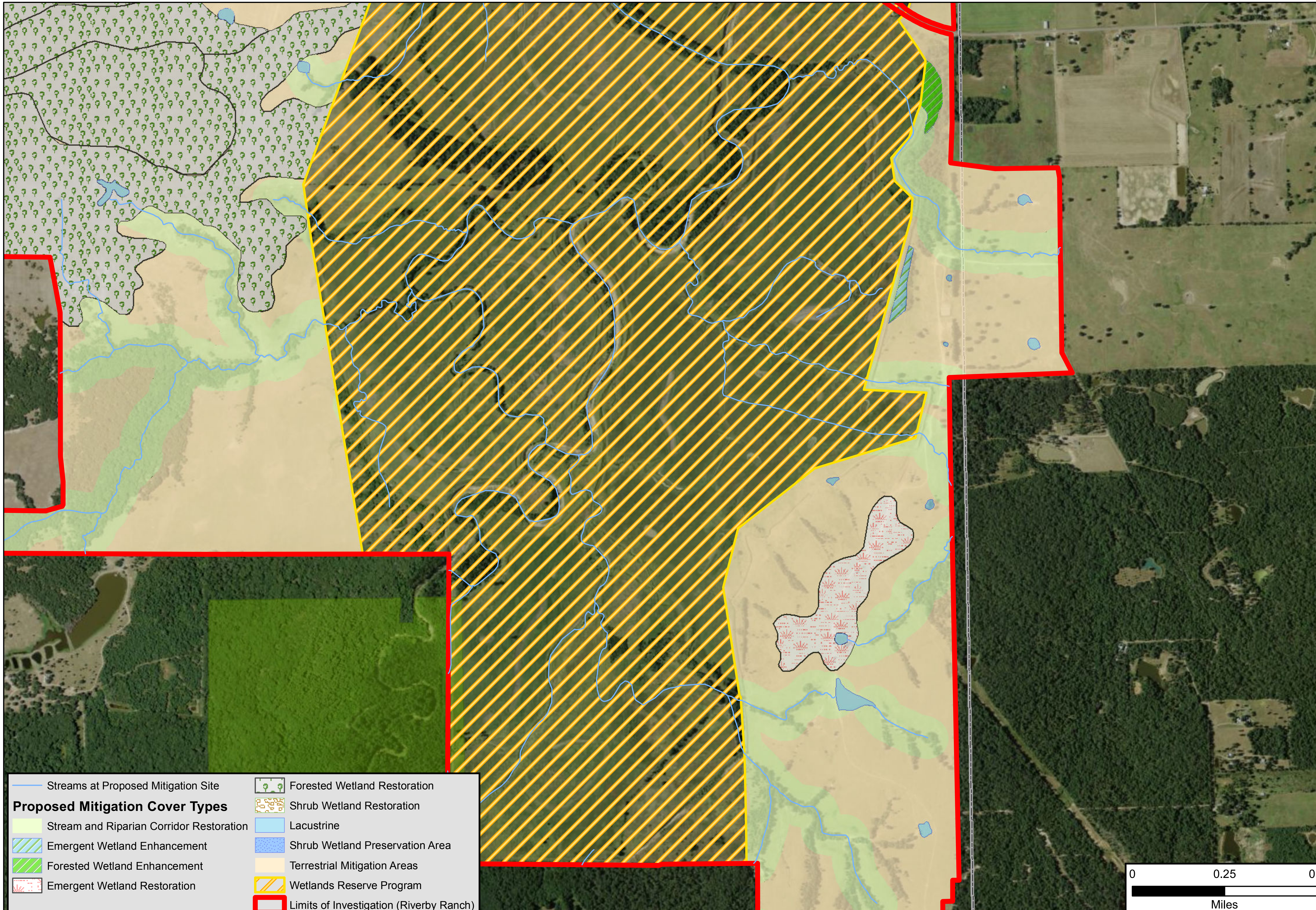
10D-2

FIGURE



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Aquatic and Terrestrial Mitigation Area Maps

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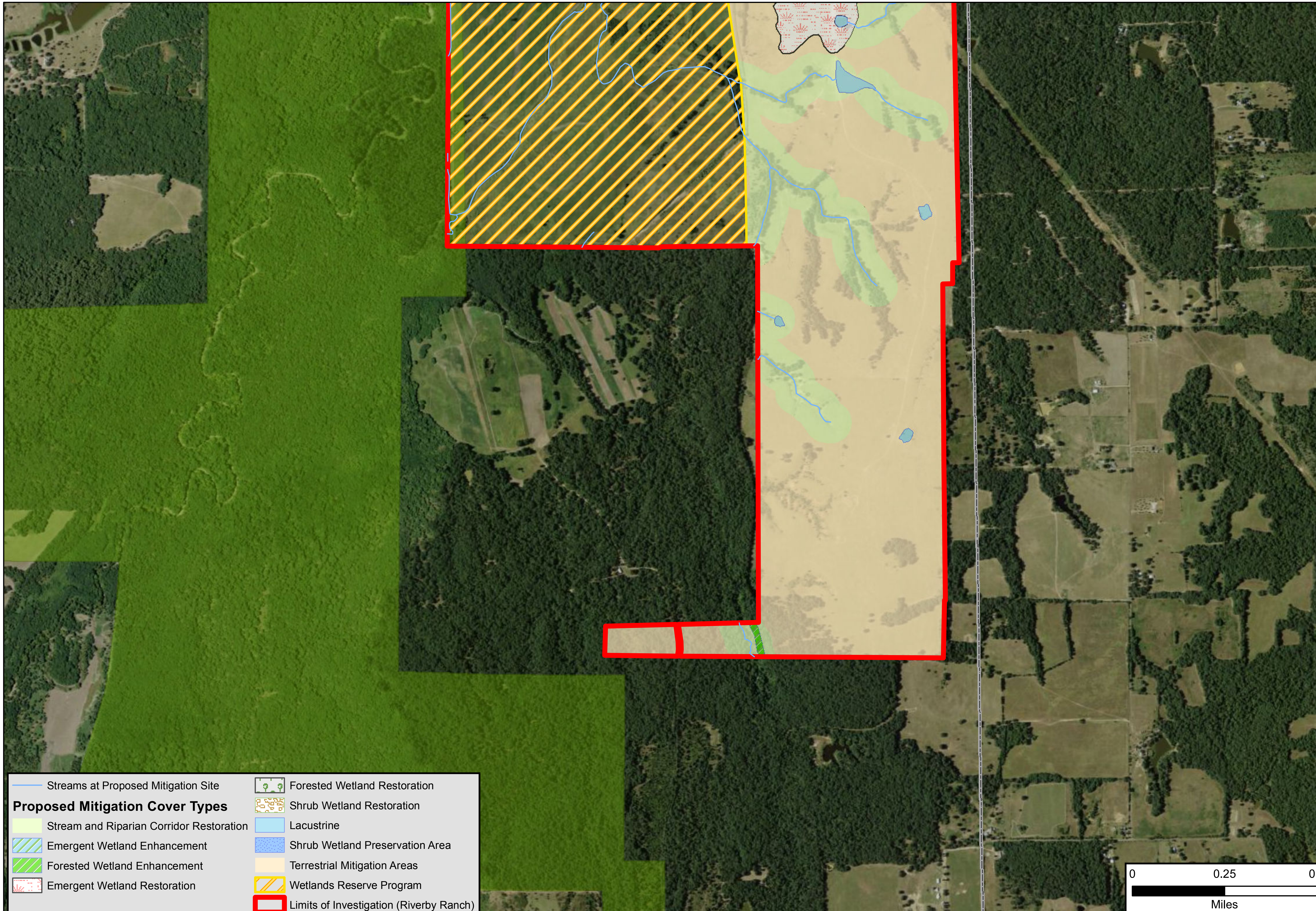
10D-3

FIGURE



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North Texas Municipal Water District

Aquatic and Terrestrial Mitigation Area Maps

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10E-1

FIGURE

Appendix B

Common and Scientific Names of Organisms Identified within Mitigation Plan

Organisms Identified within Mitigation Plan

Common Name	Scientific Name
Birds	
American crow	*Corvus brachyrhynchos*
Barred owl	*Strix varia*
Canada goose	*Branta canadensis*
Carolina chickadee	*Poecile carolinensis*
Carolina wren	*Thryothorus ludovicianus*
Common yellowthroat	*Geothylpis trichas*
Ducks	Family: *Anatidae*
Great blue heron	*Ardea Herodias*
Great egret	*Ardea alba*
Indigo bunting	*Passerina cyanea*
Northern cardinal	*Cardinalis cardinalis*
Northern harrier	*Circus cyaneus*
Painted bunting	*Passerina ciris*
Red-tailed hawk	*Buteo jamaicensis*
Solitary warbler	Family: *Parulidae*
Tufted titmouse	*Baeolophus bicolor*
White-eyed vireo	*Vireo griseus*
White-fronted goose (greater)	*Anser albifrons*
Yellow-billed cuckoo	*Coccyzus americanus*
Forbs	
American lotus	*Nelumbo lutea*
Arrowhead	*Sagittaria* spp.
Balloon vine	*Cardiospermum halicacabum*
Black-eyed susan	*Rudbeckia hirta*
Buttercup	*Ranunculus* spp.
Clasping coneflower	*Dracopis amplexicaulis*
Dock	*Rumex* spp.
Drummond phlox	*Phlox drummondii*
Eared redstem	*Ammannia auriculata*
Evening primrose (pink)	*Oenothera speciosa*
Frogfruit	*Phyla* spp.
Goldenrod	*Solidago* spp.
Illinois bundleflower	*Desmanthus illinoensis*
Indian blanket	*Gaillardia pulchella*
Ironweed	*Vernonia* spp.
Lazy daisy	*Aphanostephus* sp.
Lemon mint	*Monarda citriodora*
Mockbishop weed	*Ptilimnium nuttallii*
Partridge pea	*Chamaecrista fasciculata*
Pennsylvania smartweed	*Polygonum pensylvanicum*
Plains coreopsis	*Coreopsis tinctoria*

Common Name	Scientific Name
Ragweed	*Ambrosia* spp.
Redstems	*Ammannia* spp.
Roundleaf groundsel	*Packera obouta*
Smartweeds	*Polygonum* spp.
Sumpweed	*Iva annua*
Water primrose	*Ludwigia* spp.
Wild pea	*Lathyrus* spp.
Grasses	
Barnyardgrass	*Echinochloa crus-galli*
Broomsedge bluestem	*Andropogon virginicus*
Bushy bluestem	*Andropogon glomeratus*
Crowngrass	*Paspalum* sp.
Eastern gamagrass	*Tripsacum dactyloides*
Indiangrass	*Sorghastrum nutans*
Little bluestem	*Schizachyrium scoparium*
Prairie wildrye	*Elymus canadensis*
Purpletop	*Tridens flavus*
Sand dropseed	*Sporobolus cryptandrus*
Sand lovegrass	*Eragrostis trichodes*
Sideoats grama	*Bouteloua curtipendula*
Switchgrass	*Panicum virgatum*
Virginia wildrye	*Elymus virginicus*
Insects	
Butterflies	Order: *Lepidoptera*
Mosquitoes	Family: *Culicidae*
Bees	Order: *Hymenoptera*
Dragonflies	Order: *Odonata*
Mammals	
Raccoon	*Procyon lotor*
American Beaver	*Castor canadensis*
River otter	*Lutra canadensis*
Feral hog	*Sus scrofa*
White-tailed deer	*Odocoileus virginianus*
Reptiles	
Ornate box turtle	*Terrapene ornata*
Cottonmouth water moccasin	*Agkistrodon piscivorus*
Copperhead	*Agkistrodon contortrix*
Amphibians	
Frogs	Order: *Anura*
Southern Leopard frog	*Rana sphenocephala*
Rushes and Sedges	
Blue sedge	*Carex glaucodea*

Common Name	Scientific Name
Cherokee sedge	*Carex cherokeensis*
Flatsedge	*Cyperus* spp.
Flatstem spikerush	*Eleocharis compressa*
Grassleaf rush	*Juncus marginatus*
Green flatsedge	*Cyperus virens*
Horned beakrush	*Rhynchospora corniculata*
Slimpod rush	*Juncus diffusissimus*
Spikerush	*Eleocharis* spp.
Shrubs and Vines	
American beautyberry	*Callicarpa americana*
Baccharis	*Baccharis* spp.
Buttonbush	*Cephalanthus occidentalis*
Coralberry	*Symphoricarpos orbiculatus*
Deciduous holly	*Ilex decidua*
Hydrolea	*Hydrolea ovata*
Poison ivy	*Toxicodendron radicans*
Salt cedar	*Tamarix chinensis*
Sandbar willow	*Salix exigua*
Swamp privet	*Forestiera acuminata*
Virginia creeper	*Parthenocissus quinquefolia*
Trees	
American sycamore	*Platanus occidentalis*
Black cherry	*Prunus serotina*
Black hickory	*Carya texana*
Black oak	*Quercus velutina*
Black walnut	*Juglans nigra*
Black willow	*Salix nigra*
Bois d'Arc	*Maclura pomifera*
Box elder	*Acer negundo*
Bur oak	*Quercus macrocarpa*
Cedar elm	*Ulmus crassifolia*
Chinkapin oak	*Quercus muehlenbergii*
Eastern cottonwood	*Populus deltoides*
Elm	*Ulmus* spp.
Green ash	*Fraxinus pennsylvanica*
Hackberry	*Celtis occidentalis*
Honey locust	*Gleditsia triacanthos*
Pecan	*Carya illinoinensis*
Post oak	*Quercus stellata*
Red mulberry	*Morus rubra*
Shumard oak	*Quercus shumardii*
Southern red oak	*Quercus falcata*
Sugarberry	*Celtis laevigata*
Water oak	*Quercus nigra*

Common Name	Scientific Name
White oak	*Quercus alba*
Willow oak	*Quercus phellos*
Other	
Crayfish	Family: *Cambaridae*
Mussels	Family: *Unionidae*
Mosquitofish	*Gambusia affinis*
Land snails	Class: *Gastropoda*

Appendix C

May 13, 2011, Response to TCEQ Request for Information, Attachment F, *Impacts to Terrestrial and Riparian Habitats*

ATTACHMENT F
Impacts to Terrestrial and Riparian Habitats

The North Texas Municipal Water District has provided evaluations of the impacts of the proposed Lower Bois d'Arc Creek Reservoir to the Commission through supplemental reports to the water right application and supporting documents to the Section 404 permit application. A list of these reports and associated relevant sections is provided at the end of this attachment. The following discussions are compilations of data analyses and evaluations that have been previously reported. New and/or changed information in this attachment includes an updated list of threatened and endangered state-listed species in Fannin County and a comparative map of the 100-year floodplain with and without the proposed reservoir (Figure F-1).

DIRECT IMPACTS OF PROJECT

The proposed Lower Bois d'Arc Creek reservoir will impact approximately 17,068 acres which includes 16,641 acres for the lake and 427 acres for the construction of the dam and spillways. Much of the existing site has been altered over the past 100 years mainly due to agricultural practices and stream channelization. Currently, 38 percent of the project site is cropland and grassland, 37 percent is riparian woodland/bottomland hardwoods, and most of the remainder of the site is upland/ deciduous forests. Generally, the habitat quality is the highest for cropland, tree savanna (132 acres) and grassland. Riparian woodland/bottomland hardwood habitat is low quality, with a habitat suitability index of 0.25 (on a scale of 0 to 1). The habitat types and acreages found within the reservoir site are shown in Table F-1. The habitat suitability indices by cover type are shown in Table F-2.

Table F-1
Habitat Types and Acreage Found on Lower Bois d'Arc Reservoir Site

Habitat Type	Acreage
Evergreen Forest	228
Upland / Deciduous Forest	2,216
Riparian Woodland / Bottomland Hardwood / Forested Wetland (Total for HEP Purposes) *Riparian Woodland / Bottomland Hardwood* *Forested Wetland*	6,330 *1,728* *4,602*
Shrubland	63
Shrub Wetland	49
Grassland / Old Field	4,761
Emergent / Herbaceous Wetland	1,223
Cropland	1,757
Riverine	219
Lacustrine	87
Tree Savanna	132
Shrub Savanna	4
Grand Total	**17,068**

Source: Table 3-4, *Environmental Report Supporting an Application for a Section 404 Permit,* FNI, 2008.

Table F-2
Habitat Suitability Indices by Cover Type

Cover Type	Average HSI Values	Area (acres)	Habitat Units (HUs)
Upland Deciduous Forest	0.47	2,216	1,042
Evergreen Forest	0.35	228	80
Tree Savanna	0.73	132	96
Shrubland	0.57	63	36
Cropland	0.72	1,757	1,265
Grassland / Old Field	0.60	4,761	2,857
Riparian Woodland / Bottomland Hardwood	0.25	6,330	1,583
Shrub Wetland	0.46	49	23
Emergent / Herbaceous Wetland	0.42	1,223	514
		TOTAL HABITAT UNITS	**7,494**

Source: Table 12, Appendix D, "Habitat Evaluation procedure (HEP) Report for the Lower Bois d'Arc Creek Reservoir", *Environmental Report Supporting an Application for a Section 404 Permit*, FNI, 2008

Terrestrial Impacts:

Of the total 17,068 acres impacted by the construction of the proposed lake, approximately 16,762 acres are vegetated by terrestrial vegetation. This includes existing wetlands. Based on an inter-agency Habitat Evaluation Procedure study conducted at the reservoir site, these acreages represent 7,494 habitat units. With the construction of the reservoir, these habitat units will convert to aquatic habitats with approximately 2,150 acres of emergent wetlands created along the shores of the proposed reservoir (based on a 5-foot water level fluctuation). Terrestrial wildlife within the project area will likely relocate to nearby areas and new aquatic wildlife will develop within the project area.

The U.S. Fish and Wildlife Services lists one species occurring or potentially occurring in Fannin County as either threatened or endangered: least tern (endangered). The bald eagle, which was previously federally listed as threatened, has been recently delisted as recovered and being monitored for the first five years.

The Texas Parks and Wildlife Department (TPWD) also lists eleven additional terrestrial species as endangered or threatened with statewide extinction that are considered to potentially occur in Fannin County. Protections for state-listed species are limited to direct takings such as capture, trapping or killing. Incidental takings, such as destruction of habitats, are not prohibited. A list of the state listed species is shown on Table F-3. Based on the studies conducted at the site, no threatened or endangered terrestrial species are expected to be adversely affected by the proposed project.

Table F-3

State-Listed Threatened and Endangered Terrestrial Species in Fannin County

	Species	State Status	Description of Suitable Habitat
Birds	American Peregrine Falcon *Falco peregrinus anatum*	E	Found in open country habitats, including tundra, mountainous and coastal areas, and marshes; usually near water. Also in open forested areas. Cliffs are used for nest sites.
	Peregrine Falcon *Falco peregrinus*	T	Nests in tundra regions; migrates through Texas; winter inhabitant of coastlines. Subspecies *anatum* is a resident breeder in W. Texas. Open areas, usually near water.
	Bald Eagle *Haliaeetus leucocephalus*	T	Nests and winters near rivers, lakes and along coasts; nests in tall trees or on cliffs near large bodies of water.
	Eskimo Curlew *Numenius borealis*	E	Found in tundra habitats, and in grasslands, pastures, or plowed fields; may also frequent marshes or mudflats.
	Interior Least Tern *Sterna antillarum athalassos*	E	Nests along sand and gravel bars within braided streams and rivers; also known to nest on man-made structures.
	Piping Plover *Charadrius melodus*	T	Wintering migrant along Texas Gulf coast; nests near beaches and bayside mud or salt flats.
	Whooping Crane *Grus americana*	E	Potential migrant via plains throughout most of Texas to coast; winters in coastal marches of Aransas, Rufugio and Calhoun counties
	Wood Stork *Mycteria americana*	T	Forages in prairie ponds, flooded pastures or fields, ditches, and other shallow standing water, including salt-water; usually roosts communally in tall snags, sometimes in association with other wading birds; breeds in Mexico and birds move into the Gulf states in search of mud flats and other wetlands, even those associated with forested areas; formerly nested in Texas, but no breeding records since 1960.
Reptiles	Texas Horned Lizard *Phrynosoma cornutum*	T	Open, arid and semi-arid regions with sparse vegetation, including grass, cactus, scattered brush or scrubby trees; sandy to rocky soil.
	Timber/Canebrake Rattlesnake *Crotalus horridus*	T	Swamps, floodplains, upland woodlands, riparian zones, abandoned farmland; prefers dense ground cover, i.e. grapevines or palmetto.
Mammals	Black Bear *Ursus americanus*	T	The Louisiana black bear is a habitat generalist and often overwinters in hollow cypress trees either in or along sloughs, lakes, or riverbanks in bottomland habitats. Constituent elements of black bear habitat include hard and soft mast, escape cover, denning sites, corridor habitats, and some freedom from disturbance by man.
	Red Wolf *Canis rufus* (extirpated)	E	Formerly known throughout eastern half of Texas in brushy and forested areas, as well as coastal prairies. It appears that in Texas, red wolves are now extinct.

T – State-Listed Threatened E – State-Listed Endangered

Riparian Impacts

For this discussion, direct impacts to riparian habitats include impacts to streams and channels within and adjacent to the project site. Within the proposed reservoir site boundaries, all perennial and intermittent streams will be lost due to inundation of the proposed site by waters forming the Lower Bois d’Arc Creek Reservoir. It is estimated that approximately 123.3 miles of perennial and intermittent streams will be inundated. (It should be noted that a segment of Bois d;Arc Creek is listed by TCEQ as perennial, but there are anecdotal records that show there is no flow in this stream segment for extended periods of time.) The riverine habitat (219 acres) will be converted to open water or deep water habitat. Biotic assemblages typical of small, fluvial (flowing water) environments will be replaced by those typical of large lacustrine environments. This includes changes in phytoplankton, zooplankton, benthic macroinvertebrates, and fish populations. Stream channels in and near the upper reaches and perimeter of the reservoir will experience increased silt deposition from sediments that drop out of the water column of these streams as water velocity drops upon approaching or entering the backwater of the lake. Tributary streams will become more stable as bank cutting and instability is reduced due to lower head differentials with impounded water in the lake.

The change from lotic (river) to lentic (lake) habitat will shift the present species composition toward more pool-associated species. Based on the fish assemblages found during the instream flow study, Lower Bois d'Arc Creek Reservoir would probably be characterized by combinations of red shiner, longear sunfish, bullhead minnow, logperch, and orange spotted sunfish as the dominant species. Other common fish expected in the proposed Lower Bois d’Arc Creek Reservoir would include gizzard shad, threadfish shad, bluegill, and redear sunfish. The few fluvial species identified during the instream flow study would likely relocate to the downstream corridor and be supported by instream flow releases.

The dominant fish populations found in Bois d’Arc Creek and surrounding water bodies are all adapted to lacustrine habitats and therefore most would be expected to continue to occur in the proposed reservoir. Although these species may occur in the reservoir, relative abundance may vary due to the introduction of predator and competing species over time, which may affect the survivability and population densities of some of the present species. In addition, vast expanses of new habitat for some of the resident species will be created, which will cause these species numbers to increase dramatically. Over time new species, such as flathead catfish, blue catfish, striped bass, white bass, or other fish suitable to large, open water bodies, even if not originally native, will likely be introduced either naturally or intentionally into the lake and will affect species abundance, diversity and distribution.

No detrimental impacts to mussel species resulting from the construction of the proposed Lower Bois d’Arc Creek Reservoir project are expected to occur. According to available literature, it appears that all species identified during site visits can and do adapt to life in a lake environment. (Howells et al, 1996 and Roe, 2002)

There are no federally listed threatened or endangered aquatic species within the Bois d’Arc Creek watershed. The state has listed five fish species and one aquatic reptile as threatened which are shown on Table F-4. No mollusks known to occur or potentially occur in Fannin County have been listed as threatened or endangered.

INDIRECT IMPACTS OF PROJECT

Indirect impacts include direct or associated actions of the project that potentially impact habitat upstream, adjoining, and downstream of the project site.

Terrestrial and Riparian Habitats

Losses to terrestrial habitats will result from secondary or indirect impacts as residential areas are constructed adjacent to and/or in proximity to the proposed reservoir. Over time, these residential areas, along with the associated infrastructure, such as schools, roads and utilities, and attendant commercial and recreational facilities would likely result in additional habitat loss to adjacent upland habitats. These developments would likely have occurred without the project, but may occur sooner with the reservoir in place. It is proposed that the development around the lake will be controlled and monitored by a county agency. The NTMWD is purchasing property to the spillway elevation of 541 ft msl and purchasing a flowage easement to elevation 545 ft. Restrictions on development in these zones will provide added protections to the terrestrial habitats around the lake.

Table F-4

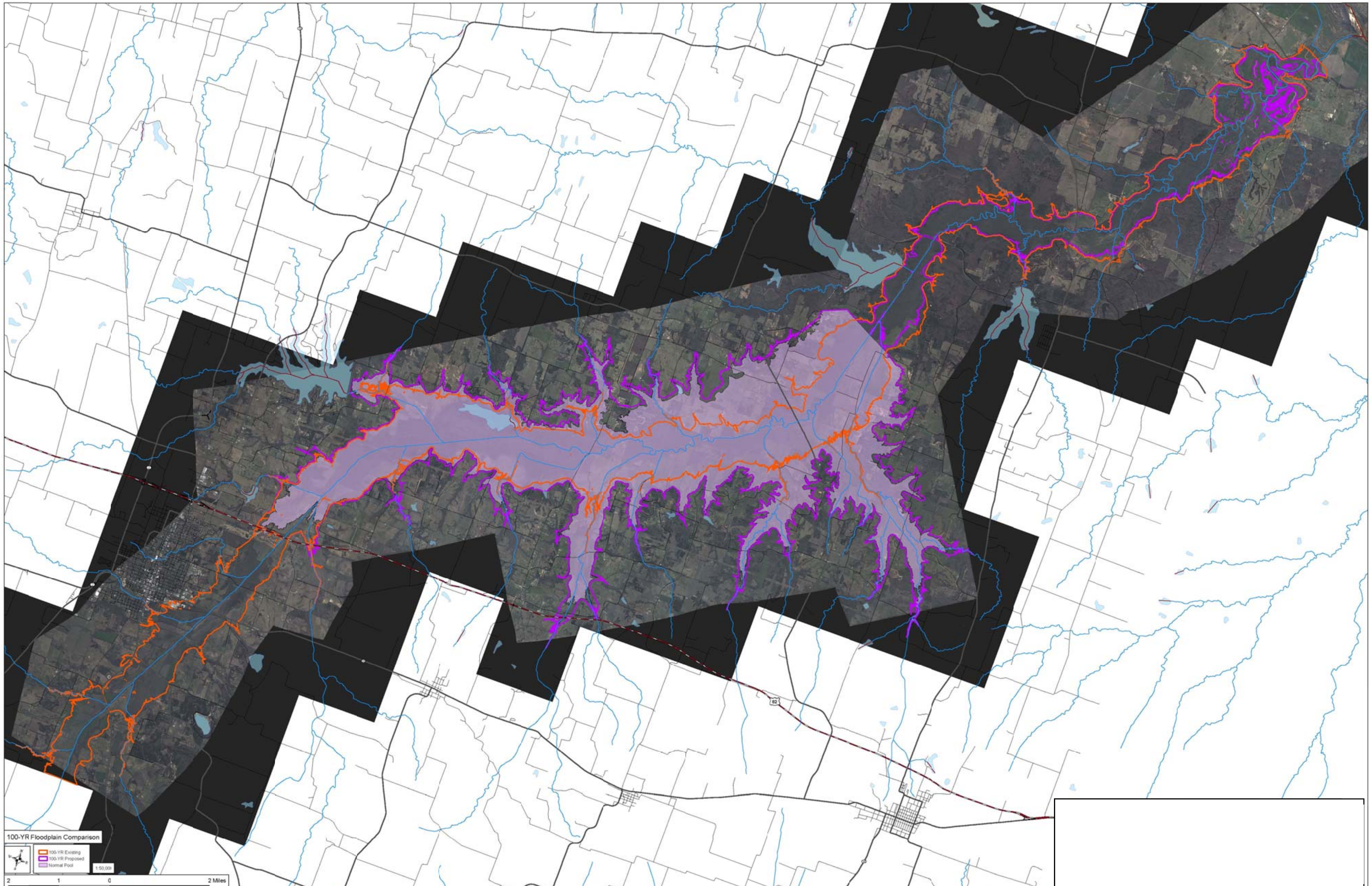
State-Listed Threatened and Endangered Aquatic Species in Fannin County

	Species	State Status	Description of Suitable Habitat
Reptiles	Alligator Snapping Turtle *Macrochelys temminckii*	T	Deep water of rivers, canals, lakes, and oxbows; also swamps, bayous, and ponds near deep running water; sometimes enters brackish coastal waters; usually in water with mud bottom and abundant aquatic vegetation; may migrate several miles along rivers; active March-October; breeds April-October.
Fishes	Blackside Darter *Percina maculata*	T	Clear, gravelly streams; prefers pools with some current, or even quiet pools, to swift riffles.
	Blue Sucker *Cycleptus elongatus*	T	Usually inhabits channels and flowing pools with a moderate current; bottom type usually consists of exposed bedrock, perhaps in combination with hard clay, sand, and gravel; adults winter in deep pools and move upstream in spring to spawn on riffles.
	Creek Chubsucker *Erimyzon oblongus*	T	Small rivers and creeks of various types; seldom in impoundments; prefers headwaters, but seldom occurs in springs; young typically in headwater rivulets or marshes; spawns in river mouths or pools, riffles, lake outlets, upstream creeks.
	Paddlefish *Polyodon spathula*	T	Prefers large, free-flowing rivers, but will frequent impoundments with access to spawning sites; spawns in fast, shallow water over gravel bars; larvae may drift from reservoir to reservoir.
	Shovelnose Sturgeon *Scaphirhynchus platorynchus*	T	Open, flowing channels with bottoms of sand or gravel; spawns over gravel or rocks in an area with a fast current; never more than a rare occurrence in Rio Grande.

T – State-Listed Threatened

As part of the instream flow study, habitat evaluations of the downstream corridor were conducted. The discussion of these results and findings is included in Appendix C of the *Instream Flow Study Supplemental Data* (FNI, 2010). This study evaluated stream hydrology with the proposed instream flow regime, geomorphic processes, and fauna in the downstream riparian corridor and adjacent terrestrial habitats. Impacts to the habitats downstream of the reservoir are expected to be minimal due to several factors: (1) the existing community is not dependent upon overbank flow for reproduction and overall success. Many of the species along Bois d'Arc Creek riparian corridor are equally likely to occur in uplands; (2) the local site conditions (e.g., rainfall, soil type, and land cover) contribute to floodplain inundation; (3) the proposed release of continuous base flows should increase channel-groundwater connectivity and promote growth of streambank vegetation; (4) the reduction in highly erosive flows would allow the stream to aggrade over time increasing the potential for floodplain connectivity; and (5) downstream hydrology will continue to contribute to instream flow and supplement floodplain connectivity. Certain aspects of the riparian corridor may even be improved as a result of the dam, including increased streambank stabilization, vegetation growth, and gain of hardmast producing woody trees.

Flood studies conducted in support of this project found that the construction of the Lower Bois d'Arc Creek Reservoir will not increase flooding upstream or downstream of the project site. A study conducted in 2005 and updated in 2007 evaluated the potential impacts of the Lower Bois d'Arc Creek Reservoir for the 10-, 50-, 100- or 500-year flood events. The study results found that the reservoir did not increase water levels upstream of the Highway 82 bridge for the simulated 10-, 50-, 100- or 500-year flood events. The hydrologic modeling shows that flood levels decrease immediately downstream of the dam, and then return to existing levels without the project within about one mile downstream of the dam. Figure F-1 shows the comparison of the 100-year floodplain with and without the proposed reservoir.



Coordinate System:
NAD 1983 StatePlane Texas North Central FIPS 4202 Feet

PREVIOUS STUDIES SUBMITTED TO TCEQ

The direct and indirect impacts associated with the inundation of the proposed reservoir are discussed in more detail in the following reports:

Wtr Rt Report	*Report Supporting an Application for a Texas Water Right for Lower Bois d'Arc Creek Reservoir*, 2 volumes, submitted to TCEQ on December 29, 2006
404 Report	*Environmental Report, Supporting an Application for a 404 Permit for Lower Bois d'Arc Creek Reservoir*, submitted to TCEQ water rights permitting section on October 8, 2008
JD Report	*Section 404 Permit Application and Jurisdictional Determination Report*, submitted to TCEQ water rights permitting section on October 8, 2008
IFS	*Instream Flow Study Report for the Proposed Lower Bois d'Arc Creek Reservoir, May 2010.* Submitted to USACE and Cooperating agencies on May 27, 2010. Submitted to TCEQ on June 1, 2010.
Supplemental IFS	*Instream Flow Study Supplemental Data, September 2010,* Submitted to USACE and cooperating agencies on September 17, 2010. Submitted to TCEQ on September 23, 2010.

Topic of Interest Regarding Impacts to Terrestrial and Riparian Habitats:

Water Quality Study	Chapter 4.4 and Appendix H *Wtr Rt Report* *IFS*, Main Report and Appendix E
Wetlands Delineation	*JD Report, JD Pipeline Realignment, JD WTP*
(discussions)	Chapters 3.3.2, 5.3.2, *404 Report*
Baseline Habitat Evaluation	Chapter 3.4 and Appendix D, *404 Report,* *IFS, Supplemental IFS*
Geomorphic Assessment of Bois d'Arc Creek	*RGA*, Chapter 3.3.2, *404 Report;* *IFS, Supplemental IFS*
Flooding Studies	Chapters 3.3.1, 4.3.1 and 5.3.1 and Appendix A, *404 Report*
Instream Flow Assessment	*IFS, Supplemental IFS.*
Downstream Impacts	*Supplemental IFS*, Appendix C

References:

Howells, R.G., et al. 1996. Freshwater Mussels of Texas. Texas Parks and Wildlife Press. Austin, Texas.

Roe, Kevin J. 2002. Conservation Assessment for the Yellow Sandshell (*Lampsilis teres*). USDA Forest Service, Region 9. Saint Louis, MO.

Texas Parks and Wildlife Department, Annotated County Lists of Rare Species, downloaded from http://www.tpwd.state.tx.us/landwater/land/maps/gis/ris/endangered_species, May 2011.

Appendix D

May 27, 2014, Lower Bois d'Arc Creek Littoral Zone/Fringe Wetland Development Technical Memorandum

MEMORANDUM

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TO: Simone Kiel, P.E.

CC: Steve Watters, PWS; Randall Howard

FROM: Michael Votaw, CWB, PWS

SUBJECT: Lower Bois d'Arc Creek Littoral Zone/Fringe Wetland Development

DATE: 5/27/2014

PROJECT: NTD06128 – Lower Bois d'Arc Creek Reservoir

Introduction

On May 14-15, 2014, environmental scientists with Freese and Nichols, Inc. (FNI) conducted pedestrian surveys along the lake margins of five reservoirs located in Northeast Texas. Reservoirs surveyed were Cooper Reservoir, Pat Mayse Reservoir, Lake Bonham, Coffee Mill Lake, and Davy Crockett Reservoir (Figure 1). These reservoirs were selected based on their proximity to the proposed Lower Bois d'Arc Creek reservoir site. The purpose of the survey was to identify plant species that occur within the littoral zone/fringe wetlands along the margins of these reservoirs in order to better predict the species expected to develop within the littoral zone/fringe wetland areas of the proposed Lower Bois d'Arc Creek Reservoir. An additional purpose of this investigation was to evaluate the expected plant response during extended periods of low water elevations within the reservoir (i.e., below 530 ft. msl).

Results

All five of the reservoirs that were surveyed had developed functioning littoral zone/fringe wetlands along their shorelines that extended for some distance into the reservoir pool. These littoral zone/fringe wetlands showed high plant diversity with over 49 different species of plants being observed. Species observed at each reservoir during the survey are listed in Table 1. This list is not meant to be comprehensive and it is only representative of the species that were readily observable/identifiable at the locations that were surveyed. Photographs of the littoral zone/fringe wetlands observed at each of these reservoirs are located in Attachment 1. Species that were observed most frequently at the reservoirs that were surveyed include soft rush and other rush species, obedient plant, frog fruit, cattail, goldenrod, several species of smartweed, winter bentgrass, black willow, buttonbush, and a variety of different sedge and dock species.

Based on the results of the pedestrian survey, it is likely that a wide variety of plant species would develop within the littoral zone/fringe wetland areas of the proposed Lower Bois d'Arc Creek Reservoir. Although it is not possible to predict exactly which species will establish within the littoral zone/fringe wetland areas around the proposed Lower Bois d'Arc Creek Reservoir, many of the species identified above and within Table 1 would likely be present.

Table 1. Plant Species Identified within the Littoral Zone/Fringe Wetlands of Five Reservoirs in Northeast Texas.

Reservoir	Cooper	Pat Mayse	Bonham	Coffee Mill	Davy Crockett
Species					
Ravenfoot sedge (*Carex crus-corvi*)	●				
Sedge (*Carex* spp.)	●		●	●	
Buttonbush (*Cephalanthus occidentalis*)	●	●	●	●	●
Curly dock (*Rumex crispus*)	●	●	●		
Winter bentgrass (*Agrostis hyemalis*)	●	●	●		
Goldenrod (*Solidago* spp.)	●	●	●		●
Rush (*Juncus* spp.)	●	●	●	●	●
Blackberry (*Rubus* sp.)	●				
Smartweed (*Polygonum* spp.)	●	●	●		●
Balloonvine (*Cardiospermum halicacabum*)	●				
Loosestrife (*Lythrum* sp.)	●				
Eastern baccharis (*Baccharis halimifolia*)	●	●			
Black willow (*Salix nigra*)	●	●	●	●	●
Spiny aster (*Chloracantha spinosa*)	●				
Stickywilly (*Galium aparine*)	●				
Cattail (*Typha* sp.)		●	●		●
California Bulrush (*Schoenoplectus californicus*)			●		●
Water primrose (*Ludwigia peploides*)			●		
Frog fruit (*Phyla nodiflora*)		●	●		●
Ovate false fiddleleaf (*Hydrolea ovata*)			●		
Mock bishopweed (*Ptilimnium nuttallii*)			●		

Reservoir	Cooper	Pat Mayse	Bonham	Coffee Mill	Davy Crockett
Golden alexanders (*Zizia aurea*)			●	●	
Vine mesquite (*Panicum obtusum*)		●	●		
Obedient plant (*Physostegia virginiana*)		●	●	●	●
Beaksedge (*Rhynchospora* spp.)			●		
Texas toadflax (*Nuttallanthus texanus*)			●		
Rabbitsfoot grass (*Polypogon* sp.)			●		
Barnyardgrass (*Echinochloa crus-galli*)					●
Lotus (*Nelumbo lutea*)				●	●
Soft rush (*Juncus effuses*)	●	●		●	●
Buttercup (*Ranunculus* sp.)					●
Morning-glory (*Ipomoea* sp.)			●		●
Bald cypress (*Taxodium distichum*)					●
Spikerush (*Eleocharis* spp.)		●			●
False indigo bush (*Amorpha fruticosa*)					●
Water willow (*Justicia americana*)				●	●
Common selfheal (*Prunella vulgaris*)				●	
American pondweed (*Potamogeton nodosus*)				●	
Water hemlock (*Cicuta maculata*)				●	
Florida paspalum (*Paspalum floridanum*)				●	
Arrowhead (*Sagittaria* sp.)				●	
Green ash (*Fraxinus pennsylvanica*)		●		●	
Common duckweed (*Lemna minor*)				●	

Reservoir	Cooper	Pat Mayse	Bonham	Coffee Mill	Davy Crockett
Giant cutgrass (*Zizaniopsis miliacea*)		●			
Maidencane (*Panicum hemitomon*)		●			●
Ironweed (*Vernonia* sp.)		●	●		
Common marshmallow (*Althaea officinalis*)		●			
River birch (*Betula nigra*)		●			
Pennywort (*Hydrocotyle* sp.)		●			

Plant Response to Extended Periods of Low Water Levels

As described in the Mitigation Plan for the proposed Lower Bois d'Arc Creek Reservoir, littoral zone/fringe wetlands are expected to develop in locations three feet deep or less (between elevations 531-534 ft. msl) within the reservoir. The time it will take for these wetlands to develop is unknown, but it is estimated to take two to three years following inundation. These wetlands would most likely develop in broad, shallow areas and in coves where tributaries flow into the reservoir. It is estimated that approximately 1,402 acres of these littoral zone/fringe wetlands would develop and provide on-site mitigation.

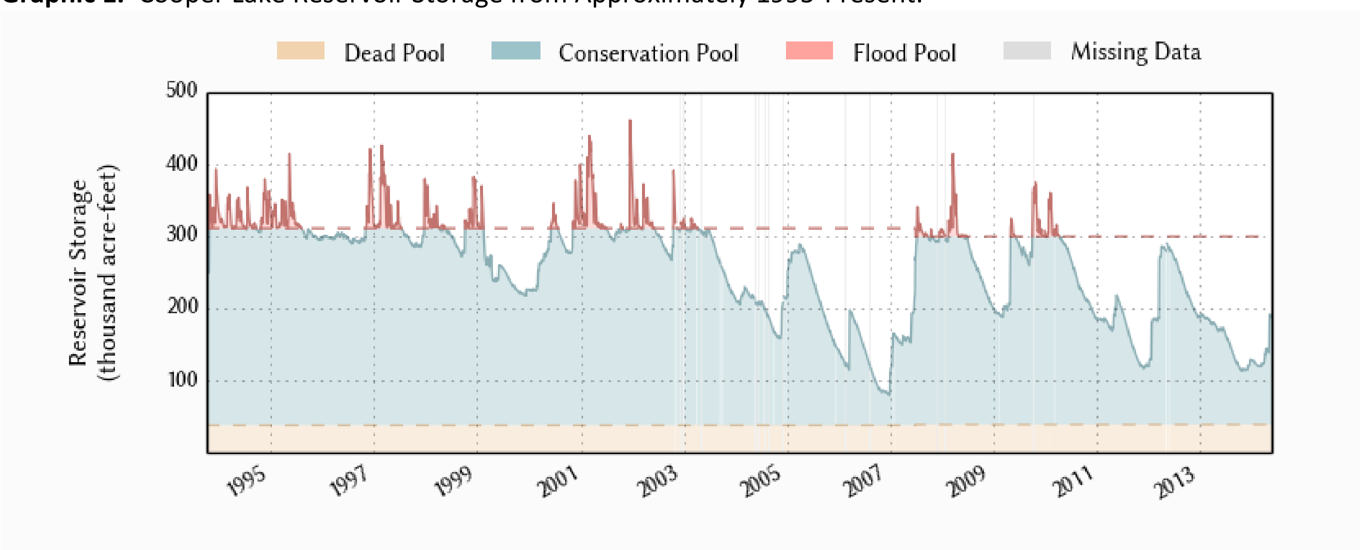
Wetlands, contrary to their name, do not always contain water. Many seasonal and temporary wetlands experience periods of drought at some point in time. Such wetlands tend to flood or recharge during winter months and will hold water into spring or early summer before drying out in the hot summer months (http://www.ducks.org/media/Conservation/GLARO/_documents/_library/_landowner/Landowner_Guide.pdf). This is a natural process that is frequently observed in wetlands in this area of Texas. These wet/dry cycles are beneficial as they discourage development of a monoculture of plant species such as cattail and bulrush. Another benefit of this wet/dry cycle is that it encourages seed production from many of the emergent wetland plant species. In fact, many wetlands that have capacity for water-level control are managed in such a way that they are drawn down during the spring, specifically to maximize seed production from native annual plants (http://www.ducks.org/conservation/habitat/conservation-private-marsh-management). This seed production not only establishes a seed bank in the wetland sediment, it also serves as a food source for many species of waterfowl and other seed-eating wildlife species.

If low water levels (i.e., below 530 ft. msl) within the proposed Lower Bois d'Arc Creek Reservoir persist for an extended period, it is likely that some of the plant species present in these wetlands might go dormant or possibly die, especially those species that are dependent on being submerged or inundated. However, other plant species that are not dependent on being submerged or inundated would likely survive and persist. This is expected as a result of Fannin County having a total annual precipitation of approximately 44 inches (http://www.nrcs.usda.gov/Internet/FSE_MANUSCRIPTS/texas/TX147/0/Fannin.pdf), which would likely provide ample moisture for many of the plant species listed in Table 1 to survive within the littoral zone/fringe wetland areas of the reservoir once they become established.

Such persistent low water conditions were observed at both Pat Mayse Reservoir and Cooper Lake during the current field survey. Both of these reservoirs have been below their conservation pool elevations for extended periods of time as a result of the ongoing drought in this area of Texas. Within the littoral zone/fringe wetlands observed at these reservoirs, species such as cattail and smartweed were dormant or dead, while other species such as button bush, ironweed, goldenrod, as well as a variety of different species of sedges and rushes were alive. It is expected that once water levels rise in these reservoirs (i.e., return to their conservation pool elevations) and these littoral zone/fringe wetlands become inundated again, the plants in these areas that have died or gone dormant would respond by breaking dormancy, re-sprouting from root systems, or developing from the seed bank in the wetland sediment.

This expected response is reinforced by looking at reservoir storage for Cooper Lake from 1995 to present (Graphic 1) and relating that back to what was observed at the reservoir during the current field survey. According to Graphic 1, persistent low water conditions have occurred at Cooper Lake several times, including recently. However, during the current field survey, many plants were observed within the littoral zone/fringe wetlands that were living, even though they were not submerged or inundated. The same, or similar conditions, are expected to occur within the proposed Lower Bois d'Arc Creek Reservoir.

Graphic 1. Cooper Lake Reservoir Storage from Approximately 1995-Present.



http://waterdatafortexas.org/reservoirs/individual/jim-chapman

In summary, it is expected that Lower Bois d'Arc Creek Reservoir will develop the same or similar conditions within the littoral zone/fringe wetlands that were observed at the five reservoirs surveyed in this study. It is likely that a wide variety of different plant species would establish within the littoral zone/fringe wetlands that would develop around the proposed Lower Bois d'Arc Creek Reservoir. It is also likely that there will be extended periods of low water levels within Lower Bois d'Arc Creek Reservoir that will preclude constant inundation of these wetlands. However, this "drying out" is expected to increase plant diversity by discouraging development of a monoculture of plant species such as cattail and bulrush.

ATTACHMENT A

PHOTOGRAPHS

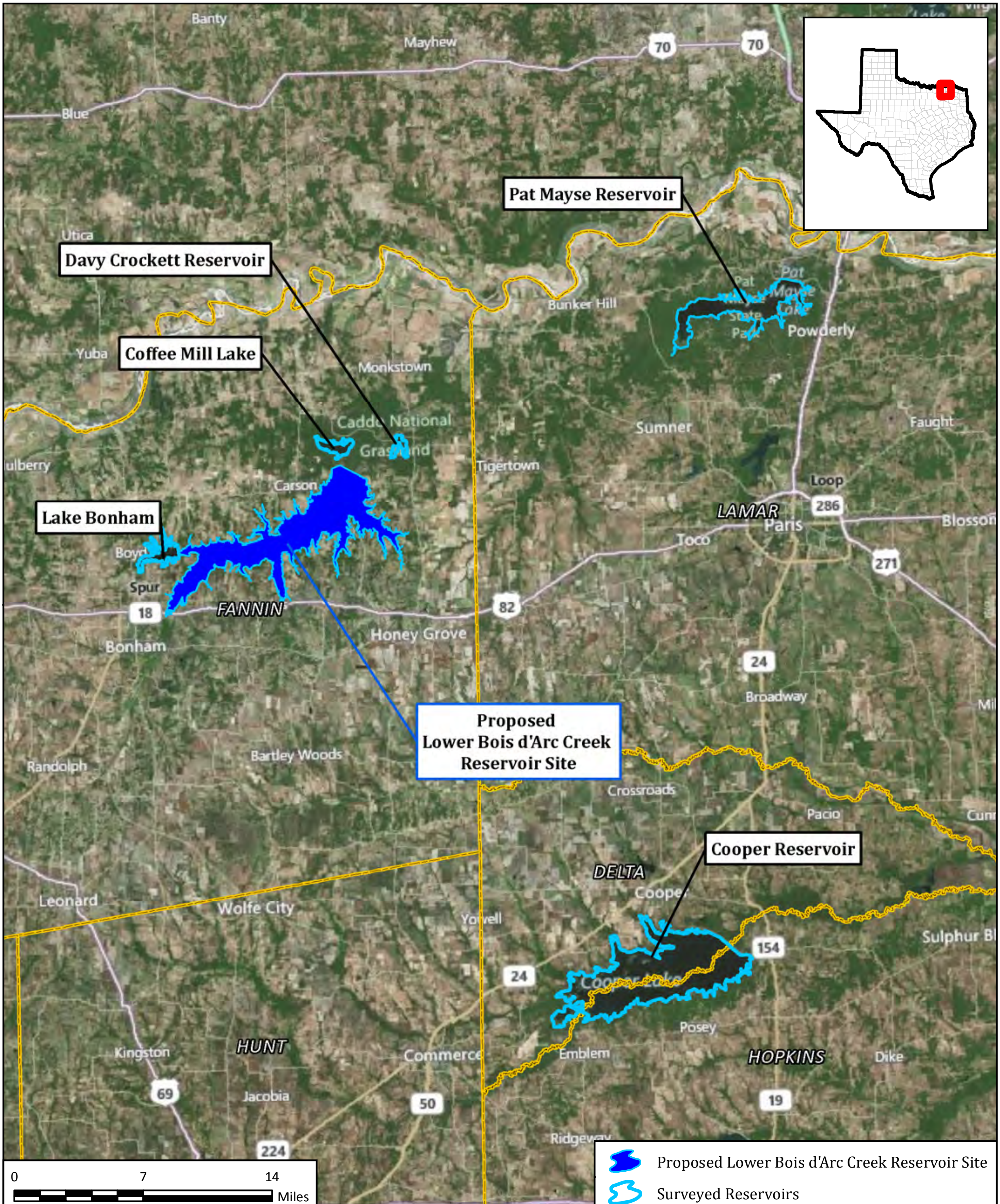
Photo 1. View of littoral zone/fringe wetland area at Pat Mayse Reservoir.

Photo 2. View of littoral zone/fringe wetland area at Lake Bonham.


Photo 3. View of littoral zone/fringe wetland area at Coffee Mill Lake.


Photo 4. View of littoral zone/fringe wetland area at Cooper Lake.

Photo 5. View of littoral zone/fringe wetland area at Davy Crockett Reservoir. Photograph shows fringe wetland regrowth after being dewatered and burned as part of the USFS's management program.



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N W E S

NTMWD
Lower Bois d'Arc Creek Reservoir

Littoral Zone/Fringe Wetland Reservoir Survey

FN JOB NO	NTD06128
FILE NAME	Regional_Reservoirs.mxd
DATE	5/27/2014
SCALE	1:450,000
DESIGNED	SSJ
DRAFTED	ssj

1

FIGURE

Path: H:\ENVIRONMENTAL\WORKING\Regional_Reservoirs.mxd

NAD 1983 StatePlane Texas North Central FIPS 4202 Feet

APPENDIX F – DRAFT RESERVOIR OPERATION PLAN

Please see next page.

Draft Operation Plan
Proposed Lower Bois d'Arc Creek Reservoir

1.0 Introduction

North Texas Municipal Water District (NTMWD) supplies treated water to customers in suburban communities north and east of Dallas. Figure 1 is a diagram of the NTMWD raw water supply system (System). Currently NTMWD obtains raw water from six reservoirs[1] and from reuse. The primary reservoirs include Lakes Lavon, Chapman, Texoma and Tawakoni as shown on Figure 1. The operation of the System is governed by numerous water rights, regulatory requirements, contracts, and operating agreements. In operating the System, NTMWD considers the availability and reliability of the sources of supply, water quality, pumping costs, and other factors. NTMWD also operates several raw water pipelines, three water treatment plants (WTPs), a manmade wetland, sixteen wastewater treatment plants (WWTPs), and a large treated water transmission network

Because NTMWD's service area is growing rapidly, new infrastructure and water sources are planned to be added in the future. Lower Bois d'Arc Creek Reservoir (LBCR) is one of several new sources. Since there will be many changes to the System, the operation of the System will change over time as required to meet future needs. This draft operation plan describes how the LBCR will fit into the System, operational requirements associated with the Texas Commission on Environmental Quality's (TCEQ) proposed water right permit (Water Permit), anticipated monthly water use patterns and some of the operational factors that will govern the System and the operation of the reservoir itself when the LBCR is added to the System.

[1] The six reservoirs include Lakes Lavon, Texoma, Chapman, Tawakoni, Bonham and Fork.

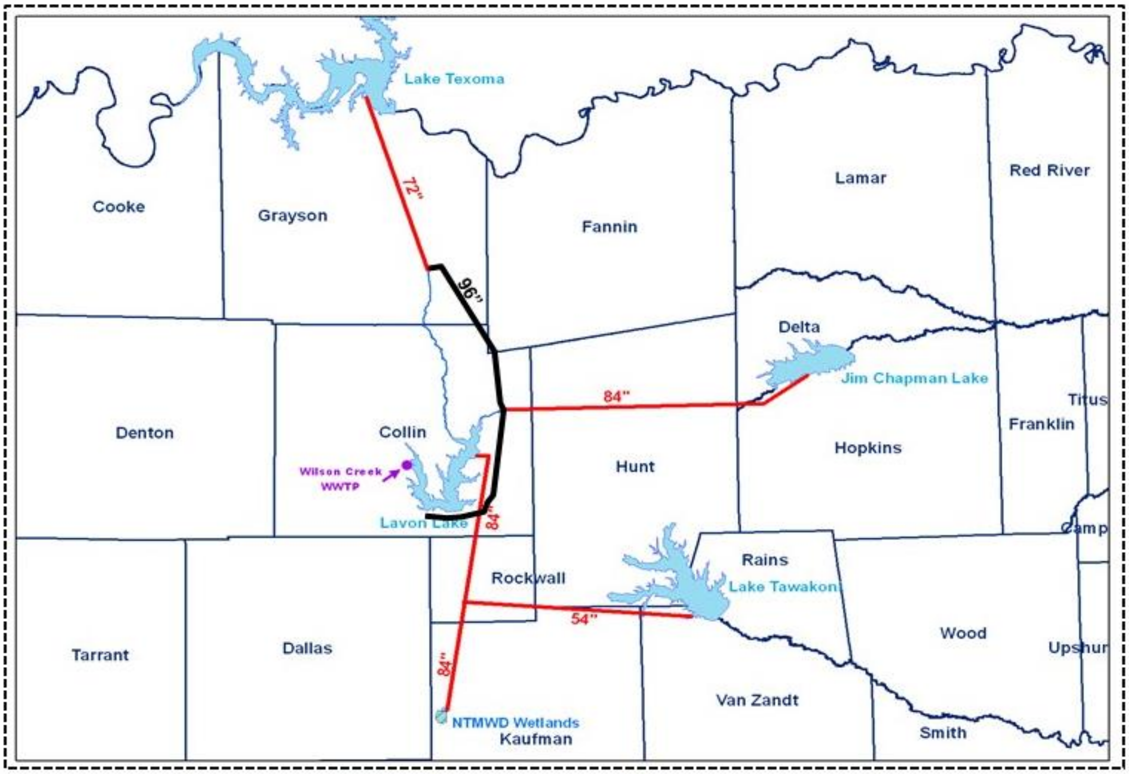

Figure 1 – NTMWD Existing Raw Water Transmission System

2.0 Future Supplies – Lower Bois d'Arc Creek Reservoir

The LBCR will be located on Bois d'Arc Creek in the Red River Basin. Supplies from the LBCR will be pumped by pipeline to a planned fourth NTMWD WTP near the City of Leonard in Fannin County (Leonard WTP). From there treated water will enter into the NTMWD treated water distribution system. It is anticipated that much of this supply will be used for the growing north and northeast part of the NTMWD service area (Figure 2), but it could also be used in other parts of the treated water distribution system. The Leonard WTP eventually may also treat supplies from other sources.

The LBCR will be a significant and much needed source of reliable high-quality water for NTMWD. It will replace temporary sources of water such as those from the Upper Sabine Basin, and will provide supplies to meet growth in the NTMWD service area. NTMWD expects to fully utilize the LBCR water supplies within the next 15 to 20 years.

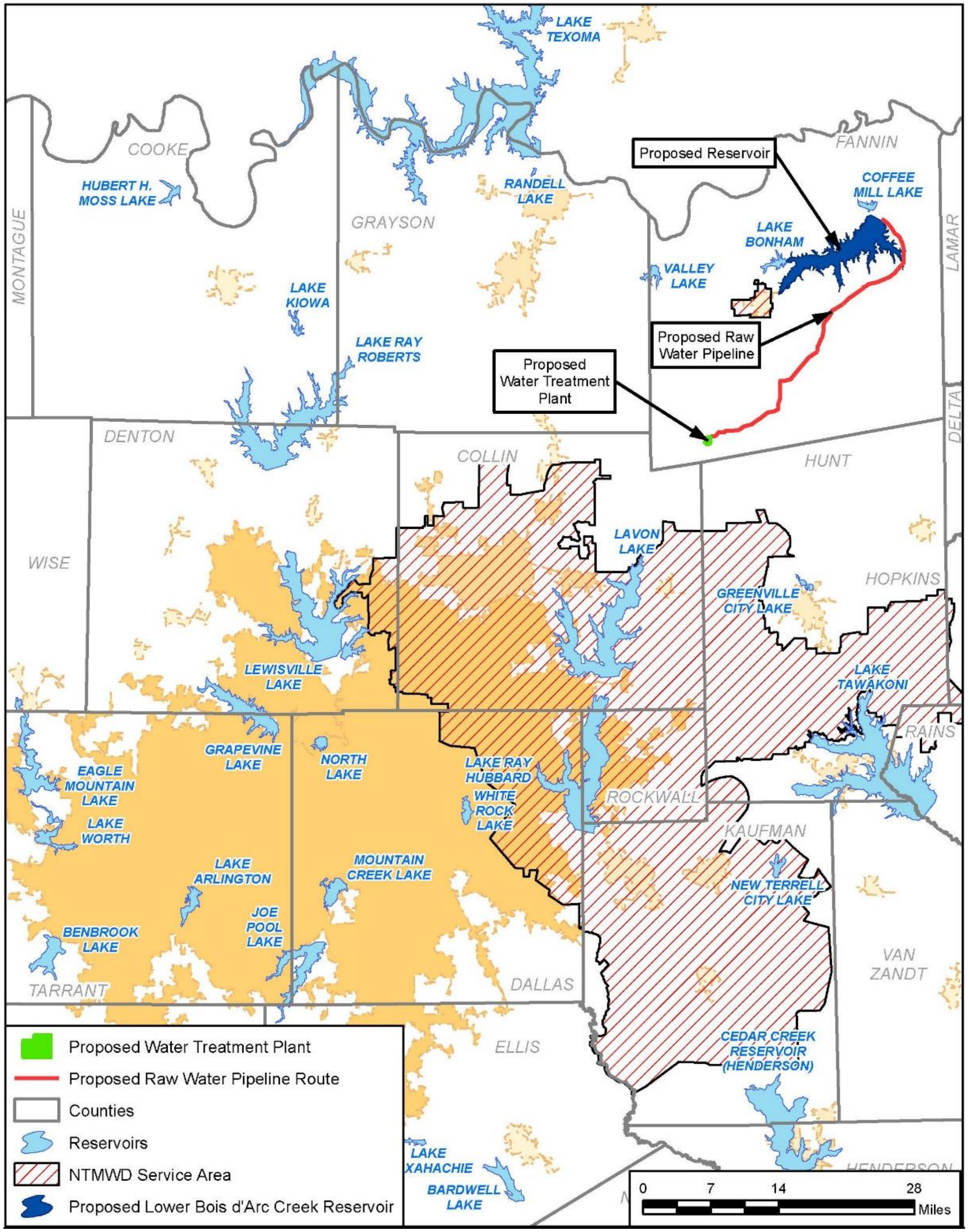

Figure 2 - NTMWD Service Area

Operation of the LBCR will be conducted in compliance with Texas water law and the Water Permit. Some of the specific operational considerations NTMWD will implement, including requirements of the Water Permit, are listed below:

- Storage – LBCR is authorized to impound 367,609 acre-feet of State water for municipal, industrial, agricultural and recreational use.
- Diversions – NTMWD is authorized to divert 175,000 acre-feet per year at a maximum diversion rate of 365.15 cfs from any point on the perimeter of the reservoir.
- Pass-Throughs (Pass-Throughs are inflows that are released (or "passed through") through the LBCR Dam to Bois d'Arc Creek. Pass-Throughs do not include releases of stored water. For purposes of this operation plan, the terms "pass-through" and "release" are used interchangeably.)
    - Downstream senior water rights - In compliance with State water law, NTMWD will pass inflows through the dam for existing water right holders. There are two existing water rights on Bois d'Arc Creek between the LBCR and the confluence with the Red River and thirteen Texas water rights on the Red River downstream of the confluence with Bois d'Arc Creek.
    - Environmental flows – NTMWD will pass inflows through the dam in compliance with the environmental flow requirements in the draft Water Permit. The environmental flow regime is based on the Texas Instream Flow Program and requires Seasonal base flow and pulse flow releases.
    - Wastewater discharges – The NTMWD will also pass the effluent return flow of the City of Bonham that is discharged upstream of LBCR for environmental flow purposes downstream of the dam. The City's discharges have historically ranged from <1 cfs to 3.5 cfs, with an average of 1.8 cfs over the last three years. (Note: all effluent return flows to the LBCR are considered as inflow to the reservoir and will be considered for environmental flow purposes. NTMWD has control over the City of Bonham's effluent return flows and has committed to pass these flows for environmental purposes during subsistence conditions.)
- Monitoring and Compliance
    - Monitoring Plan – A Monitoring Plan was developed by NTMWD for the Water Permit. This plan was reviewed and accepted by the TCEQ for monitoring the hydrology, water quality and biology for compliance with the Water Permit. A copy of this plan is included in Attachment 1.
    - Accounting Plan – An accounting plan is required by Texas to document compliance with the Water Permit. This plan documents inflows, pass-throughs and compliance with the environmental flow requirements. A copy of the narrative for the Accounting Plan for LBCR is included in Attachment 2.

Reservoir Inflows / Impoundment

Inflows will be stored in the LBCR in compliance with the Water Permit. The normal conservation pool elevation is 534 ft msl. Water that enters the reservoir above the normal pool level will be discharged downstream over the uncontrolled service spillway. The service spillway is a 60' wide labyrinth weir structure. Water that flows over the service spillway is discharged to Bois d'Arc Creek via a concrete spillway channel. The emergency spillway elevation is 541 ft msl. If water levels in the lake exceed 541 ft msl, the flood water will be released downstream over the uncontrolled emergency spillway.

Daily inflows to the reservoir will be determined in the accounting plan by two methods: a mass balance calculation and a partial gage/drainage area ratio calculation. The mass balance calculation is used to determine compliance with impoundment and diversions requirements for the Water Permit. The USGS gage/drainage area ratio calculation is used to determine compliance with environmental flows.

Mass-Balance Method. The mass balance calculation will use daily records of reservoir storage, diversions, spills, downstream releases, rainfall and evaporation to calculate the inflow to the reservoir. This calculation will be used to determine compliance with the impoundment and diversion requirements in the Water Permit.

Gage/Drainage Area Ratio Method. A stream gage will be installed upstream from the reservoir at Texas Hwy 56. This gage will capture approximately 144 square miles of drainage area, which is 44% of the drainage area for the lake. To estimate the total inflow to the lake, the drainage area ratio method will be applied to the remaining 56% of the contributing drainage area. Wastewater discharges from the City of Bonham and City of Honey Grove will be recorded and included in the inflow calculations. The daily inflow to the reservoir by the partial gage/drainage area ratio calculation will be estimated as follows:

> Estimated inflow to reservoir = Measured Flow Upstream x (327 square miles at dam) / (144 square miles at measurement point) + Wastewater Discharge from Bonham + Wastewater Discharge from Honey Grove

Diversions

Water will be diverted by NTMWD through a multi-level intake tower located near the dam that transports the water to a pump station located immediately downstream of the dam. The intake structure will be a rectangular tower with two cells, each of which will have the capacity to withdraw water for the needed water supply demands as well as the releases of inflow required for base and subsistence flows. Under normal operating conditions, both cells will be used concurrently and will feed a pair of 78" pipes that will be concrete encased through the dam embankment to the pump station located shortly downstream. Diversions could occur through a single cell when the other is closed for maintenance, but this operation is not planned to occur during times of high demand. In the pump station, the two 78" pipes will feed a 90" suction header line that will distribute the flow to the pumps being utilized. An approximately 27" pipeline (referred to as the low level outlet works) will extend from this suction header line to the spillway channel and will be used to deliver releases of inflow required for base and subsistence flows (including the subsistence period freshet as required by the water period) to the downstream channel via the spillway chute. Releases for downstream water right holders can be made from this 27" pipe or through the service spillway outlet works. Both diversions and downstream flow releases can be made at the same time.

Flows into the intake structure to be pumped or released as base or subsistence bypass flows will be screened in order to minimize the potential for impingement and/or entrainment. In accordance with the Water Permit the velocity of the water into the intake structure shall be no more than 1 foot per second.

Pass-Throughs for Environmental Flows

Environmental flows will be passed through the dam in compliance with the special conditions in the Water Permit. These conditions were developed from site-specific instream flow studies of Bois d'Arc Creek (FNI, May 2010 and FNI, September 2010) and were found by the TCEQ to provide a sound ecological environment in Bois d'Arc Creek downstream of the dam.

Environmental flows are defined for normal and subsistence hydrologic conditions in the watershed. Subsistence conditions are defined as when the reservoir is below 40% capacity. This corresponds to approximately 9% of the historical hydrologic record. Normal conditions are all other times.

In compliance with the Texas Instream Flow program, the environmental flow regime includes base flows and pulse flows during normal hydrologic conditions. During subsistence conditions, only base flows and a subsistence period freshet are applicable during operations. Base flows are daily operational flows and are limited to inflows to the reservoir. Pulse flows are typically associated with a rain event. The characteristics of a pulse flow include a peak, volume and duration. Pulse events are not released during subsistence conditions. A subsistence period freshet is a small pulse that is released only during subsistence conditions. The conditions and frequency of the subsistence period freshet differ from the pulse events. The decisions and triggers to pass inflows through the reservoir for environmental flow purposes are outlined in detail in the Accounting Plan (Attachment 2).

If there are inflows to the reservoir, environmental flows will be passed through the dam, by season, in accordance with the criteria in Table 1. In accordance with the Water Permit, passage of environmental flows are limited to the inflow into the reservoir. If inflows into the reservoir are less than the environmental flow requirements, NTMWD is only obligated to pass the amount of inflow into the reservoir. The base flow values for summer and fall-winter in Table 1 were selected to provide connectivity of flow in Bois d'Arc Creek at FM 409. The base flow amounts in the spring were selected to provide flows adequate for spawning.

Pulse flows provide for channel maintenance and water quality functions. A qualifying pulse event is one in which the peak flow criterion is met and either the volume or duration criteria is met (see Table 1). A qualifying pulse event that enters the reservoir is passed through the reservoir if a comparable pulse event does not occur naturally at the FM 409 stream gage. If the number of events for a season are met, then no additional pulse flows are passed through the dam for that season. If a qualifying pulse event does not occur during a season, then no pulse flows are passed. Each season is independent of each other for purposes of meeting the environmental flow criteria.

A subsistence period freshet provides a creek bed wetting flow during periods of drought. Similar to a pulse event, the subsistence period freshet consists of a peak, volume and duration. A qualifying subsistence period freshet that enters the reservoir is passed-through the dam if a qualifying event does not occur naturally at FM 409 within the previous 60 days. Once a qualifying event is recorded at the FM 409 gage or passed through the reservoir, the 60-day time period begins again until the reservoir is no longer in subsistence conditions.

In addition to the environmental flow pass-throughs outlined in the Water Permit, NTMWD will pass the effluent return flows of the City of Bonham through the LBCR to Bois d'Arc Creek downstream of the dam, even under subsistence flow conditions. NTMWD has under contract only the right to that portion of Bonham's wastewater that is discharged to a State watercourse, and intends to continue to release these flows for environmental purposes. Bonham could develop a direct reuse project in the future, which could reduce the effluent return flows. However, it is anticipated that with the projected growth of Bonham, the wastewater effluent would increase and a future direct reuse project would not significantly impact current effluent return flow amounts. The effluent return flows of the City of Honey Grove to Honey Grove Creek would also be considered as inflow for the purposes of determining environmental flow pass-throughs. Honey Grove controls its effluent discharges and these discharges could be reduced if the City implemented a reuse project. The NTMWD would still be required to pass inflows in accordance with the seasonal environmental criteria and enhancement of Bois d'Arc Creek does not rely on these effluent return flows. It is anticipated that the passage of effluent return flows will result in a minimum daily pass-through of 1 cfs, but likely would be higher since current wastewater discharges average 1.8 cfs for the City of Bonham and 0.5 cfs for the City of Honey Grove.

Table 1 - Environmental Flow Criteria for Bypassing Inflows through the Reservoir

Season	**Months**	**Subsistence**	**Base**	**Pulse**
Fall-Winter	November - February	1 cfs*	3 cfs	2 per season Trigger: 150 cfs Volume: 1,000 ac-ft Duration: 7 days
Spring	March - June	1 cfs*	10 cfs	2 per season Trigger: 500 cfs Volume: 3,540 ac-ft Duration: 10 days
Summer	July - October	1 cfs*	3 cfs	1 per season Trigger: 100 cfs Volume: 500 ac-ft Duration: 5 days

cfs = cubic feet per second ac-ft = acre-feet

*A subsistence period freshet requirement with a trigger level of 20 cfs, a volume of 69 af, and a duration of 3 days, to occur no more than every 60 days, also applies.

As discussed under **Diversions**, base and subsistence flows will be released from the reservoir through the multi-level intake tower and low level outlet works to be discharged to the service spillway chute. Pulse flows will be released from the reservoir through multiple levels of sluice gates located in the service spillway (referred to as the service spillway outlet works). The service spillway outlet works consist of two 5'x5' gates and two 6'x5' sluice gates located at three different elevations. Typical pulse flow patterns for each season are included in the Accounting Plan and shown in Attachment 2. If needed, the lower level pulse flows can be released from the reservoir through the low level outlet works or released through the service spillway outlet works. A gage will be included as part of the low level outlet work for measuring flow rates. Flows released through the service spillway outlet works will be measured using a stage-discharge curve. The stage-discharge curve will be calibrated based on measured flows.

To assist with the reservoir operations for environmental flow pass-throughs, dissolved oxygen and temperature profiling of the lake water column will be conducted in the main body of the lake near the reservoir intake tower on a weekly basis beginning the first week of each May. Weekly monitoring will continue until a temperature and dissolved oxygen gradient is observed indicating that stratification has become established. After determining that stratification is present, monitoring frequency will be decreased to monthly until stratified conditions no longer exist. The profile data collected will be used to determine which gates on the intake tower should be operated to deliver oxygenated water for pass-throughs. Verification that surface water quality standards for dissolved oxygen and temperature for Bois d'Arc Creek are met will be provided by the water quality measurements at the stream gage at FM 409 downstream of the dam.

Monitoring and Compliance

NTMWD will use data collected from three stream gages to assist with operations and compliance determination with the water permit:

- A new stream gage located at Texas Hwy 56 will be used to calculate inflows to the reservoir for operations of environmental flow pass-throughs.
- The existing stream gage at FM 409 will be used to monitor flow and water quality (temperature and dissolved oxygen) of Bois d'Arc Creek downstream of the dam for compliance with environmental flows.
- A new stage discharge gage will be installed near FM 100 to measure larger flow events (> 500 cfs) that are expected to occur naturally in the lower part of the basin.

It is anticipated that a rainfall gage and evaporation pan will be installed at the dam to collect data for calculating inflows by mass-balance. Alternatively, existing nearby gages may be used. There are several active nearby rain gages, including one at Bonham (410923) and Honey Grove (414257). The most likely nearby evaporation gage is located at Lake Jim Chapman. However, the NTMWD may choose to use other gages if needed.

Biological monitoring of Bois d'Arc Creek will be conducted in accordance with the special conditions in the Water Permit and as outlined in the Mitigation Plan. Documentation of environmental flow releases will be provided to the USACE in accordance with the reporting requirements in Section 10 of the Mitigation Plan.

Daily operation data will be recorded in the LBCR Accounting Plan (Attachment 2). The TCEQ will verify compliance with the Water Permit through inspection of the Accounting Plan and the required annual reporting.

If the monitoring indicates that the operations are not meeting water quality standards or biological indices, NTMWD will immediately begin an adaptive management initiative. This initiative will assess the root cause of the non-compliance, identify remedial actions and implement those actions. Each adaptive management initiative will be unique to the non-compliance.

3.0 Normal Operations

LBCR will be operated as part of the NTMWD water system. Figure 3 shows the projected annual supplies from NTMWD's current sources and potential future sources as of February 2014.

Under normal operations, it is expected that the full yield of the reservoir will be 85% utilized within ten years of operation (2030). Figure 4 shows the projected annual diversions from LBCR based on current normal year projected demands.

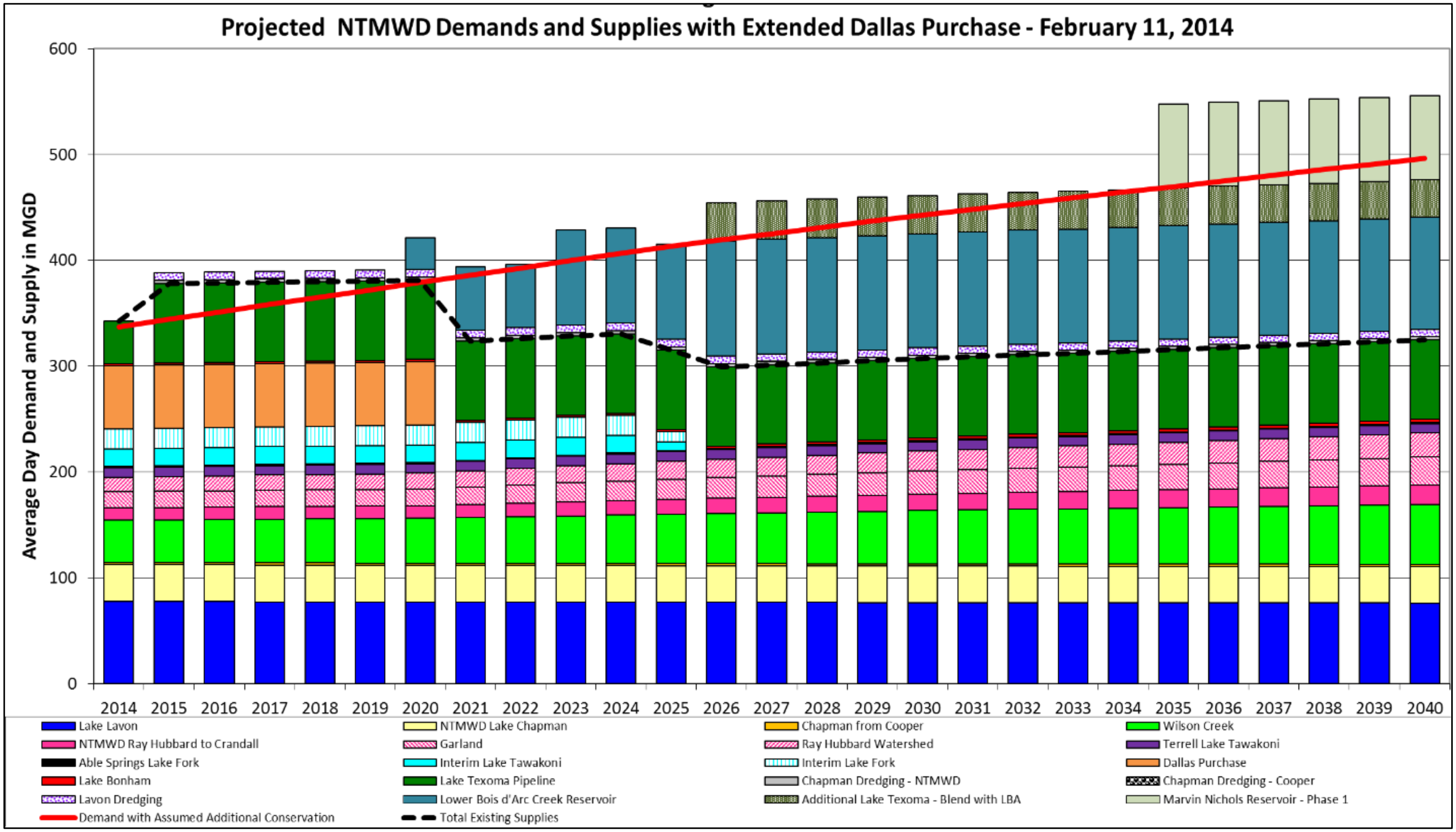

Figure 3 - NTMWD System Demands

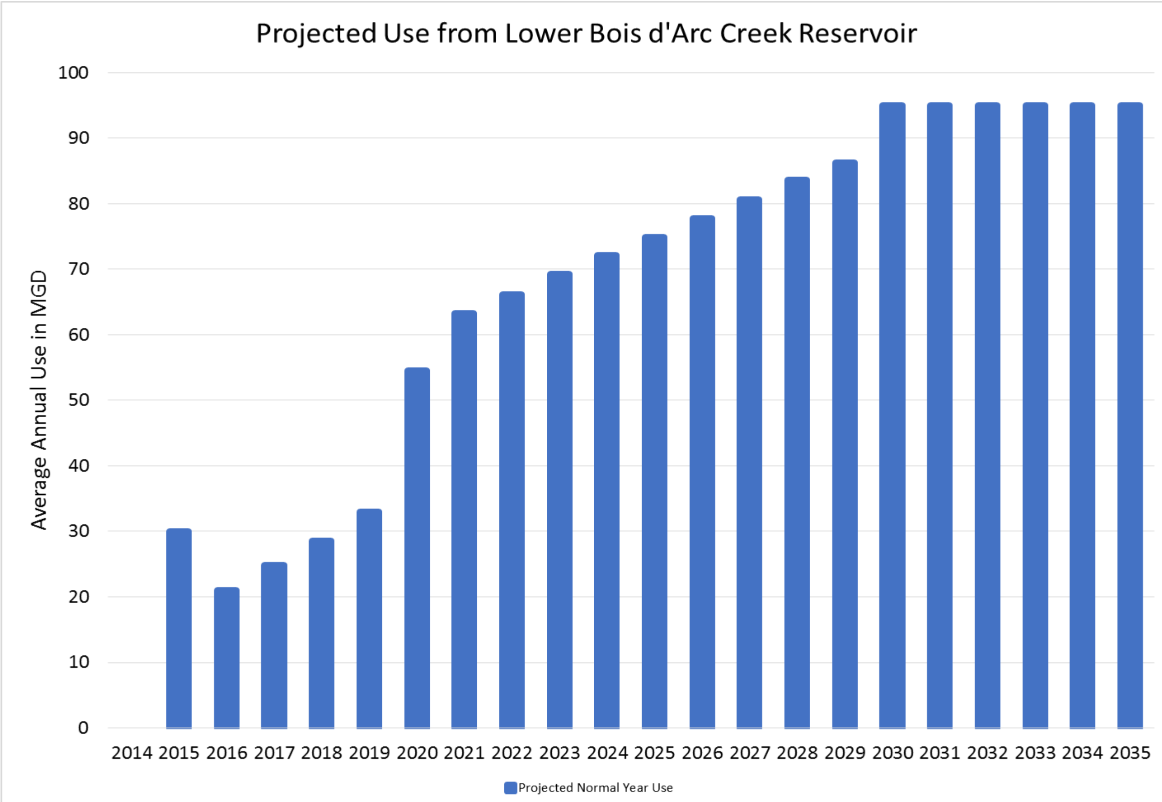

Figure 4 - Projected Normal Year Demands on LBCR

It is expected that the reservoir will be operated on a firm yield basis (diversions totaling approximately 120,000 acre-feet per year) or less during normal year demand and climatic conditions. During wet periods, the reservoir may be operated at its maximum diversion rate of 236 MGD. A potential operations scenario provided in Attachment 3 assumes that overdraft operations could occur as long as the LBCR is less than 2 feet below the top of conservation storage and the maximum diversion amount of 175,000 acre-feet per year has not been reached. When the LBCR drops more than 2 feet below the top of conservation storage, the diversions would be reduced to less than the LBCR firm yield. Modeling studies of the overdraft operation found little differences in the downstream flows at FM 409 and little difference in the water levels in the lake between the potential overdraft operation and normal operations.

Some of the factors that can affect the operation of the LBCR as part of the System include:

- *Climatic conditions.* For example, during relatively wet times NTMWD may elect to use less imported water if Lake Lavon is full, reducing power consumption.
- *Available infrastructure.* Initially the full use of the LBCR may be limited by treatment and distribution capacity. At times, use of the LBCR may increase if another reservoir or other water transfer facilities are out of service which would limit the use from other supply sources.

- *Other future water sources.* As NTMWD adds more sources of supply to the System the operation of the Reservoir may change to accommodate the use of those supplies, particularly if those sources are treated at the Leonard WTP.

Figure 5 shows the flow frequency at FM 409 under firm yield operations. These flows are from modeling runs using the daily RiverWare model that was developed to examine environmental flows for the project. The final environmental flows are included in the modeling. Flows are displayed on both a normal and a log scale. The log scale graph is provided to facilitate examination of the low flow periods. As shown on these graphs, there is expected to be a minimum of about 2 cfs flow in Bois d'Arc Creek at all times due to passing the wastewater discharges from Bonham. This will provide water to the downstream ecological system during conditions when the Bois d'Arc Creek would otherwise be dry. Note that in Figure 5 flows are at 2 cfs approximately 20 percent of the time. This does not imply that the reservoir will be in subsistence condition 20 percent of the time. According to the model, subsistence conditions occur about 9 percent of the time. The model limits releases from the LBCR to inflows to the reservoir, so inflows are about 2 cfs approximately 20 percent of the time. The remaining 11 percent of the time that flows are at 2 cfs are periods when there is little or no inflow into the LBCR other than wastewater discharges, but reservoir storage is above the subsistence trigger level.

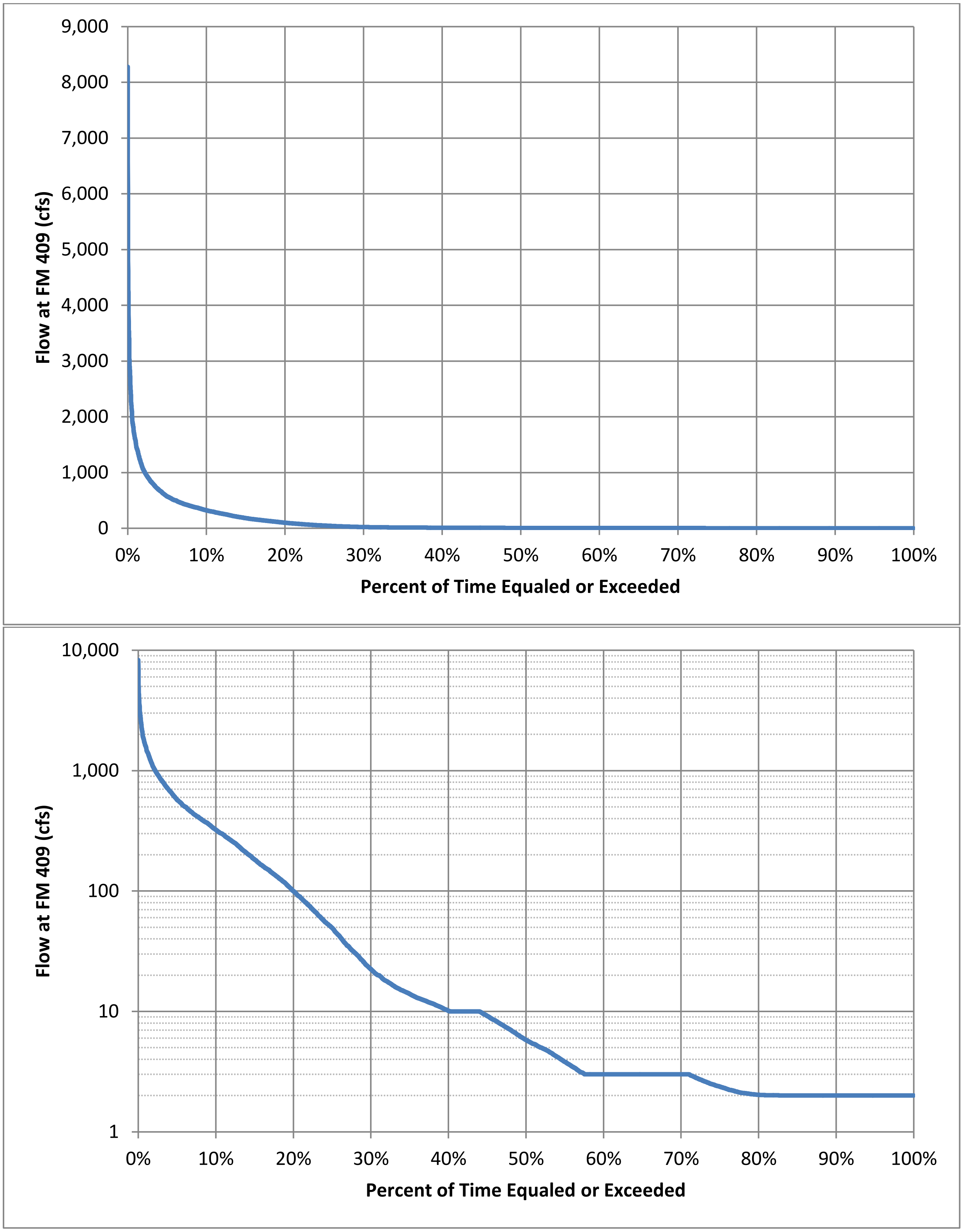

Figure 5: Modeled Flow Frequency at FM 409

4.0 Drought Operations

During drought there are two considerations: increased demands and potentially reduced storage in NTMWD water sources. Based on projected dry year demands, the expected demand on LBCR is shown in Figure 6.

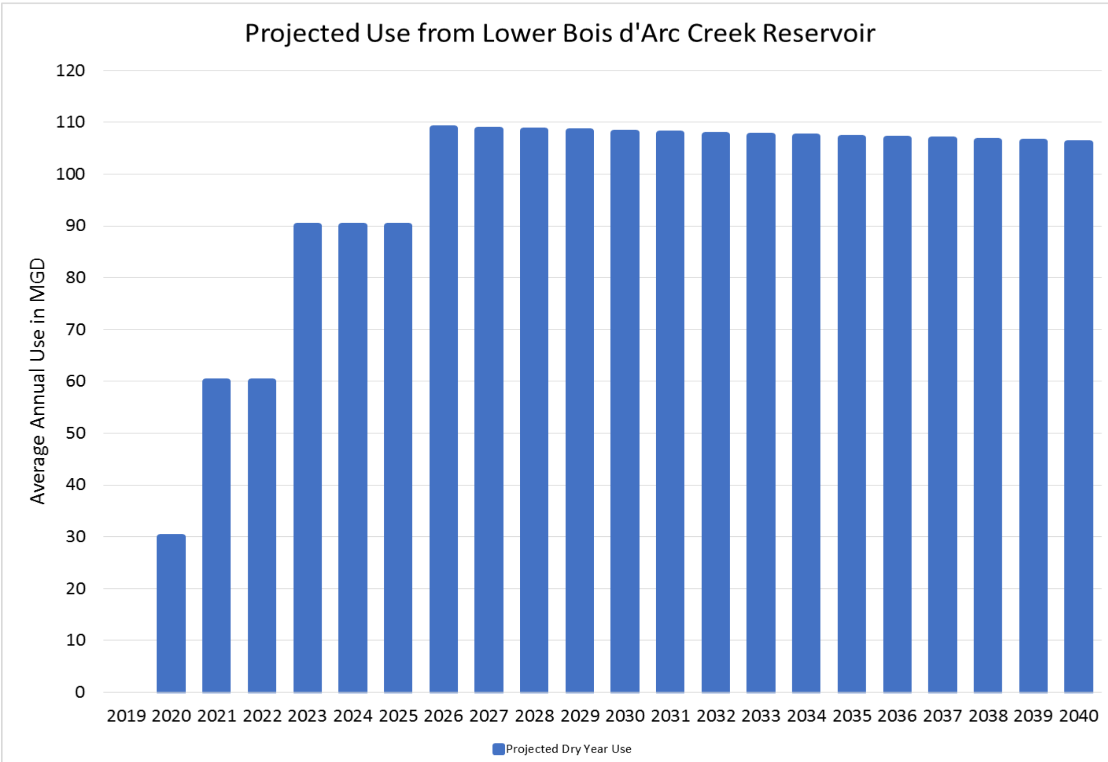

Figure 6 – Projected Dry Year Demands on LBCR

Under drought conditions, it is expected that full utilization of the reservoir would occur sooner (within six years) than under normal operations. As with normal operations, NTMWD intends to manage the reservoir in concert with its other water sources.

Upon completion of the reservoir, NTMWD will update its drought contingency plan to include the LBCR. The drought contingency plan will identify specific triggers and actions in response to drought conditions. One of the goals of the drought plan is to reduce system demands so that NTMWD can better manage its water supplies during dry periods.

Under the Water Permit, the reservoir is considered in subsistence conditions when the lake storage reaches 40% capacity. During this period, wastewater inflows will be passed through the dam to Bois d'Arc Creek. If a rain event occurs such that LBCR receives inflows of at least 20 cfs peak flow and 69 acre-feet pulse volume, and a corresponding event does not occur at the FM 409 gage, NTMWD will release a subsistence period freshet during a 60-day period. This will provide the downstream Bois d'Arc Creek with a small pulse event for maintaining downstream habitats even under subsistence conditions.

Attachment 1

Monitoring Plan

NORTH TEXAS MUNICIPAL WATER DISTRICT
MONITORING PLAN
For Proposed Lower Bois d'Arc Creek Reservoir

BACKGROUND:
The North Texas Municipal Water District (NTMWD) has applied for a water right (Application No. 12151) to store, divert and use water from the proposed Lower Bois d'Arc Creek Reservoir. During processing of the water right Application No. 12151, Commission staff determined that the environmental flow regime outlined in the draft permit maintains a sound ecological environment downstream of the dam. To document the downstream flow regime in Bois d'Arc Creek after the dam is completed and closed, Commission staff has recommended that a monitoring program be implemented.

The NTMWD has also applied for a USACE Section 404 Permit to construct the proposed reservoir. As part of the water right application and the USACE Section 404 application, the NTMWD has prepared a mitigation plan. This mitigation plan will be approved by the federal and state agencies and made part of the Section 404 Permit. The Mitigation Plan outlines the actions necessary to compensate for project impacts, details the monitoring of these mitigating actions, and specifies when the mitigation actions have met compliance with the mitigation goals.

BOIS D'ARC CREEK MONITORING PROGRAM
The Monitoring Program for Bois d'Arc Creek will consist of three primary components:

1. Hydrologic Monitoring
2. Biological Monitoring
3. Water Quality Monitoring

<u>Hydrologic Monitoring</u>
Hydrologic Monitoring of Bois d'Arc Creek downstream of the dam will consist of daily measurements at the existing USGS gage at FM 409 and a new partial record stage recording gage near FM 100. Hydrologic parameters monitored by the NTMWD at the FM 409 gage will include flow readings on 15-minute intervals and calculated average daily flows. Parameters monitored by the NTMWD at the new FM 100 gage will include stage data to calculate larger flows (flows greater than 500 cfs).

Hydrologic monitoring will begin after closure of the dam and data will be summarized on an annual basis and submitted to the Commission. After five and ten years of data collection, the NTMWD will prepare a summary report describing the results of its hydrologic monitoring. Hydrologic monitoring at FM 100 will cease after ten years or when the biological monitoring component ceases, whichever is later.

<u>Biological Monitoring</u>
Biological Monitoring will be conducted in accordance with the approved Mitigation Plan. Biological monitoring will be performed in years 1, 3, 5 and 10 following closure of the dam. A biological monitoring report will be submitted to the Executive Director of the TCEQ within six (6) months of the completion of the field activities. A summary report comparing the biological monitoring data to baseline conditions also will be prepared in years 5 and 10. If the metrics show no trends indicating

degradation of the aquatic community and the annual diversions from the reservoir have exceeded 100,000 acre-feet during at least one year of operation prior to the year 5 monitoring, then monitoring will end after 10 years. If these conditions are not met, biological monitoring will continue to be performed each subsequent 5 years until such conditions are met and a minimum of two yearly sampling events have been conducted following the diversion of 100,000 acre-feet in a given year.

Water Quality Monitoring

Water quality will be monitored downstream of the reservoir after closure of the dam to verify compliance with the stream standards for dissolved oxygen and temperature. Water quality parameters will be continuously recorded at the USGS gage at FM 409, and include at a minimum water temperature, pH, dissolved oxygen and specific conductivity.

To assist with the reservoir operations for environmental flow pass throughs, dissolved oxygen and temperature profiling of the lake water column will be conducted in the main body of the lake near the reservoir intake tower on a weekly basis beginning the first week of each May. Weekly monitoring will continue until a temperature and dissolved oxygen gradient is observed indicating that stratification has become established. After determining that stratification is present, monitoring frequency will be decreased to monthly until stratified conditions no longer exist. The profile data collected will be used to determine which gates on the intake tower should be operated to deliver oxygenated water for pass throughs. Verification that instream water quality criteria for dissolved oxygen and temperature are met will be provided by the measurements at the USGS gage at FM 409 downstream of the dam.

Water quality monitoring data will be summarized on an annual basis and submitted to the Commission. After five and ten years of data collection, the NTMWD will prepare a summary report describing the results of its water quality monitoring. The summary reports will be prepared as part of the hydrologic monitoring report. Water quality monitoring of dissolved oxygen and temperature at FM 409 and within the main body of the lake will continue through the life of the project. All formal water quality reporting to the Commission will cease after 10 years or when the biological monitoring ceases, whichever is later.

Attachment 2

Accounting Plan Narrative

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Simone Kiel 9/5/14

FREESE AND NICHOLS, INC.
TEXAS REGISTERED
ENGINEERING FIRM
F-2144

NORTH TEXAS MUNICIPAL WATER DISTRICT
RESERVOIR ACCOUNTING PLAN
For the Lower Bois d'Arc Creek Reservoir

Simone Kiel, P.E. and Jon S. Albright, Freese and Nichols, September 5, 2014

INTRODUCTION

The North Texas Municipal Water District (the "District") is seeking a water use permit to store, divert and use surface water from the proposed Lower Bois d'Arc Creek Reservoir (the "Reservoir") in Fannin County. This water would be used within the District's service area.

The District has a pending application (Application No. 12151) that requests, among other things, the following rights:

- The impoundment of up to 367,609 acre-feet.
- The use of the impounded water for recreation purposes.
- The diversion and use of up to 175,000 acre-feet per year for municipal, industrial and agricultural purposes.
- The diversion from any point on the perimeter of the Reservoir at a maximum diversion rate of 365.15 cfs (163,889 gpm, 236 mgd).

This accounting plan provides the framework to document compliance with the environmental flow regime that has been developed by the Texas Commission on Environmental Quality, which is shown in the table below (Table 1). A qualifying pulse occurs when the peak and either the volume or duration criterion have been met. If the District intentionally releases water downstream to generate a qualifying pulse at the USGS gage 07332622, Bois d'Arc Creek at FM 409, then the qualifying pulse at FM 409 must meet the peak and both the volume and duration criteria.

Table 1
Environmental Flow Regime for the Reservoir

Season	Months	Subsistence Flow (cfs)[1]	Base Flow (cfs)	Pulse Volume (ac-ft)	Pulse Duration (days)	Pulse Peak Flow (cfs)
Spring	March-June	1	10	3,540	10	500
Summer	July-October	1	3	500	5	100
Fall/Winter	Nov-Feb	1	3	1,000	7	150

1. A subsistence period freshet requirement with a trigger level of 20 cfs, a volume of 69 ac-ft, and a duration of 3 days, as further defined below, also applies.

During subsistence conditions, a subsistence flow freshet requirement will be in effect. Similar to the pulse flow requirements, a qualifying freshet occurs when the peak and either the volume or duration criterion have been met. The freshet requirement occurs only during subsidence periods and there is a consideration of a 60-day period between qualified freshets. Once the Reservoir is no longer in subsistence conditions, the pulse flow requirements outlined in Table 1 return in effect.

ELEMENTS OF THE ACCOUNTING PLAN

The accounting plan includes the following tables:

Table 1: Basic Input Data – includes basic data for the Reservoir on a daily basis, including elevation, releases, diversions from the lake, etc.

Table 2: Calculation of Reservoir Inflows – calculates daily inflow to the Reservoir using a basic mass-balance calculation.

Table 3: Calculation of Environmental Flows – calculates the environmental flow conditions for compliance with the agreed on environmental flow regime for the Reservoir, with the exception of the subsistence freshet.

Table 4: Calculation of Subsistence Freshet - calculates the environmental flow conditions for compliance with the subsistence freshet for the Reservoir

Table 5 - Net Reservoir Evaporation – computes the net Reservoir evaporation rate from the Reservoir. This information is used for the calculation of inflows in Table 2.

Table 6: Summary Reporting Data for Water Right – provides a monthly summary of data necessary for the annual water right report.

Table 7: Summary of Environmental Flows for Current Year – summarizes the environmental flows for the calendar year.

These tables are discussed individually in the following sections of the plan. There are also three tables that provide reference data. These include: a) Area-Capacity-Elevation table (ACE); b) Factors, which provides unit conversion factors and pan evaporation factors; and c) Release Patterns, which presents qualifying release patterns for pulse events by season and the subsistence freshet. In addition to these tables there are two charts that track daily inflows to the Reservoir and flows at FM 409. These charts are tools for the District to use to identify and confirm qualifying pulse events for compliance with environmental flow requirements.

The Accounting Plan Excel workbook is currently developed for one 365-day year. Each year a new workbook template will be used. A leap year template will be used for leap years.

TABLE 1 – BASIC INPUT DATA

This table gives the basic input data for the Reservoir on a daily basis. Data on this worksheet are hand entered and will be either measured by the District or obtained from outside sources (such as USGS). The columns in the table are developed as follows:

(1.1) Date. This is the date to which the data apply.
(1.2) Daily Elevation. This is Reservoir surface water elevation, which will be recorded by District staff each day. It will be recorded in feet mean sea level.
(1.3) Pumped Amount. This is the volume of water pumped from the Reservoir each day. This is measured in Million Gallons (MG).
(1.4) Releases. This is the daily average amount of water released from the Reservoir for environmental flows and/or for senior water rights. This is measured at the dam in cubic feet per second (cfs).
(1.5) Type of release. This denotes whether the release is a base flow release (1), a pulse release (2), a subsistence freshet release (3), or a supplemental release (4) used to create a pulse at FM 409. Subsistence flows (other than the freshet release) and supplemental releases are classified as base flows for this column. Base and subsistence flow releases are determined using Table 3 – Calculations of Environmental Flows, Columns 3.6 through 3.8. Pulse flow releases from the Reservoir are determined using Table 3 Columns 3.10 through 3.30. Freshet releases are determined using Table 4 – Calculations of Subsistence Freshet. Tables 3 and 4 are discussed in more detail later in this Accounting Plan narrative. This column is formatted with a drop down menu such that only numbers 1 – 4 can be entered.
(1.6) Spills. This is the daily volume of water spilled from the Reservoir. It is measured in day second feet (dsf). (A dsf is one cfs of discharge for one day.)

(1.7) Flow at FM 409. This is the average daily flow recorded by the USGS at the FM 409 gage. This is measured in cfs.

(1.8) Rainfall. This is measured rainfall data at the dam for the Reservoir. (It is assumed that a rainfall gage will be installed at the dam.) This is measured in inches of rainfall.

(1.9) Pan Evaporation. This is the amount of evaporation at the dam for the Reservoir. (It is assumed that an evaporation pan will be installed at the dam. Alternatively, daily evaporation data may be obtained from an existing nearby lake.) This is measured in inches of evaporation.

(1.10) Flow at FM 100. This is the daily average flow for a future partial flow gage on Bois d'Arc Creek located near FM 100. It is anticipated that the flow gage will measure flows at and above 500 cfs. Flows less than 500 cfs will be denoted either as a dash or "<500".

(1.11) Flow at TX 56. This is the daily average flow for a future USGS flow gage on Bois d'Arc Creek located near Texas Highway 56. This is measured in cfs. Data from this flow gage will be used to provide estimates of inflows to the Reservoir under low flow conditions for purposes of environmental flow compliance.

(1.12) Bonham Wastewater Discharge. This is the amount of wastewater discharged to the Bois d'Arc Creek watershed from the City of Bonham's wastewater treatment plant. It is measured in cfs.

(1.13) Honey Grove Wastewater Discharge. This is the amount of wastewater discharged to the Bois d'Arc Creek watershed from the City of Honey Grove's wastewater treatment plant. It is measured in cfs.

Data from the previous year's accounting plan for December 31 will be entered on row 12, and include End-of-Day Elevation (1.2), Pumped Amount (1.3), Releases (1.4) and Spills (1.6). The number of pulses credited during November and December of the previous year will be entered in cell K2. This value is taken from Table 3, cell AG4 of the previous year's accounting plan.

TABLE 2 – CALCULATION OF RESERVOIR INFLOWS

This table calculates the inflow to the Reservoir using two methodologies: 1) a basic mass-balance computation and 2) a measured gage flow with drainage area ratio computation. The gage flow/drainage area method also considers wastewater discharges from the Bonham and Honey Grove wastewater treatment plants. The gage flow/drainage area method will only be used for environmental flow calculations and compliance for days on which the flows that are calculated by the mass-balance method are 150 cfs and less. On days that flows exceed 150 cfs by the mass-balance method, the mass-balance method would be used for environmental flow calculations and compliance.

The columns in the table are developed as follows:

Columns (2.1) through (2.11) describe the Reservoir inflows using mass-balance method:

(2.1) Date. This is the date to which the data apply. It is referenced from Table 1 (1.1).

(2.2) Month. This is the month to which the data apply.

(2.3) Storage. This is the calculated Reservoir storage in acre-feet based on the previous day's measured surface water elevation (Table 1 (1.2)) and the Area-Capacity-Elevation Table.

(2.4) Area. This is the calculated Reservoir area in acres (ac) based on the previous day's measured surface water elevation (Table 1 (1.2)) and the Area-Capacity-Elevation Table.

(2.5) Net Evaporation. This is the net evaporation rate in feet for the Reservoir. This rate is calculated in Table 4.

(2.6) Net Reservoir Evaporative Loss. This is the calculated daily evaporative loss based on the surface area of the Reservoir (Columns (2.4) x (2.5)). It is reported in acre-feet of loss.

(2.7) Diversion. This is the actual diversion from the lake in acre-feet. The information is taken from Table 1 (1.3) and converted from million gallons to acre-feet.

(2.8) Releases. This is the actual releases from the lake in acre-feet. The information is taken from Table 1 (1.4) and converted from cubic feet per second (cfs) to acre-feet.

(2.9) Spills. This is the actual spills from the lake in acre-feet. The information is taken from Table 1 (1.6) and converted from day second feet (dsf) to acre-feet.

(2.10) Inflow (ac-ft). This is the mass-balance calculated inflow to the lake in acre-feet. It is determined by the change in storage from the previous day (2.3 for the current day minus 2.3 for the previous day) plus the net evaporative loss (2.6), diversions (2.7), releases (2.8), and spills (2.9).

(2.11) Inflow (cfs). This is the mass-balance calculated inflow to the lake (2.10) converted to cfs.

Column (2.12) calculates the Reservoir inflows using gage/drainage area method:

(2.12) Inflow (cfs). This is the calculated inflow to the lake using the gage/drainage area method by multiplying the gage flow at TX 56 (1.11) times the drainage area ratio [Factor (C21)] plus the Bonham wastewater discharges (1.12) and the Honey Grove wastewater discharges (1.13).

Columns (2.13) and (2.14) describes the Reservoir inflows that are used for environmental flow purposes:

(2.13) Inflow (cfs). This column selects the appropriate inflow value for environmental flow calculations and compliance. If the inflow using the mass-balance method (2.11) is greater than 150 cfs, then the mass-balance method inflow (2.11) is recorded in this column. If the mass-balance method (2.11) is less than or equal to 150 cfs, then the gage/drainage area inflow (2.12) is recorded.

(2.14) Inflow (ac-ft). This is the calculated inflow to the lake (2.13) converted to ac-ft that is used for environmental flow calculations and compliance.

TABLE 3 – CALCULATION OF ENVIRONMENTAL FLOWS

This table calculates the environmental flow conditions for compliance with the environmental flow regime for the Reservoir, with the exception of the Subsistence Freshet, which is calculated in Table 4. This environmental flow regime is shown on Table 1 and provided for reference in the spreadsheet in the array located in cells F2:L4. The columns in this table are developed as follows:

Columns (3.1) through (3.5) describe the Reservoir inflow and identify the season:

(3.1) Date. This is the date to which the data apply. It is referenced from Table 1 (1.1).

(3.2) Month. This is the month to which the data apply.

(3.3) Season. This is the corresponding season as defined for environmental flows. It is based on the month (3.2) and the environmental flow regime shown on Table 1.

(3.4) Reservoir Inflow. This is the Reservoir inflow expressed in cfs. It is taken from Table 2 (2.13).

(3.5) Reservoir Day Type. This is the classification of day type for purposes of environmental flows. A day would be classified as "subsistence" if the Reservoir is below elevation 516.4 ft msl. A day would be classified as "pulse" if the previous day is a base flow day and inflows are greater than 25 cfs. The 25 cfs level provides a distinction between varying base flow levels and pulse flows for purposes of initiating a pulse event. The 25 cfs value, based on inspection of historical data for Bois d'Arc Creek, is a good indicator of when a pulse is about to occur. The "pulse" day classification remains in effect until the flows return to the season's base flow criteria. All other days are classified as "base" flow days.

Columns (3.6) through (3.9) describe the base flow calculations:

(3.6) Seasonal Base Flow. This is the seasonal base flow criterion. This is referenced from the environmental flow regime and season (3.3). It is measured in cfs.

(3.7) Base Flow Calculation. This is the required base flow release. It is calculated as the smaller amount of the inflow (3.4) or seasonal base flow (3.6). It is calculated for both "base" flow and "pulse" flow days (3.5). While temporarily impounding pulse flows, base flow releases will continue to be made. If the temporarily impounded pulse flow is subsequently released from the Reservoir, the base flow releases made during temporary impoundment are considered for compliance of the volume requirements for pulse flow release in Column (3.42) and (3.43). It is measured in cfs.

(3.8) Subsistence Flow Calculation. This is the required subsistence flow release (not including the subsistence freshet). It is calculated as the smaller amount of the inflow (3.4) or subsistence flow criterion (1 cfs). It only applies to "subsistence" days (3.5). It is measured in cfs. Days not designated as "subsistence" are shown as "NA" for "Not Applicable".

(3.9) Actual Base/Subsistence Flow Releases. This is the amount of flow that is actually released to satisfy the base flow and subsistence flow (excluding the subsistence freshet) requirements of the environmental flow regime. It is taken from Table 1 (1.4) for releases noted as base flow (Table 1 (1.5) = 1) and flows designated as supplemental releases (Table 1 (1.5) = 4). For pulse flow releases (Table 1 (1.5) = 2), the season's base flow requirement (3.6) is recorded in this column. Subsistence freshet flows (Table 1 (1.5) = 3) are shown as "NA" for not applicable.

Columns (3.10) through (3.12) describe the pulse flow seasonal qualifiers:

(3.10) Qualifying Duration. This is the seasonal pulse flow duration criterion. This is referenced from the environmental flow regime and season (3.3). This is measured in days.

(3.11) Qualifying Volume. This is the seasonal pulse flow volume criterion measured in acre-feet. This is referenced from the environmental flow regime and season (3.3).

(3.12) Qualifying Pulse Peak. This is the seasonal pulse flow peak criterion measured in cfs. This is referenced from the environmental flow regime and season (3.3).

Columns (3.13) through (3.18) describe the pulse flow calculations for the Reservoir:

(3.13) Reservoir Pulse Volume. This is the daily volume of inflow to the Reservoir for days that are designated as a "pulse" day. The volume is in acre-feet and is referenced from Table 2 (2.14).

(3.14) Reservoir Pulse Duration. This calculates the number of days in a continuous pulse with the maximum number of days equal to the qualifying duration for the season (3.10).

(3.15) Reservoir Cumulative Pulse Volume. This is the cumulative volume of the pulse entering the Reservoir, calculated for the previous (n) days of the pulse, where the maximum (n) is the qualifying duration for the season. This is calculated in acre-feet.

(3.16) Reservoir Qualifying Pulse Volume. This column compares the Reservoir cumulative pulse volume (3.15) to the qualifying volume (3.11). If the cumulative volume of the pulse equals or exceeds the qualifying volume, then a "Y" is recorded for "Yes". If the cumulative volume is less than the qualifying volume, then an "N" is recorded for "No".

(3.17) Reservoir Qualifying Pulse Duration. This column compares the duration of the Reservoir pulse (3.14) to the qualifying pulse duration (3.10). If the duration of the pulse equals the qualifying duration, then a "Y" is recorded for "Yes". If the duration is less than the qualifying duration, then an "N" is recorded for "No".

(3.18) Reservoir Qualifying Pulse Peak. This column compares the Reservoir pulse flow (3.4) to the qualifying pulse peak (3.12). If the daily pulse flow (cfs) equals or exceeds the qualifying peak flow, then a "Y" is recorded for "Yes". If the flow is less than the qualifying peak flow, then an "N" is recorded for "No". Since this analysis is not applicable to subsistence conditions, an “N” is recorded for “No” if the Reservoir is in subsistence conditions.

Columns (3.19) through (3.26) describe the pulse flow calculations at FM 409:

(3.19) Flows at FM 409. This is the average daily flow at the USGS gage at FM 409 in cfs. It is obtained from Table 1 (1.7).

(3.20) FM 409 Pulse Day. This is the determination of whether the flows at FM 409 constitute a pulse flow. A pulse day would be recorded as “Y” (for yes) if flows at FM 409 are greater than 25 cfs or the previous day was classified as a pulse and the flows have not returned to seasonal base flow level. The 25 cfs level provides a distinction between varying base flow levels and pulse flows for purposes of initiating a pulse event. The 25 cfs value, based on inspection of historical data for Bois d’Arc Creek, is a good indicator of when a pulse is about to occur. All other days are classified as a non-pulse flow day and recorded with an “N” for “No”. Since this analysis is not applicable to subsistence conditions, an “N” is recorded for “No” if the Reservoir is in subsistence conditions.

(3.21) FM 409 Pulse Volume. This is the daily volume of flow at FM 409 for days that are designated as a pulse day. The volume is in acre-feet.

(3.22) FM 409 Pulse Duration. This calculates the number of days in a continuous pulse at FM 409 with the maximum number of days equal to the qualifying duration for the season (3.10).

(3.23) FM 409 Cumulative Pulse Volume. This is the cumulative volume of the pulse at FM 409, calculated for the previous (n) days of the pulse, where the maximum (n) is the qualifying duration for the season. This is reported in acre-feet.

(3.24) FM 409 Qualifying Pulse Volume. This column compares the FM 409 cumulative pulse volume (3.23) to the qualifying volume (3.11). If the cumulative volume of the pulse equals or exceeds the qualifying volume, then a “Y” is recorded for “Yes”. If the cumulative volume is less than the qualifying volume, then an “N” is recorded for “No”.

(3.25) FM 409 Qualifying Pulse Duration. This column compares the duration of the FM 409 pulse (3.22) to the qualifying pulse duration (3.10). If the duration of the pulse equals the qualifying duration, then a “Y” is recorded for “Yes”. If the duration is less than the qualifying duration, then an “N” is recorded for “No”.

(3.26) FM 409 Qualifying Pulse Peak. This column compares the flows at FM 409 (3.19) to the qualifying pulse peak (3.12). If the daily pulse flow (cfs) equals or exceeds the qualifying peak flow, then a “Y” is recorded for “Yes”. If the flow is less than the qualifying peak flow, then an “N” is recorded for “No”. Since this analysis is not applicable to subsistence conditions, an “N” is recorded for “No” if the Reservoir is in subsistence conditions.

(3.27) Deliberate Release to Create a Pulse. This column records whether a release (not a qualified pulse release) was made from the Reservoir to create a pulse at FM 409. If such a release is made, a qualifying pulse at FM 409 must meet both the volume and duration criteria. This is determined from Table 1 (1.5). If the type of release recorded on Table (1.5) = 4, then a "Y" is recorded for "Yes". For all other types of releases, an "N" is recorded for "No".

Columns (3.28) through (3.30) describe the pulse flow credit determination:

(3.28) Pulse Credit at FM 409. This column records whether a qualifying pulse occurred at FM 409. This is hand entered based on whether there was a qualifying peak flow at FM 409 [(3.26) ="Y"] and the pulse had a qualifying duration [(3.25) = "Y"] or volume [(3.24) = "Y"]. A value of "1" is recorded in this column during the time of the qualifying pulse or immediately following qualification. If flow is released from the Reservoir to create a qualifying pulse at FM 409 (Column (3.27) shows a "Y" during or immediately preceding the pulse event), the pulse must meet both the volume and duration criteria (i.e., both Columns 3.24 and 3.25 must show a "Y" during the pulse event). The pulse can be counted as qualifying pulse at FM 409 (3.28), but it cannot also be counted as qualifying pulse release from the Reservoir (3.29). If the pulse flow requirements have been met for the season (see Table Z1:AC4), then no additional recordings are needed for the season. Pulses recorded during November and December of the current year fall/winter season (AG4) will be counted in the following calendar year accounting plan for compliance purposes. Pulses recorded in November and December of the previous year (AF4) are credited against the fall/winter season pulse criteria for the current year. The value in cell AF4 is referenced from T1-Input, cell K2.

(3.29) Pulse Release from Reservoir. This column records whether a qualifying pulse was released from the Reservoir. This is hand entered based on whether there was no qualifying pulse at FM 409 (i.e., review of Columns 3.24 through 3.26 shows that the flows at FM 409 did not exceed the peak flow criteria or if the peak flow criteria was met but neither the volume or duration was met), yet there was a qualifying peak flow into the Reservoir (3.18) and the Reservoir pulse had a qualifying duration (3.17) or volume (3.16) during the same time period, and a qualifying pulse is subsequently released from the Reservoir. A value of "1" is recorded in this column during the time of the release of the qualifying pulse. Pulse flow releases will meet the minimum qualifying peak flow and the qualifying volume or duration for the specific season. Qualifying pulse flow will be released as close as practicable to the release patterns by season that are included in the worksheet called *Release Patterns*. The flow from a qualifying pulse released from the Reservoir **that is counted as a qualifying pulse** cannot also be counted as a qualifying pulse at FM 409. If the pulse flow requirements have been met for the season (see Table Z1:AC4), then no additional recordings are needed for the season. Pulses recorded during the months of November and December in the current year winter season (AG4) will be counted in the following calendar year accounting plan for compliance purposes.

(3.30) Released Pulse Amount. This is the amount of flow released from the Reservoir specifically to meet the pulse flow requirements of the environmental instream flow regime. It is taken from Table 1 (1.4) for releases noted as pulse flow (Table 1 (1.5) = 2) less the amount released for base flow (3.9).

Table Z1:AC4: This table shows the required number of pulses per season and the number of credited pulses by season. The number of credited pulses is the sum of the recorded pulses in Columns (3.28) and (3.29) for each respective season. The credits for the fall/winter season include the recorded pulses in January and February of the current year plus the number of pulses recorded in November and December from the previous year. As discussed above, qualifying pulses that occur during the winter portion of the Fall/Winter season (November and December) from the previous year are shown in cell AF4. Qualifying pulses that occur during the winter portion of the Fall/Winter season (November and December) in the current year are recorded in cell AG4. Once the number of credited pulses equals the number of required pulses for a season, no additional recordings of pulses is required for the respective season.

Columns (3.31) through (3.38) provide checks for base/subsistence flow compliance and Columns (3.39) through (3.45) provide a check on compliance for pulse flows that are released directly from the Reservoir. These checks are included to allow the District to make adjustments if needed during the appropriate season.

Since base/subsistence flow calculations are made at the end of the day and the base/subsistence flow for the day would have already been released, the Accounting Plan provides a 14-day window for verification that the cumulative base/subsistence flow released (recorded in day-second-feet (dsf)) equals or exceeds the cumulative base/subsistence flow calculated to be released (dsf). If the calculations show that the actual base/subsistence flow released is less than the amount calculated, the District can adjust the base/subsistence releases over the subsequent 14 days.

Columns (3.31) through (3.34) describe the compliance check for base flows:

(3.31) Counter (Days). This column counts the number of days up to a maximum of 14 days that base flows are passed from the Reservoir. It includes all days except the days the Reservoir is in subsistence conditions. This column is used to calculate the cumulative base flows released and the cumulative base flows that were calculated for release over a period up to 14 days.

(3.32) Cumulative Calculated Base Flow Releases (dsf). This calculates the cumulative calculated base flow (3.7) over the previous number of days (3.31). This is calculated in day-second-feet (dsf). The annual total is shown in the last row (below data entries for December 31 of the current year).

(3.33) Cumulative Actual Base Flow Releases (dsf). This calculates the cumulative base flow that was released from the Reservoir (3.9) over the previous number of days

(3.31). This is calculated in day-second-feet (dsf). Flow that is released for purposes of creating a pulse at FM 409 is included in the cumulative base flow release amounts, however, the flow above base flow requirements cannot be counted above the current daily base flow amount unless it is used to correct a deficit from the previous 14 days. The annual total is shown in the last row (below data entries for December 31 of the current year).

(3.34) Comparison of Actual Release to Calculated Release (dsf). This column subtracts the calculated cumulative base flow release amount (3.32) from the actual cumulative base flow release (3.33). If the difference is less than "0", then the cell turns red. Negative flow amounts can be made up during the subsequent 14-day period. The annual total is shown in the last row (below data entries for December 31 of the current year). This value will help the user determine if any additional base flow releases are needed for compliance with the calculated base flow releases.

Columns (3.35) through (3.38) describe the compliance check for subsistence flows (excluding freshets):

(3.35) Counter (Days). This column counts the number of days up to a maximum of 14 days that subsistence flows are passed from the Reservoir. It includes only days the Reservoir is in "subsistence" conditions. Days that the Reservoir is in "freshet" conditions are shown as "0".

(3.36) Cumulative Calculated Subsistence Flow Releases (dsf). This calculates the cumulative calculated subsistence flow (3.8) over the previous number of days (3.35). This is calculated in day-second-feet (dsf). The annual total is shown in the last row (below data entries for December 31 of the current year).

(3.37) Cumulative Actual Subsistence Flow Releases (dsf). This calculates the cumulative subsistence flow that was released from the Reservoir (3.9) over the previous number of days (3.35). This is calculated in day-second-feet (dsf). Freshet releases are not included in this calculation. The annual total is shown in the last row (below data entries for December 31 of the current year).

(3.38) Comparison of Actual Release to Calculated Release (dsf). This column subtracts the calculated cumulative subsistence flow release amount (3.36) from the actual cumulative base flow release (3.37). If the difference is less than "0", then the cell turns red. Negative flow amounts can be made up during the subsequent 14-day period. The annual total is shown in the last row (below data entries for December 31 of the current year). This value will help the user determine if any additional subsistence flow releases are needed for compliance with the total calculated subsistence flow release.

Columns (3.39) through (3.45) describe the compliance check for pulse flows (excluding freshets) that are released from the Reservoir:

(3.39) Released Pulse Volume (ac-ft). This is the daily volume of water released from the Reservoir for a pulse flow in acre-feet. It is calculated from Column (3.30) times Factor C7.

(3.40) Released Pulse Duration (days). This calculates the number of days in a continuous pulse from Column (3.30).

(3.41) Cumulative Released Pulse Volume (ac-ft). This is the cumulative volume of water released as part of a continuous pulse. It is calculated from Columns (3.39) and (3.40) and recorded in acre-feet.

(3.42) Reservoir Cumulative Pulse Volume Released during Temporary Impoundment (ac-ft). This is the cumulative volume of a pulse inflow that was released as base flow during the period when the pulse was being temporarily impounded. It is calculated as the base flow requirement for the season (3.6) times the number of days in the pulse (3.40) and converted to acre-feet (Factor C7). It is assumed that during temporary impoundment, the inflow to the Reservoir would exceed the base flow requirements and the amounts released for base flow compliance would be the base flow requirement for the season.

(3.43) Reservoir Qualifying Pulse Volume (Y/N). This column compares the cumulative pulse volume released from the Reservoir (3.41) to the qualifying volume (3.11). If the cumulative volume of the pulse equals or exceeds the qualifying volume, then a "Y" is recorded for "Yes". If the cumulative volume is less than the qualifying volume, then an "N" is recorded for "No".

(3.44) Reservoir Qualifying Duration (Y/N). This column compares the duration of the released pulse (3.40) to the qualifying pulse duration (3.10). If the duration of the released pulse equals the qualifying duration, then a "Y" is recorded for "Yes". If the duration is less than the qualifying duration, then an "N" is recorded for "No".

(3.45) Reservoir Qualifying Peak Flow (Y/N). This column compares the flows of the released pulse (3.30) plus the flows released for base flow compliance (3.9) to the qualifying pulse peak (3.12). The total flow released on a daily basis is the basis for compliance with peak flow requirements. If the daily total released flow (cfs) equals or exceeds the qualifying peak flow, then a "Y" is recorded for "Yes". If the flow is less than the qualifying peak flow, then an "N" is recorded for "No".

TABLE 4 – CALCULATION OF SUBSISTENCE FRESHET

This table calculates the environmental flow conditions for compliance with the agreed on Subsistence Freshet for the Reservoir. A subsistence period freshet requirement is in place during the subsistence period without seasonal differences. The subsistence freshet has a trigger level of 20 cfs, a volume of 69 acre-feet, and a duration of 3 days. A qualifying freshet occurs when the peak and either the volume or duration criterion have been met. Qualified freshets that enter the Reservoir will only need to be passed if a qualified freshet does not occur at FM 409 within the previous 60-day period. At a maximum, only 1 qualified freshet would be passed within a 60-day period if a qualified freshet was recorded in the Reservoir but no qualified freshet was recorded at FM 409 over the same time period. Data from the last day of the previous year is entered on Row 12. This data is needed if the subsistence period extends across calendar years. The columns in this table are developed as follows:

Columns (4.1) through (4.4) describe the Reservoir inflow and Reservoir day type:

(4.1) Date. This is the date to which the data apply. It is referenced from Table 1 (1.1).

(4.2) Reservoir Inflow. This is the Reservoir inflow expressed in cfs. It is taken from Table 2 (2.13).

(4.3) Subsistence Day. This identifies whether the Reservoir is in subsistence conditions. A subsistence day would be classified as "Y" for "Yes" if the Reservoir is below elevation 516.4 ft msl. All other days are classified as "N" for "No".

(4.4) Reservoir Day Type. This classifies the day as either "subsidence" or "freshet" when the Reservoir is in subsistence conditions. If inflows to the Reservoir, less the wastewater discharges from Bonham [T1-Input (1.12)] and Honey Grove [T1-Input (1.13)], are less than or equal to 1 cfs, it is a subsistence day. If inflows, less wastewater discharges, are greater than 1 cfs it is a freshet day. This calculation characterizes the intent of the freshet as a natural inflow event. If the Reservoir is not in subsistence conditions, a "NA" is recorded for "Not Applicable".

Columns (4.5) through (4.10) describe the freshet flow calculations for the Reservoir:

(4.5) Reservoir Freshet Volume. This is the daily volume of inflow to the Reservoir for days that are designated as a "freshet" day (4.4). The volume is in acre-feet and is referenced from Table 2 (2.14).

(4.6) Reservoir Freshet Duration. This calculates the number of days in a continuous freshet with the maximum number of days equal to three (3).

(4.7) Reservoir Cumulative Freshet Volume. This is the cumulative volume of the freshet entering the Reservoir, calculated for the previous (n) days of the freshet, where the maximum (n) is three (3). This is calculated in acre-feet.

(4.8) Reservoir Qualifying Freshet Volume. This column compares the Reservoir cumulative freshet volume (4.7) to the qualifying volume of 69 acre-feet (G2). If the cumulative volume of the freshet equals or exceeds the qualifying volume, then a "Y" is recorded for "Yes". If the cumulative volume is less than the qualifying volume, then an "N" is recorded for "No".

(4.9) Reservoir Qualifying Freshet Duration. This column compares the duration of the Reservoir freshet (4.6) to the qualifying freshet duration of 3 days (H2). If the duration of the freshet equals the qualifying duration, then a "Y" is recorded for "Yes". If the duration is less than the qualifying duration, then an "N" is recorded for "No".

(4.10) Reservoir Qualifying Freshet Peak. This column compares the Reservoir freshet flow (4.2) to the qualifying freshet peak of 20 cfs (I2). If the daily freshet flow (cfs) equals or exceeds the qualifying peak flow, then a "Y" is recorded for "Yes". If the flow is less than the qualifying peak flow, then an "N" is recorded for "No".

Columns (4.11) through (4.18) describe the freshet flow calculations at FM 409:

(4.11) Flows at FM 409. This is the average daily flow at the USGS gage at FM 409 in cfs. It is obtained from Table 1 (1.7).

(4.12) FM 409 Freshet Day. This is the determination of whether the flows at FM 409 constitute a freshet flow during subsistence conditions. If the Reservoir is not in subsistence conditions, the day is recorded with an "NA" for "Not Applicable". During subsistence conditions, a freshet day would be recorded as "Y" if flows at FM 409 are greater than 20 cfs or the previous day was classified as a freshet and the flows have not returned to a subsistence flow level (less than 2 cfs). All other subsistence days are classified as "N" for non-freshet day.

(4.13) FM 409 Freshet Volume. This is the daily volume of flow at FM 409 for days that are designated as a freshet day. The volume is in acre-feet.

(4.14) FM 409 Freshet Duration. This calculates the number of days in a continuous freshet at FM 409 with the maximum number of days equal to the qualifying duration for the freshet (3 days).

(4.15) FM 409 Cumulative Freshet Volume. This is the cumulative volume of the freshet at FM 409, calculated for the previous three (3) days of the freshet. This is reported in acre-feet.

(4.16) FM 409 Qualifying Freshet Volume. This column compares the FM 409 cumulative freshet volume (4.15) to the qualifying volume (G2). If the cumulative volume of the freshet equals or exceeds the qualifying volume, then a "Y" is recorded for "Yes". If the cumulative volume is less than the qualifying volume, then an "N" is recorded for "No".

(4.17) FM 409 Qualifying Freshet Duration. This column compares the duration of the FM 409 freshet (4.14) to the qualifying freshet duration (H2). If the duration of the freshet equals the qualifying duration, then a "Y" is recorded for "Yes". If the duration is less than the qualifying duration, then an "N" is recorded for "No".

(4.18) FM 409 Qualifying Freshet Peak. This column compares the flows at FM 409 (3.19) to the qualifying freshet peak (I2). If the daily freshet flow (cfs) equals or exceeds the qualifying peak flow (20 cfs), then a "Y" is recorded for "Yes". If the flow is less than the qualifying peak flow, then an "N" is recorded for "No".

Column (4.19) provides the 60-day counter for the freshet flow requirement:

(4.19) Counter (Days). This column records the number of days since a qualified freshet occurred at FM 409 or was released from the Reservoir. If the Reservoir is not in subsistence conditions, a "NA" is recorded for "Not Applicable". At the start of subsistence conditions, the counter is set at 1. Once a qualified freshet is recorded at FM 409 (4.20) or released from the Reservoir (4.21), the counter is reset at 1.

Columns (4.20) through (4.22) describe the freshet flow credit determination:

(4.20) Freshet Credit at FM 409. This column records whether a qualifying freshet occurred at FM 409. This is hand entered based on whether there was a qualifying peak flow at FM 409 [(4.18) = Y] and the freshet had a qualifying duration [(4.17) = Y] or volume [(4.16) = Y] over the duration of the freshet. A value of "1" is recorded at the end of the qualifying freshet.

(4.21) Freshet Release from Reservoir. This column records whether a qualifying freshet was released from the Reservoir. This is hand entered based on whether there was no qualifying freshet at FM 409 during the previous 60-day period in subsistence conditions [i.e., review of columns 4.16 through 4.18 shows that the flows at FM 409 did not exceed the peak flow criteria (4.18) or if the peak flow criteria was met but neither the volume (4.16) or duration (4.17) was met] and a qualifying freshet was recorded into the Reservoir [i.e., review of columns 4.8 through 4.10 shows that the inflows to the Reservoir exceeded the peak flow criteria (4.10) and either the volume (4.18) or duration (4.9) was met] and a qualifying freshet is released from the Reservoir. A value of "1" is recorded during the time of the release of the qualifying freshet. Freshet flow releases will meet the minimum qualifying peak flow and the qualifying volume or duration specified for the freshet in a manner as close as practicable to the release pattern included in worksheet *Release Patterns*. The flow from a qualifying freshet released from the Reservoir **that is counted as a qualifying freshet** cannot also be counted as a qualifying freshet at FM 409.

(4.22) Released Freshet Amount. This is the amount of flow released from the Reservoir specifically to meet the freshet flow requirements of the environmental instream flow regime. It is taken from Table 1 (1.4) for releases noted as freshet flow (Table 1 (1.5) = 3).

TABLE 5 – NET RESERVOIR EVAPORATION RATE

(5.1) Date. This is the date to which the data apply. It is referenced from Table 1 (1.1).

(5.2) Month. This is the month to which the data apply.

(5.3) Pan Evaporation. This is measured pan evaporation data in inches for the Reservoir.

(5.4) Pan Factor. This is an empirical factor to estimate evaporation from a Reservoir surface based on evaporation from a pan. The coefficients for each month are based on weighted averages of pan factors developed by the Texas Water Development Board for quadrangles 411 and 412. The empirical factors are entered on the Factors worksheet.

(5.5) Gross Reservoir Evaporation. This is the estimated gross evaporation from the Reservoir surface in inches. It is equal to Column (5.3) times Column (5.4).

(5.6) Rainfall. This is measured rainfall data in inches for the Reservoir.

(5.7) Net Reservoir Evaporation. This is the estimated net Reservoir evaporation in inches from the surface of the Reservoir. It is equal to Column (5.5) minus Column (4.6).

(5.8) Net Reservoir Evaporation. This is the estimated net Reservoir evaporation from the surface of the Reservoir expressed in feet. It is equal to Column (5.7) divided by 12.

TABLE 6 – SUMMARY REPORTING DATA FOR WATER RIGHT

This table is provided to assist the District with the reporting requirements to the TCEQ on diversions associated with its anticipated water right permit for the Reservoir.

(6.1) Month Number. This is the number of the month to which the data apply.

(6.2) Month Name. This is the month to which the data apply.

(6.3) Maximum Diversion Rate. This is the maximum diversion rate in cfs for pumped amounts for the corresponding month. It is taken from Table 1 (1.3) and converted from MG to cfs. If the maximum diversion rate exceeds the permitted amount of 365.15 cfs, the cell will be highlighted in red.

(6.4) Monthly Diversions. This is the sum of diversions by month in acre-feet. It is taken from Table 2 (2.7). If the monthly or annual diversions exceed the permitted diversion amount of 175,000 acre-feet, the cell will be highlighted red.

TABLE 7 – SUMMARY OF ENVIRONMENTAL FLOWS

This table summarizes the environmental flow releases and credits taken at FM 409 in compliance with the environmental flow regime for the Reservoir. The columns in the table are developed as follows:

(7.1) Season. This is the environmental flow season to which the data apply.

(7.2) Maximum Base Flow. This is maximum base flow value (in cfs) released from the Reservoir during the corresponding season. It is taken from Table 3 (AV4:AX4). Subsistence base flows are taken from Table 3 (AY4).

(7.3) Minimum Base Flow. This is minimum base flow value (in cfs) released from the Reservoir during the corresponding season. It is taken from Table 3 (AV3:AX3). Subsistence base flows are taken from Table 3 (AY3).

(7.4) Average Base Flow. This is average base flow value (in cfs) released from the Reservoir during the corresponding season. It is taken from Table 3 (AV5:AX5). Subsistence base flows are taken from Table 3 (AY5).

(7.5) Pulse Flow – FM 409 Credit. This is the number of pulse credits taken at FM 409 by calendar season. It is taken from Column (3.27) of Table 3.

(7.6) Pulse Flows – Reservoir Release Credit. This is the number of pulses released from the Reservoir by calendar season. It is taken from Column (3.28) of Table 3.

(7.7) Pulse Flows – Total Credit. This is the total number of pulse credits for the calendar year by season. It is the sum of Columns (7.5) and (7.6).

(7.8) Freshet Flow – FM 409 Credit. This is the number of freshet credits taken at FM 409 by calendar year. It is taken from Column (4.20) of Table 4. This statistic is given only as a total for the calendar year.

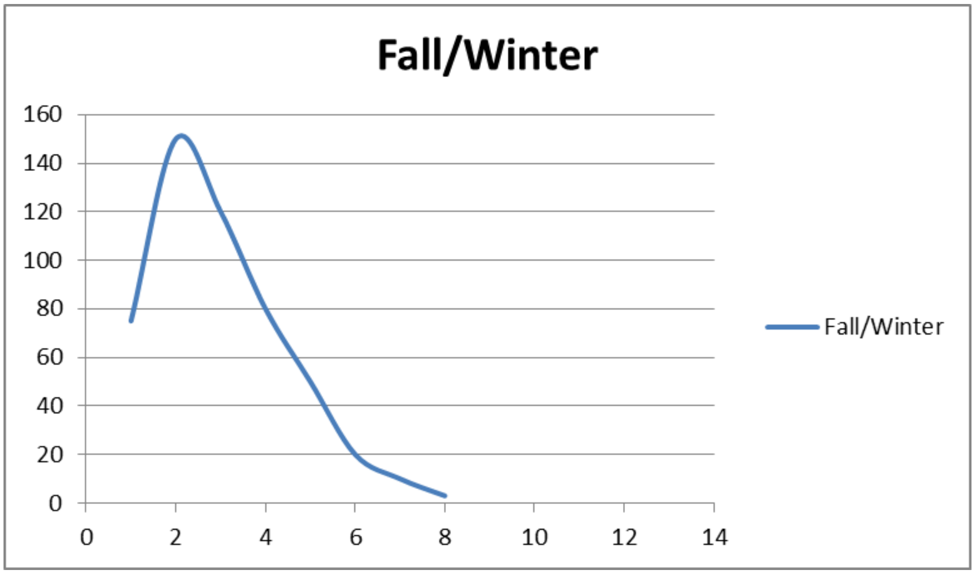
(7.9) Freshet Flows – Reservoir Release Credit. This is the number of freshets released from the Reservoir during a calendar year. It is taken from Column (4.21) of Table 4. This statistic is given only as a total for the calendar year.

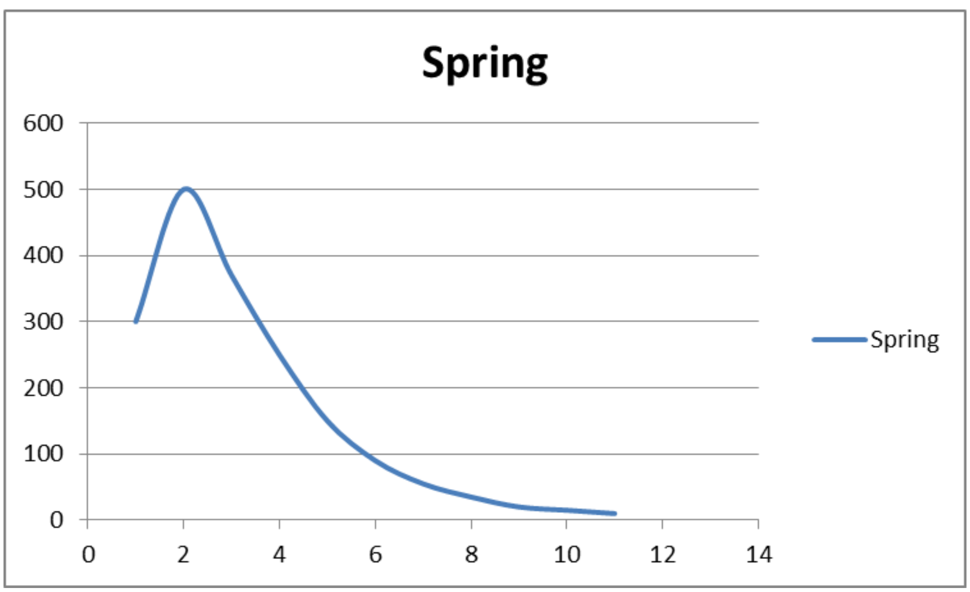
(7.10) Freshet Flows – Total Credit. This is the total number of freshets that occurred naturally at FM 409 or released from the Reservoir during subsistence conditions for the calendar year. It is the sum of Columns (7.8) and (7.9). This statistic is given only as a total for the calendar year.

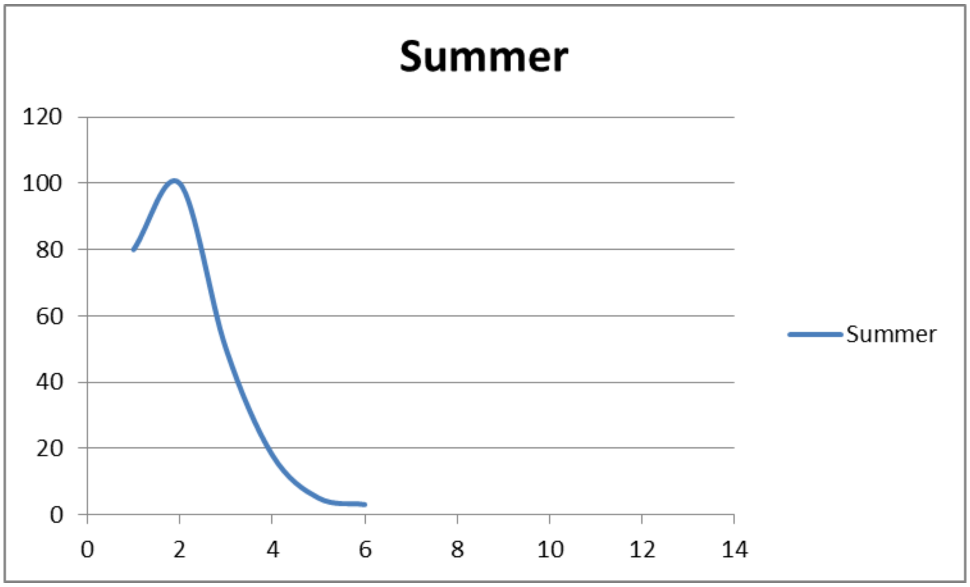
(7.11) Number of Days with Flows Greater than 500 cfs at FM 100. This is calculated from Column (1.10) of Table 1. This statistic is given only as a total for the calendar year.

Typical Pulse Flow Release Patterns

Lower Bois d'Arc Creek Reservoir



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60
40
20
0
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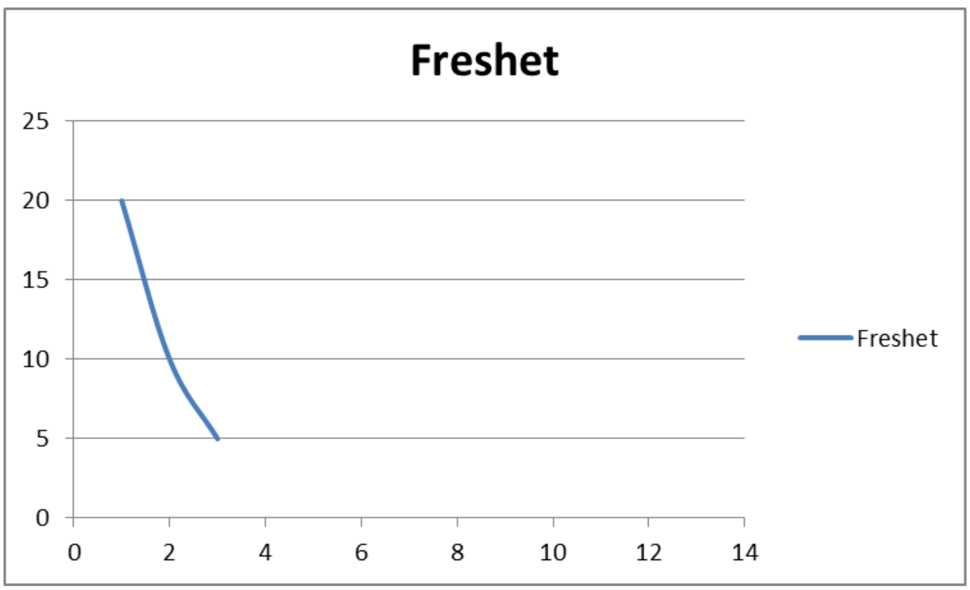
2
4
6
8
10
12
14
Summer


Freshet
25
20
15
10
5
0
0
2
4
6
8
10
12
14
Freshet

Attachment 3

Potential Overdraft Operations Memorandum

(2008 Memorandum to the Texas Commission on Environmental Quality)

Freese and Nichols

MEMORANDUM

TO: File

FROM: Jon S. Albright and Tom Gooch

SUBJECT: Request to Divert 175,000 Acre-feet per Year from the Lower Bois d'Arc Creek Reservoir

DATE: December 31, 2008

STATE OF TEXAS
THOMAS C. GOOCH
50668
LICENSED
PROFESSIONAL ENGINEER

1/3/09
Thomas C. Gooch

1. The application for Lower Bois d'Arc Creek Reservoir requests the ability to divert 175,000 acre-feet per year from the reservoir, which is greater than the estimated firm yield of 126,200 acre-feet per year. Lower Bois d'Arc Creek Reservoir will be one of several sources of water available to the North Texas Municipal Water District (NTMWD). The ability to maximize the supply from the reservoir is a key element in the operation of NTMWD's multiple sources as a system. As part of a system, the operation of Lower Bois d'Arc Creek Reservoir will depend on the development of the NMTWD other sources, demands from the system, and local demands in Fannin County. This memorandum examines one potential operation scenario considering the desire to maximize supply while balancing long-term needs.

2. For this potential operation scenario, NTMWD will divert up to 175,000 acre-feet per year from the reservoir in some years. During times when the Lower Bois d'Arc Creek Reservoir is less than full, the diversions from the reservoir will be reduced. The reduced level of diversion will be sufficient to provide reliable supplies for both NTMWD and local demand in Fannin County through a repeat of the drought of record.

3. The simulations in this memorandum used both the Texas Commission on Environmental Quality Red River Water Availability Model (TCEQ WAM), modified to include the proposed Lower Bois d'Arc Creek Reservoir, and an alternative version of the Red River WAM using hydrology developed by Freese and Nichols, Inc. (FNI WAM). The FNI hydrology is described in the December 2007 Draft Memorandum *Comparison of 2007 TCEQ WAM Hydrology to FNI WAM Hydrology.*

4. The potential operational policy in this memorandum uses a constant 236 MGD diversion (equivalent of 264,489 acre-feet per year) when the reservoir level is between 532 feet msl and the conservation elevation of 534 feet msl. Annual diversions are limited to a maximum of 175,000 acre-feet per year. When the reservoir elevation is more than two feet below conservation, demand is reduced to 114,930 acre-feet per year in the TCEQ WAM and 124,800 acre-feet per year in the FNI WAM. The reduced demand is about five percent less than the firm yield in the TCEQ WAM and about one percent less than the firm yield of the FNI WAM.

5. Figure 1a compares the simulated storage traces for the reservoir using a firm yield operation and the potential operation using the TCEQ WAM. Figure 1b compares the elevation trace for the same two scenarios. Figure 1c shows the total diversion from the reservoir in each year of the simulation, again using the TCEQ WAM. Figures 2a through 2c show the same data using the FNI WAM. Table 1 compares the frequencies that the reservoir is spilling, the reservoir is less than two feet below conservation, and the number of years overdraft supply is available.

Table 1
Comparison of WAM Runs

Statistic	TCEQ WAM		FNI WAM	
	Firm Yield	175,000 AF/Yr Operation	Firm Yield	175,000 AF/Yr Operation
Percent of Months Full	8.4%	4.5%	12.7%	6.9%
Percent of Months < 2 feet Down	22.4%	17.5%	27.3%	20.1%
Percent of Years with Overdraft Supply	-	43%	-	49%

6. Looking at the figures and Table 1 leads to the following observations:

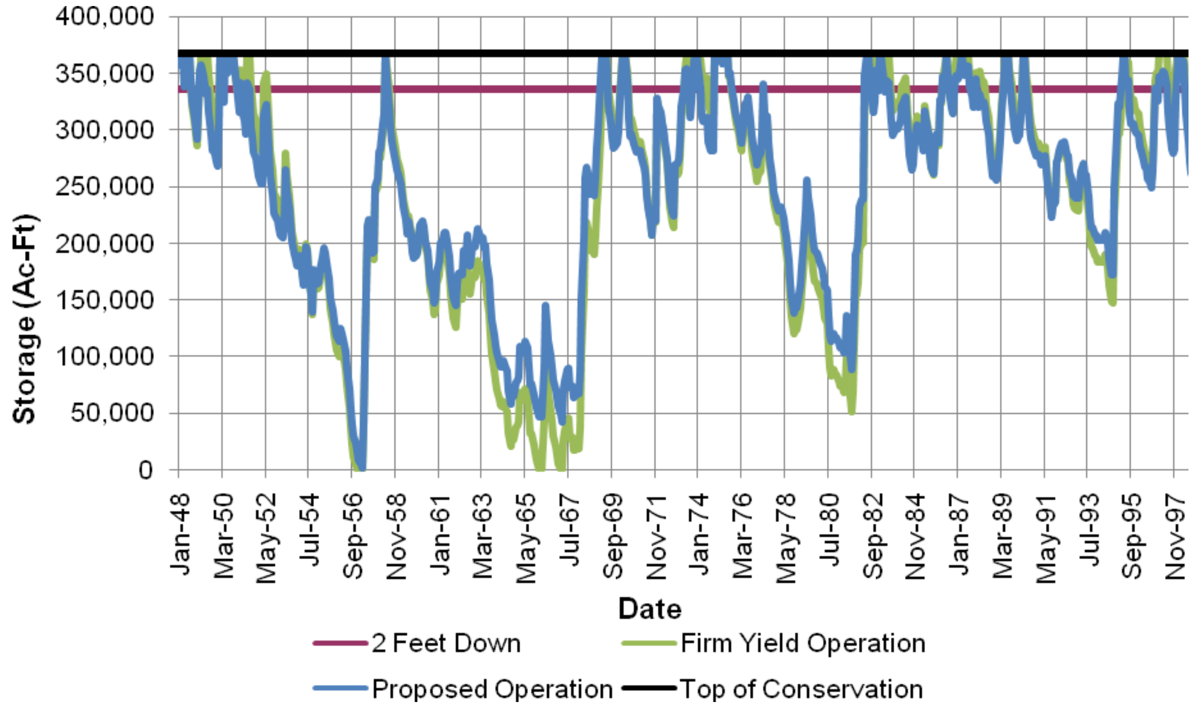
    a. The potential operation policy to use 175,000 acre-feet per year results in a slightly lower frequency of time that the reservoir is relatively full (between elevations 534 ft and 532 ft msl). However, during drought conditions when the reservoir is low there is very little change. In fact, the TCEQ WAM shows that the reservoir will have more water in storage during extremely dry periods due to the lowered demand.

    b. Some supply above the firm yield is available more than 40 percent of the time. During other times, the supply from the reservoir will be slightly less than firm yield operation.

7. **System Operation.** The operation policy in this memorandum is only one of many different potential operational policies for Lower Bois d'Arc Creek Reservoir. As previously noted, actual operation of the reservoir will depend on the level of development of the NMTWD system, demands from the system, and local demands in Fannin County. As an example of other policies that might be used, the full permitted diversion from Lower Bois d'Arc Creek Reservoir might be used even when the reservoir is drawn down below two feet if NTMWD system demands are near available supplies and if new sources are being developed that will allow reduced diversions from Lower Bois d'Arc Creek Reservoir in later years. NTMWD currently has five major sources of water (Lakes Lavon, Texoma, Chapman and Tawakoni and reuse), and will add several more over the next few decades. Some of these sources are fairly far away from the NTMWD service area and require considerable expense to pump the water to users. Water from Lake Texoma has a relatively high salt content and requires blending with other sources. Lower Bois d'Arc Creek Reservoir will be relatively close to the NTMWD service area and the water is expected to be of good quality. The ability to divert 175,000 acre-feet per year from the Lower Bois d'Arc Creek Reservoir will allow NTMWD to make efficient use of this reservoir during relatively wet times. During drier times, other sources of water will be employed to a greater extent. In all cases, NTMWD will balance the needs for reliable water supply, costs, water quality, water rights and agreements when operating its system.

8. The operation of Lower Bois d'Arc Creek Reservoir will be affected by the instream flow releases required from the reservoir. The potential for system operation will be reevaluated if instream flow releases are changed after the completion of on-going instream flow studies.

Figure 1a
Comparison of Storage Traces for Firm Yield Operation and Potential Operation using the TCEQ WAM



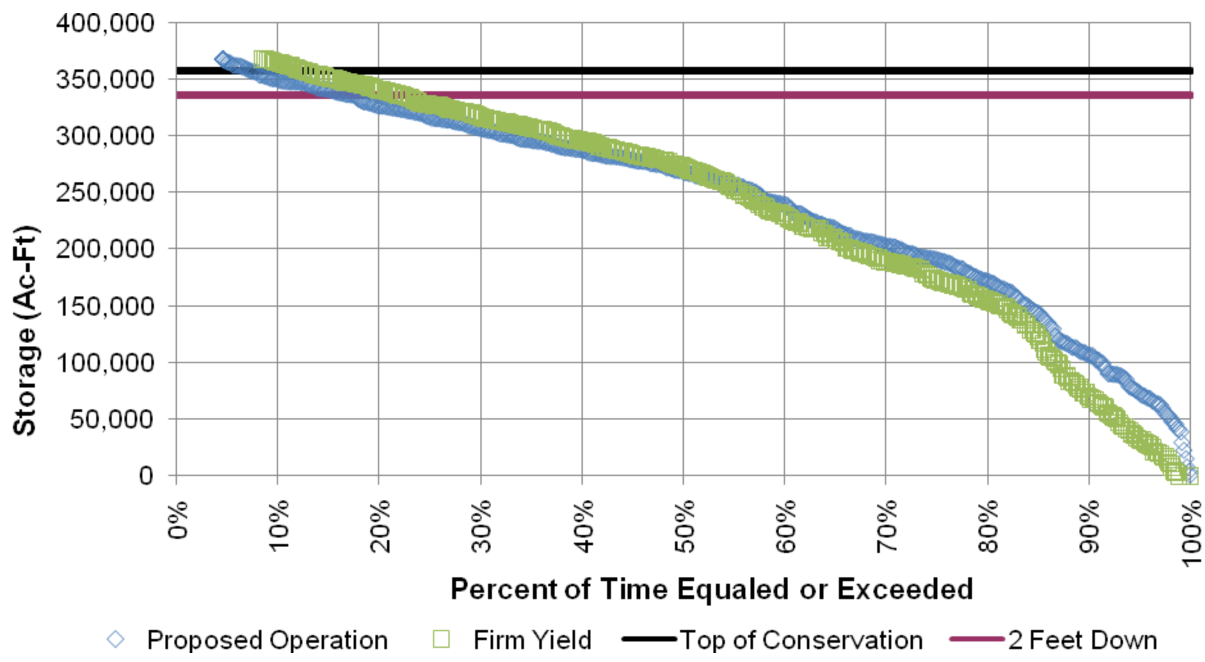
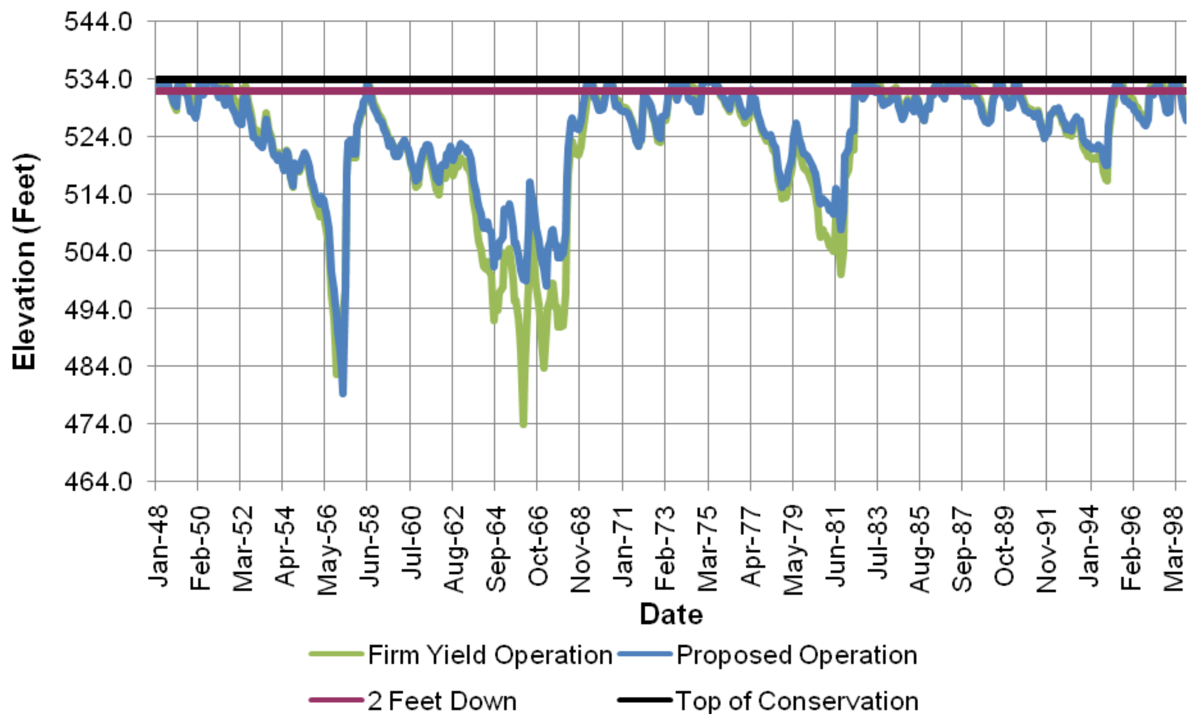


Figure 1b
Comparison of Elevation Traces for Firm Yield Operation and Potential Operation using the TCEQ WAM



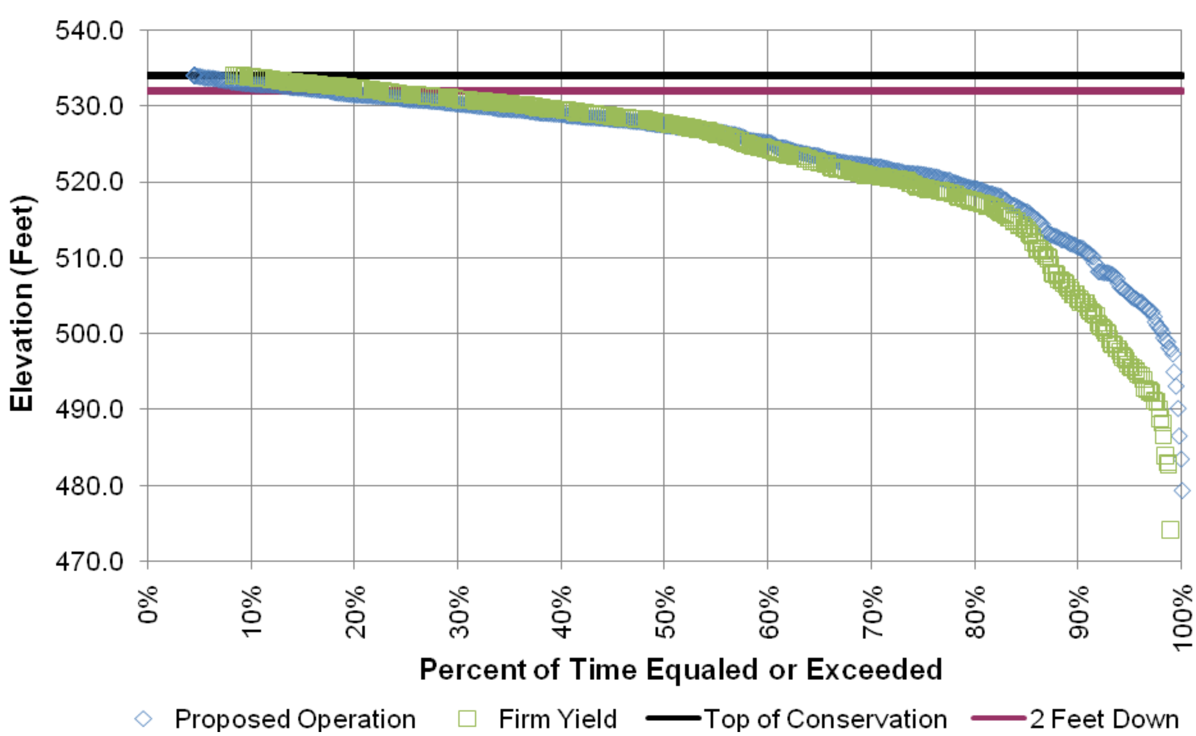


Figure 1c
Annual Diversions using Potential Operation using the TCEQ WAM

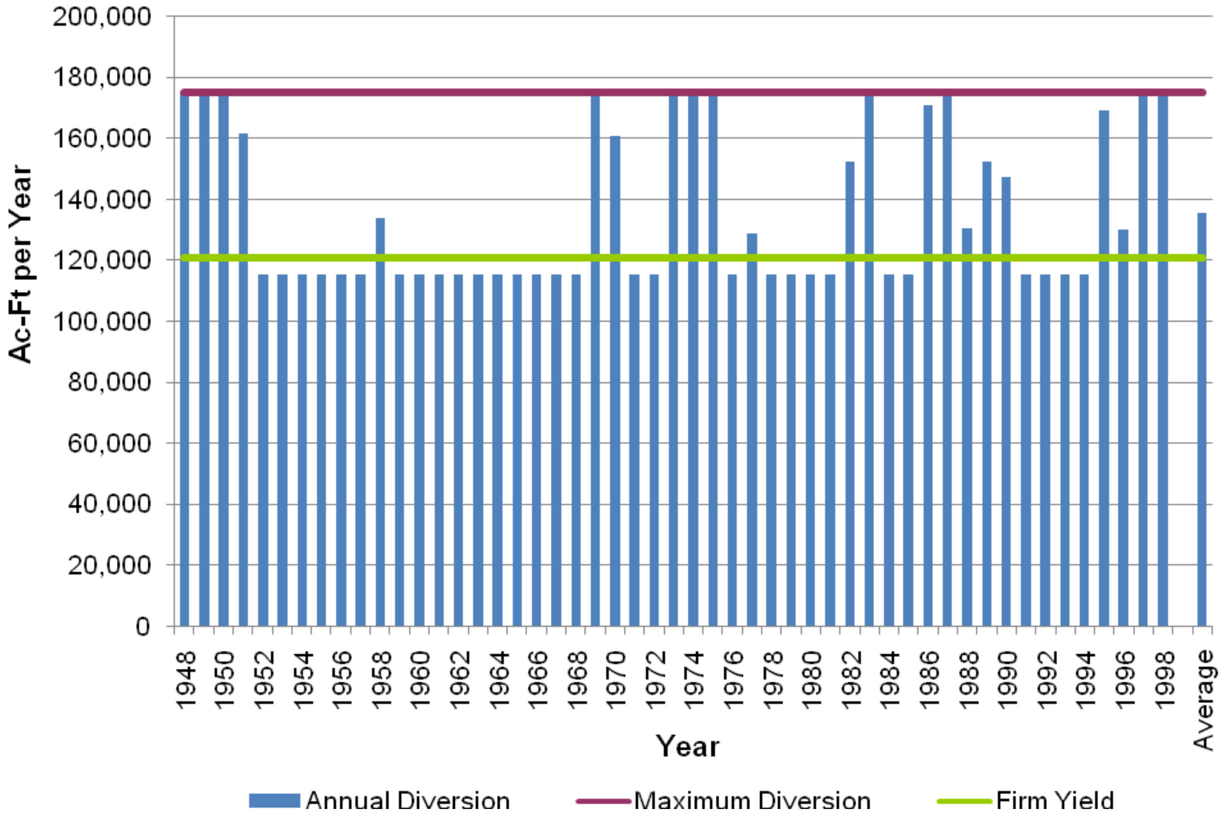
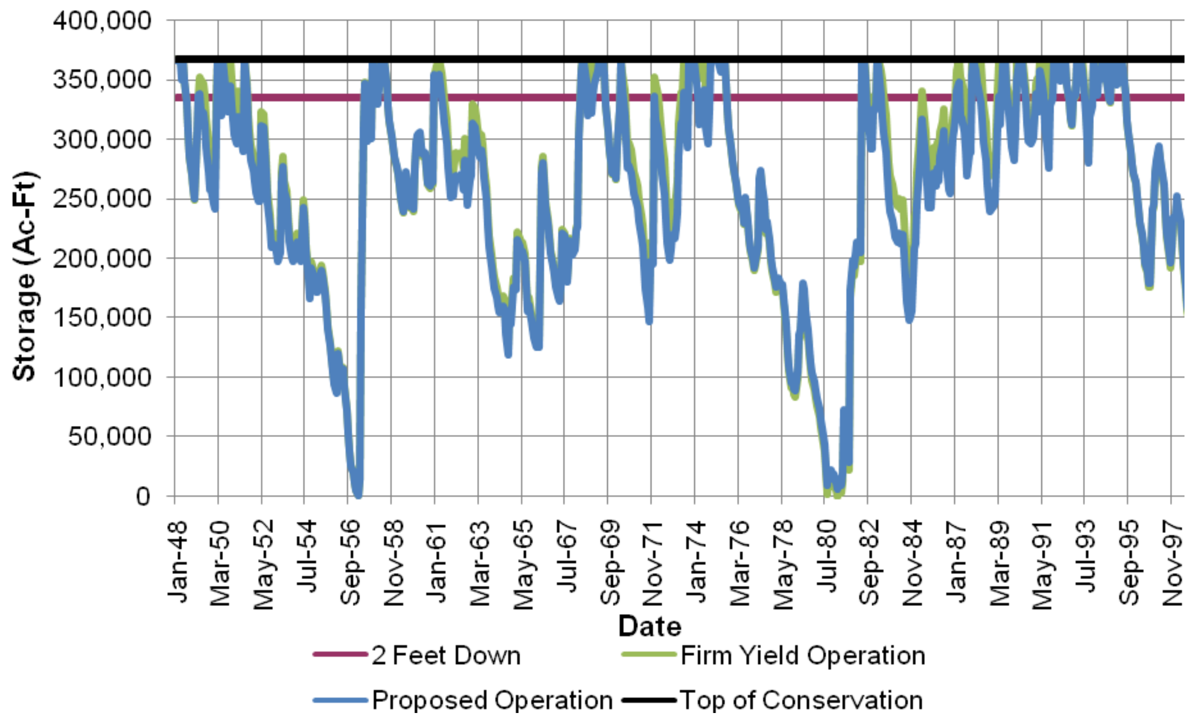


Figure 2a
Comparison of Storage Traces for Firm Yield Operation and Potential Operation using the FNI WAM



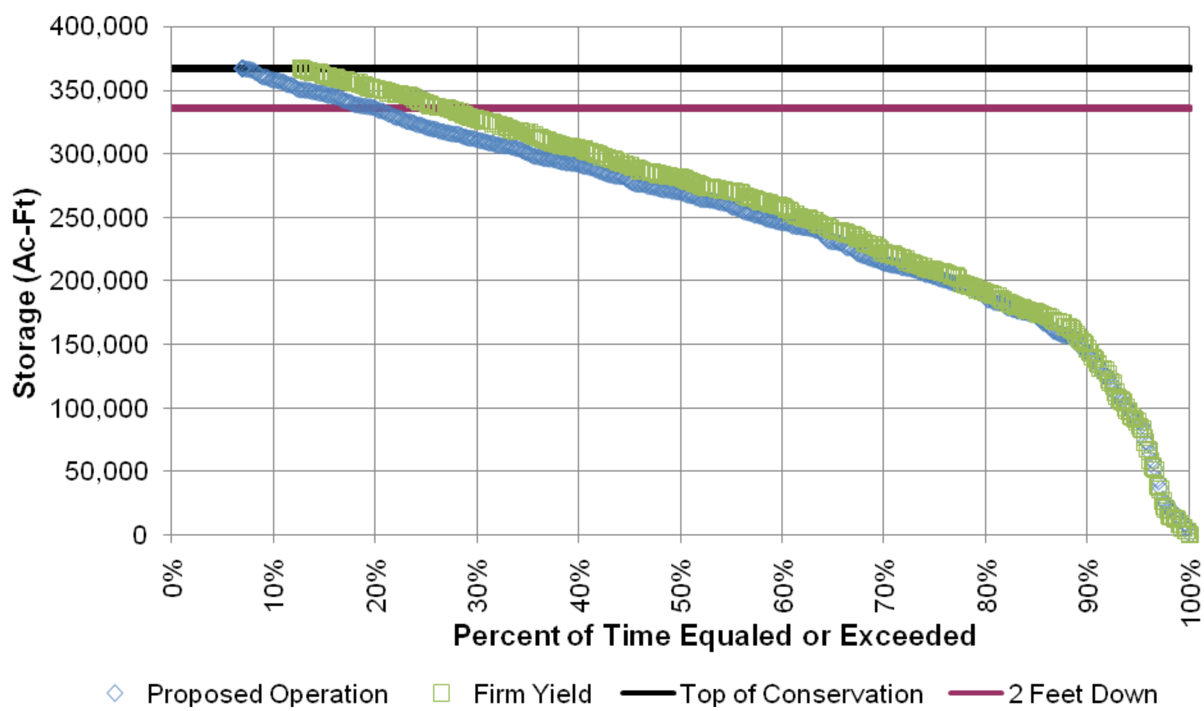
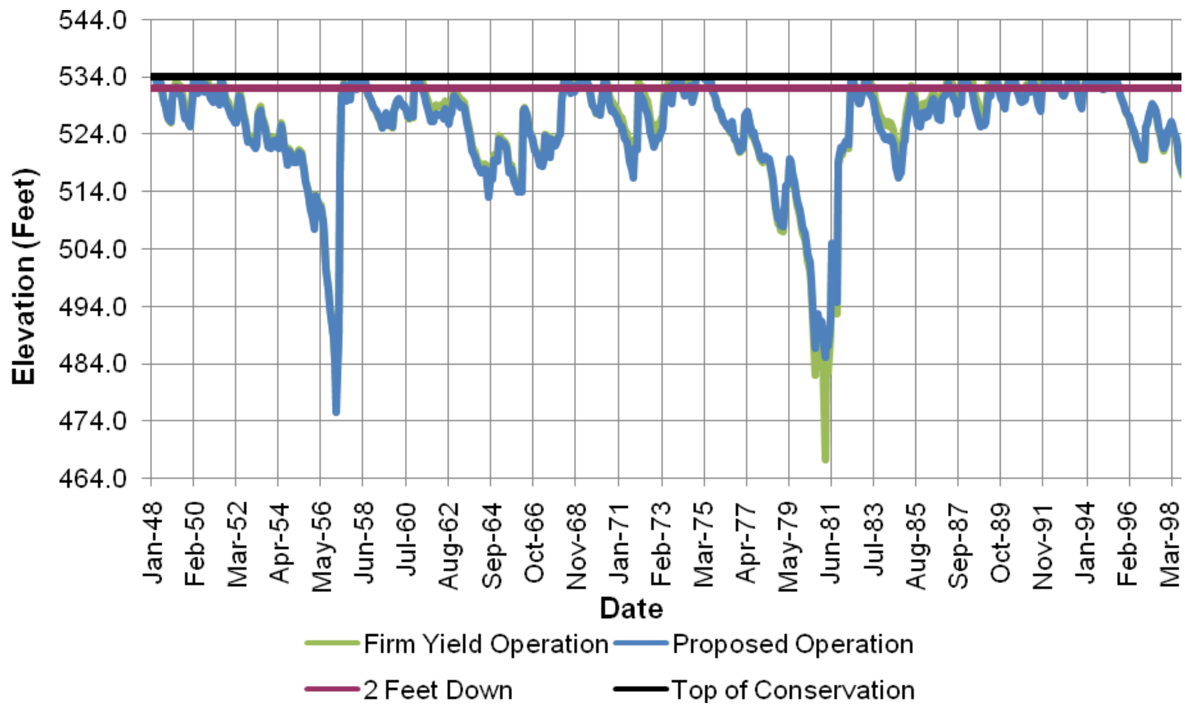


Figure 2b
Comparison of Elevation Traces for Firm Yield Operation and Potential Operation using the FNI WAM



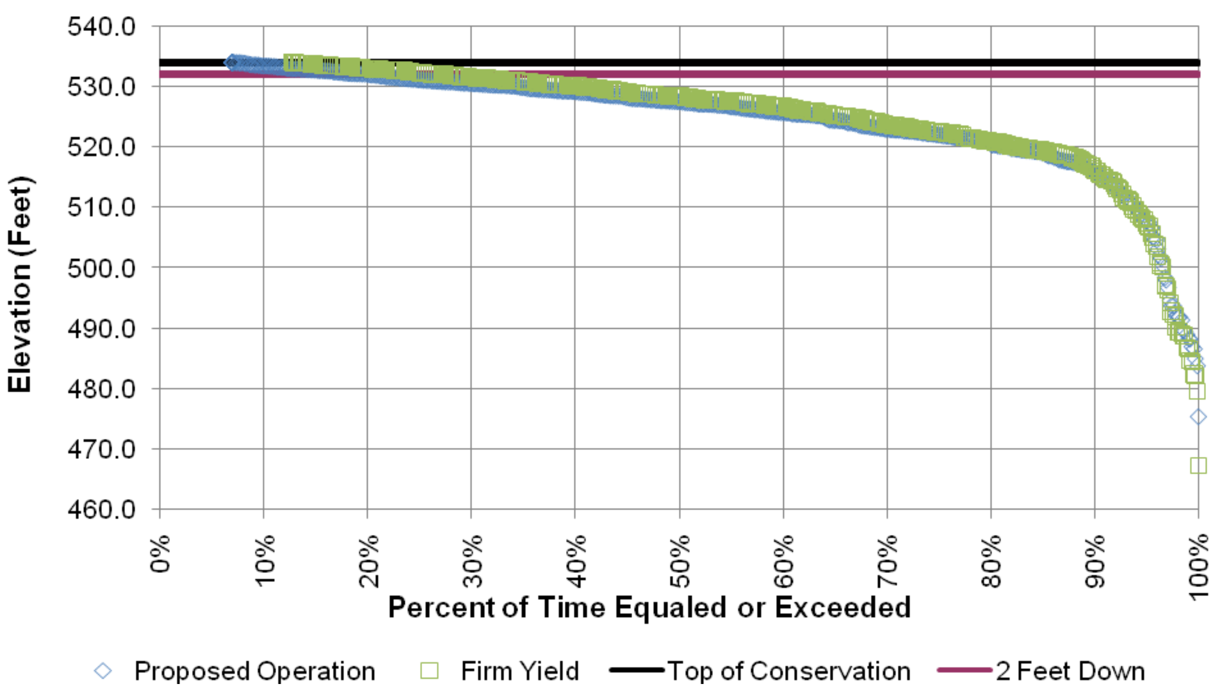
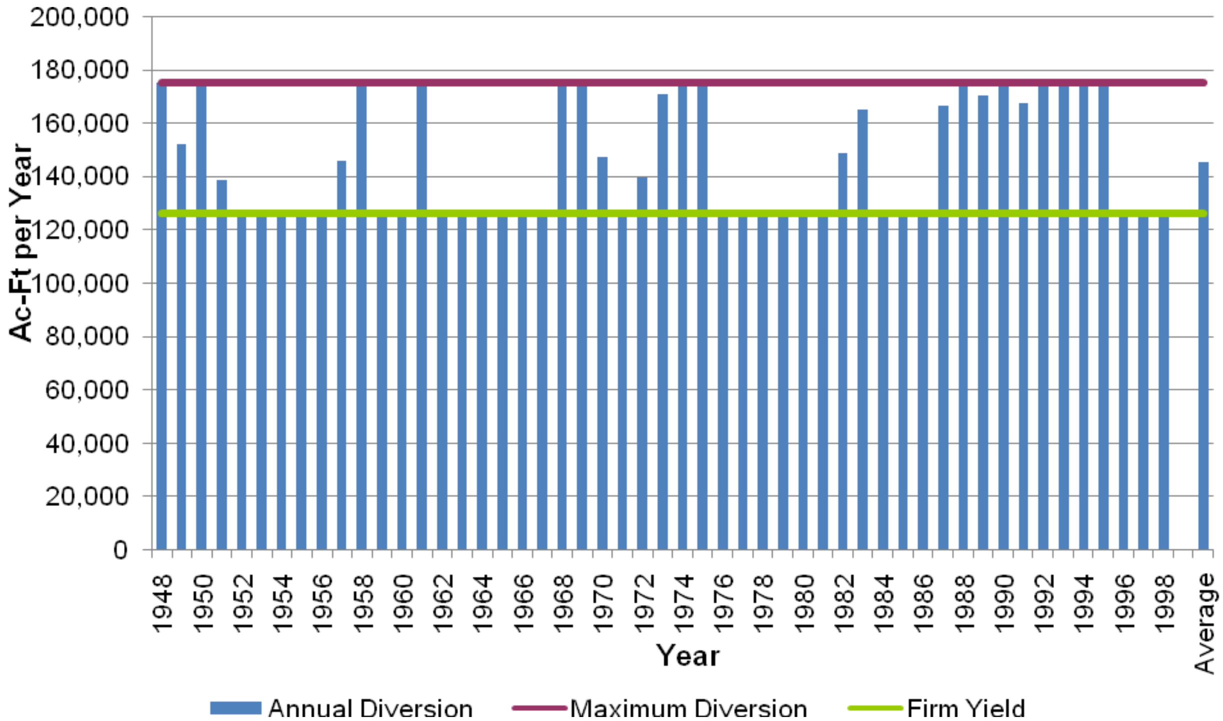


Figure 2c
Annual Diversions using Potential Operation using the FNI WAM



APPENDIX G – 2004, 2007, AND 2012 ECONOMIC STUDIES AND UPDATES BY DR. TERRY CLOWER*

Please see next page.

*At the time these studies were initially conducted, Dr. Terry Clower was director of the Center for Economic Development and Research at the University of North Texas. He is currently Northern Virginia Chair and Professor of Public Policy at the School of Policy, Government and International Affairs at George Mason University. He is also deputy director for GMU's Center for Regional Analysis.

Update of the Economic, Fiscal, and Developmental Impacts of the Proposed Lower Bois d'Arc Reservoir Project

Prepared for:

North Texas Municipal Water District

By:

Terry L. Clower, Ph.D.

March 2012
(Revised January 2015)

Executive Summary

This report provides an update of the 2007 and 2004 previous assessments of the economic, developmental, and fiscal impacts of the Lower Bois d'Arc Creek Reservoir that will be developed by the North Texas Municipal Water District (NTMWD). Construction and related spending estimates are based on projections updated in 2011 and include updated planning for ancillary infrastructure development.

- Construction of the dam to impound the proposed Lower Bois d'Arc Reservoir, intake pump station, water treatment plant, terminal storage reservoirs, and associated pipeline infrastructure will cost in the range of $385.4 million and $ 426.0 million, including planned future water treatment plant expansions. Depending on exact expenditures, local economic activity in Fannin County will increase between $509 million and $563 million during the construction phase of the reservoir development and subsequent expansion of the water treatment plant. This activity will contribute between $211 million and $234 million in gross county product and support between 4,999 and 5,525 person-years of employment with associated labor income of between $165 million and $183 million.
- It is anticipated that land acquisition for the reservoir and related mitigation areas will cost about $75 million, representing a boost to landowner household income. Assuming that local property owners take about 20 percent of this value as household income, with the remainder being used for personal and business investments, a portion of land acquisition costs will support new spending in the Fannin County area. This additional spending will create about $11 million in new economic activity in the county and support over $3.4 million in local labor income.
- Combined with the impacts of household spending supported by anticipated land acquisition payments, the total economic impacts related to the construction of the dam, pump stations, water treatment plant, and related infrastructure will boost economic activity in Fannin County by between $521 million and $574 million, support from 5,105 to 5,631 person years of employment, and pay $169 million to $186 million in labor income.[1]
- The economic activity associated with creating the Lower Bois d'Arc Creek will likely spill over to neighboring counties. Estimates of total economic activity associated with dam and other infrastructure development in the region including Fannin, Collin, Delta, Lamar, and Hunt counties will be between $682 million and $833 million.
- After construction of the dam and pipeline is completed, ongoing impacts from the operation and maintenance of these infrastructures will support about 24 Fannin County jobs and spur about $2 million in new economic activity per year.
- Once the lake is impounded, new recreational spending will likely arrive in Fannin County as visitors come to fish, boat, and participate in other water-recreation activities.

[1] Some estimates do not precisely sum due to the rounding of figures in the text.

These visitors will bring $17 million to $22 million in new annual spending to the local economy.

- The lake will also likely attract many new residents to Fannin County. It is estimated that over a 30-year period at least 1,100 new full-time resident households will be established around the lake. An additional 2,100 residences will likely be built as vacation/weekend/second homes. These new households will be in addition to any other growth projected for Fannin County. The construction of these homes will bring an average of about 133 jobs per year to the local economy over the development period.
- The reservoir will also support new industrial and commercial activities beyond those described for the hospitality industry. Using Texas Water Development Board usage estimates, it is projected that $145 million in new economic activity in Fannin County (supporting over 1,600 jobs) could be made possible by the availability of a new reliable water resource.
- The pace and quality of development will depend on many market-related factors. One of the most critical factors will be the extent to which counties, cities, and towns adopt well-reasoned development plans to promote quality growth while also ensuring that infrastructure development and publicly-provided services keep pace with new demand. Examples of infrastructures will include electric services, roads, water services, and public safety and other municipal services.
- Spending by new residents in the local economy will increase economic activity in Fannin County by $81 million to $89 million each year. This analysis also suggests that economic activity in the larger region, including Fannin, Hunt, Delta, Grayson, and Lamar counties, will rise by as much as $116 million per year in response to having these new residents living near the proposed reservoir. This activity will support 857 to 947 jobs paying $21.9 million to 24.3 million in annual labor income in the five county region.
- Once developed, the proposed reservoir will enhance the region's attractiveness as a business location. As a recreational amenity, the lake will enhance the quality of life features of the region, which are an increasingly important factor in business site location decisions.
- Local taxing jurisdictions will enjoy not only substantial temporary gains in revenues from business activities related to construction of the dam, pipelines and related infrastructure, and new housing, they will also see new revenues based on increased property values and spending by visitors and residents. Property taxes on new housing alone will add $1.9 million to county tax revenues net of any losses due to the impoundment of the reservoir and related environmental mitigation. Similarly, net gains in area school district revenues will be $3.9 million per year at full development. Local taxes on retail sales will generate at least $303,000 per year with an additional $183,000 per year provided by hotel occupancy taxes.

This report includes one attachment. Attachment A is an economic and fiscal impacts analysis of operations at the Riverby Ranch in Fannin County, Texas, which has been purchased by the NTMWD to mitigate environmental impacts related to the development of the Lower Bois d'Arc Creek Reservoir.

Table ES1
Temporary Local Economic Impacts of Construction of the Lower Bois d'Arc Creek Reservoir Dam
Fannin County

Description	Impact	
Dam Construction, Pipeline Construction, Water Treatment Plant, Pump Station and other infrastructure		
Description	Range of Impacts	
Economic Activity	$509,330,002	$562,943,686
Gross County Product	$211,355,290	$233,603,216
Labor Income	$165,237,561	$182,630,989
Person-Years of Employment	4,999	5,525
Property Income	$36,367,192	$40,195,318
Indirect Business Taxes	$9,750,537	$10,776,909

Sources: North Texas Municipal Water District, Author's estimates.

Table ES2
Economic and Fiscal Impacts of Household Spending Derived from Land Sales

Description	Impact
Land Acquisition Costs	$75,230,000
Economic Activity	$11,346,692
Gross County Product	$7,158,139
Labor Income	$3,411,702
Person-Years of Employment	106
Property Income	$2,817,739
Indirect Business Taxes	$928,698

Sources: North Texas Municipal Water District, Authors' estimates.

Table ES3
Total Local Economic Impacts of Development of the Lower Bois d'Arc Creek Reservoir Dam on Fannin County

Description	Impact	
Includes Dam, Pipeline, Water Treatment Plant, Pump Station and Land Acquisition Costs		
Description	Range of Impacts	
Economic Activity	$520,676,694	$574,290,378
Gross County Product	$218,513,429	$240,761,355
Labor Income	$168,649,265	$186,042,691
Person-Years of Employment	5,105	5,631
Property Income	$39,184,931	$43,013,057
Indirect Business Taxes	$10,750,537	$11,705,607

Sources: North Texas Municipal Water District, Author's estimates.

Table ES4
Recurring Annual Local Economic Impacts
(2011 dollars)

Description	Impact
Dam, Pump Station, Pipeline, and Water Treatment Plant Operations Impacted counties: Fannin	
Economic Activity	$2,137,000
Labor Income	$769,000
Jobs	24
Recreational Visitor Spending	
Annual Spending	$16,748,000 to $21,982,000
Economic Activity	$21,176000 to $28,233,000
Labor Income	$6,235000 to $8,344,000
Jobs	295 to 393
Resident Spending Permanent and Weekend/Vacation Residents: Fannin, Lamar, Grayson, Hunt, Delta	
Economic Activity	$105,294,000 to $ 116,378,000
Labor Income	$21,940,000 to $24,250,000
Jobs	857 to 947
New Industrial and Commercial Activities Based on Projected Water Usage	
Economic Activity	$145,197,000
Labor Income	$48,111,000
Jobs	1,607

Source: Author's estimates.

Table ES5
Recurring Annual Fiscal Impacts of New Housing Developments
and Resident and Recreational Out-of-Area Visitor Spending*

Description	Impact
Total Taxable Value of Housing (permanent & weekend residents)	$326,200,000
Reduction in Property Value due to Inundation and Mitigation**	($10,484,000)
Net gain in Taxable Property Values	$315,716,000
Estimated New County Property Tax Revenues	$1,920,000
Estimated New School District Property Tax Revenues	$3,910,000
Total Potential*** Municipal Sales Taxes (0.01 rate)	$303,000
Hotel Occupancy Tax Revenues*	$183,000

* At build out.
** Assumes operating impact on Legacy Ridge County Club.
*** Value will be impacted by land annexation and business location decisions.
Source: Author's estimates.

Section 1: Introduction

Addressing future water needs for the North Texas Municipal Water District's service area has led to the consideration of developing several new water supplies. One proposal is for a reservoir to be located along the Lower Bois d'Arc Creek just northeast of the City of Bonham in Fannin County. The following report updates the findings of the 2007 and 2004 analyses of the economic, fiscal, and developmental impacts of this proposed reservoir.

Our estimates of the economic impacts of the reservoir and related economic activity are based on the IMPLAN input-output economic modeling system developed by the Minnesota IMPLAN Group. The modeled impacts include the direct effects of spending for construction activities and consumption spending, the indirect effects of local vendors providing goods and services to the primary firms, and the induced impacts of employees of these firms spending a portion of their earnings in the local economy. The impacts estimated in this analysis include:

- Economic Activity: The total value of transaction from direct, indirect, and induced effects.
- Contributions to Gross County/Area Product: A value-added measure equivalent to national Gross Domestic Product.
- Labor Income: Includes salaries, wages, proprietor's income, and certain benefits.
- Employment/Jobs: Employment estimates are expressed differently if the supporting spending is temporary or recurring. The construction/development phases of building the dam, related infrastructure, and new housing are temporary – once construction is completed, the impacts cease. The model employed in this analysis provides an estimate of the number of jobs associated with a given level of spending, but since that spending will occur over several years, the jobs impacts occur over several years. For example, if the construction of a new building takes three years to complete and will support 300 jobs, the estimate is not saying there will be 300 jobs each lasting for three years. Rather the estimate is saying there will be 300 person-years of employment supported. On average, the impact of the building construction would be 100 jobs per year; however, construction employment is highly variable based on the phase of the construction program, so the actual job impacts at any given time could vary dramatically. Therefore, jobs related to temporary expenditures are expressed as person-years of employment. For recurring spending such as pump station operations, tourist spending, and household spending, the impact estimates are considered recurring and the job estimates are for "permanent" jobs each year.
- Property Income: This category of impacts includes rents, royalties, dividends, and corporate profits supported by the new economic activity. For example, a worker at a new lake front hotel rents a house in Fannin County. The rent received by that worker's landlord is a property income.
- Indirect Business Taxes: This source of state and local government revenue includes sales and use taxes, property taxes, fees for permits and licenses, and other sources of revenue associated with indirect business transactions and induced household spending related to the spending categories included in this analysis.

This report begins with an economic overview of Fannin County and then proceeds to measure the new employment, income, spending, and tax revenues that will attend the construction and operations of the dam and related transportation, storage, and treatment facilities. Then the "ancillary" development likely to occur in conjunction with the dam is explored, in particular the construction of new homes and recreationally based businesses. New and recurring income, employment, and economic activity associated with this ancillary development are estimated. Finally, the impact of the proposed project on revenues to local taxing jurisdictions is examined.

Section 2: Economic Overview of Fannin County

Like many rural counties in Texas, Fannin County saw its historical peak of population and economic activity around the turn of the 20th century. The 1900 census showed a population of 51,793. Cotton and corn production were the chief crops in an economy dominated by agricultural production. Later in the 20th century, dairy operations rose in prominence, but the county suffered tremendous economic losses during the depression years and after World War II. Children of farmers sought their fortunes elsewhere. By 1970, the population had dropped to 22,705. However, after 1970 the population stabilized and began to slowly increase. In 2010 Fannin County's population had risen back to 33,915, though the growth rate in the past ten years has slowed substantially compared to the 1990s at 8.6 percent versus 22.8 percent, respectively.

As can be seen in Figure 1, year-over-year employment change in Fannin County has typically trailed the state as a whole – sometimes dramatically. These data suggest that one critical economic development strategy for Fannin County should be to diversify their economic base, particularly toward industries with greater stability over time.

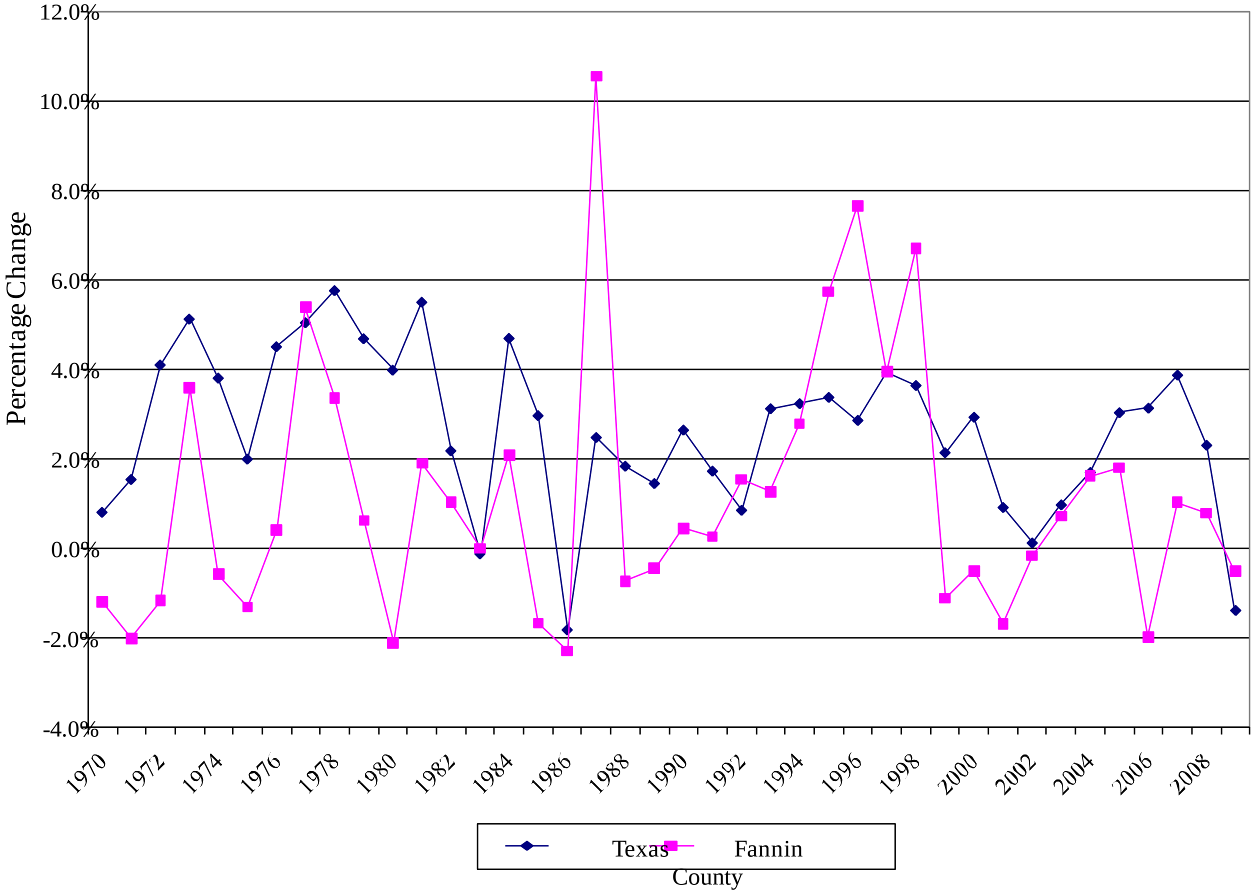
The proposed reservoir offers several economic development opportunities for Fannin County. In addition to the substantial economic activity that would be generated by construction projects related to the reservoir over a multi-year period, the new lake would attract recreational users whose spending, in turn, would spur investment in new hospitality venues. By supporting new residents and hosting new recreation-based industries, the proposed reservoir offers an excellent diversification opportunity for Fannin County.

Section 3: Economic Impacts of Dam and Related Infrastructure Construction

In this section we examine the economic impacts of the construction of the proposed Lower Bois d'Arc Reservoir dam and related infrastructure. These estimates are based on the latest cost projections for the facilities expressed in current year (2011) dollars.

Economic impact assessments for the dam and related infrastructure construction projects are examined in two models. The first looks at the impacts that will likely remain in Fannin County. However, based on the size of the development projects, businesses and residents of nearby counties will also benefit from the economic activity associated with the construction of the dam. For purposes of this analysis, we have included an estimate of the total impacts that will likely occur in a wider economic area defined by Fannin, Delta, Lamar, Grayson and Hunt counties.

Figure 1
Year-to-Year Percentage Change
Total Employment State of Texas and Fannin County
1970-2009



Source: U.S. Department of Commerce

The most recent estimates call for expenditures on dam construction to be about $112 million, including design, engineering, and related costs. In addition, related infrastructure including a water treatment plant, storage reservoirs, transport pipeline, water intake pump station, and related facilities add about $293 million to construction expenditures. This includes future planned expansions of the water treatment plant. To allow for changes in materials and other costs, we generally express cost estimates and the resulting economic impacts as a range of possible values.[2] Total expenditures for the Lower Bois d'Arc Creek reservoir and related infrastructure will be between $385 million and $426 million over several years. Based on the relative presence, or absence, of industries providing materials and supporting services to dam construction projects, some of the economic activity will "leak" out of the local area. Even so,

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[2] Some spending categories, such as lake area housing construction and the impacts of new industrial activity, remain single point estimates.

these expenditures will increase total economic activity in Fannin County by $509 million to $563 million and boost gross county product (value added) by $211 million to $234 million (see Table 1). This new activity will create over 5,000 person years of employment and increase local labor income by somewhere between $165 million and $183 million. In addition, property incomes will increase by $36 million to $40 million. Indirect business taxes will boost state and local tax revenues by $9.8 million to $10.8 million.

Table 1
Temporary Local Economic Impacts of Construction of the Lower Bois d'Arc Creek Reservoir Dam
Fannin County

Description	Impact	
Dam Construction, Pipeline Construction, Water Treatment Plant, Pump Station and other infrastructure		
Description	Range of Impacts	
Economic Activity	$509,330,002	$562,943,686
Gross County Product	$211,355,290	$233,603,216
Labor Income	$165,237,561	$182,630,989
Person-Years of Employment	4,999	5,525
Property Income*	$36,367,192	$40,195,318
Indirect Business Taxes**	$9,750,537	$10,776,909

* Includes rents, royalties, dividends, and corporate profits.
** Includes property taxes, sales taxes, and fees for permits and licenses paid on secondary transactions from water district spending.
Sources: North Texas Municipal Water District, Author's estimates.

Property owners for the land that will be consumed by the lake and the additional acreage that may be set aside for flood easements and environmental mitigation purposes will be compensated. These payments to land owners represent a transfer of income to the local economy supporting new spending in the region. Acquiring the land for the reservoir and related mitigation lands will be expected to cost about $75 million. Most of the affected landowners will be area residents. Assuming that about 20 percent of the land purchase price is taken as household income, as opposed to reinvesting the proceeds into other assets, we estimate that proceeds of land sales will boost local economic activity by about $11 million, supporting about $3.4 million in labor income for Fannin County workers (see Table 2).

When added to the impacts of construction activities, the non-recurring impacts of development the Lower Bois d'Arc Creek Reservoir will boost economic activity in Fannin County by somewhere between $521 and $574 million, increase county gross product $219 to $241 million, and support 5,105 to 5,631 person-years of employment. Labor income associated with these jobs will be between $169 million and $186 million; and property income will rise by $39 million to $43 million. Indirect business taxes will rise by $10.8 to $11.7 million (see Table 3).

Table 2
Economic and Fiscal Impacts of Household Spending Derived from Land Sales

Description	Impact
Land Acquisition Costs	$75,230,000
Economic Activity	$11,346,692
Gross County Product	$7,158,139
Labor Income	$3,411,702
Person-Years of Employment	106
Property Income*	$2,817,739
Indirect Business Taxes**	$928,698

* Includes rents, royalties, dividends, and corporate profits.
** Includes property taxes, sales taxes, and fees for permits and licenses paid on secondary transactions from water district spending.
Sources: North Texas Municipal Water District, Authors' estimates.

Table 3
Temporary Local Economic Impacts of Development of the Lower Bois d'Arc Creek Reservoir Dam on Fannin County

Description	Impact	
Includes Dam, Pipeline, Water Treatment Plant, Pump Station and Land Acquisition Costs		
Description	Range of Impacts	
Economic Activity	$520,676,694	$574,290,378
Gross County Product	$218,513,429	$240,761,355
Labor Income	$168,649,265	$186,042,691
Person-Years of Employment	5,105	5,631
Property Income*	$39,184,931	$43,013,057
Indirect Business Taxes**	$10,750,537	$11,705,607

* Includes rents, royalties, dividends, and corporate profits.
** Includes property taxes, sales taxes, and fees for permits and licenses paid on secondary transactions from water district spending.
Sources: North Texas Municipal Water District, Author's estimates.

Looking at the expanded economic region defined by Fannin, Collin, Lamar, Delta, Grayson and Hunt counties, the impacts are larger reflecting these additional counties' abilities to attract a portion of the jobs and business activity related to the development of the reservoir. Including the spillover to these adjacent counties, total economic activity associated with property acquisition and the construction of the Lower Bois d'Arc Creek reservoir dam and other infrastructure rises to between $682 million and $833 million during the reservoir development phase. The increase in gross area product will be $347 million to $425 million. Total labor income paid in the six-county region will increase between $256 to $313 million through the creation of between 5,430 and 6,636 person-years of employment. Property income will also rise to between $73 million and $89 million, while state and local governments will see between $18.7 million and $22.8 million in revenue from indirect business taxes (see Table 4).

Table 4
Temporary Local Economic Impacts of Development of the Lower Bois d'Arc Creek Reservoir Dam
Fannin, Collin, Delta, Lamar, Grayson, and Hunt Counties

Description	Impact	
Includes Dam, Pipeline, Water Treatment Plant, Pump Station and Land Acquisition Costs		
Description	Range of Impacts	
Economic Activity	$681,688,798	$833,175,198
Gross Regional Product	$347,401,467	$424,601,793
Labor Income	$255,942,225	$312,818,275
Person-Years of Employment	5,430	6,636
Property Income*	$72,807,443	$88,986,875
Indirect Business Taxes**	$18,651,798	$22,796,642

* Includes rents, royalties, dividends, and corporate profits.
** Includes property taxes, sales taxes, and fees for permits and licenses paid on secondary transactions from water district spending.
Sources: North Texas Municipal Water District, Author's estimates.

Section 4: Ongoing Economic Impacts of Dam and Pipeline Operations

Once the dam and pipeline are built, ongoing operations and maintenance of these infrastructures will continue to provide a modest number of jobs and a minor boost to local economic activity. Recurring maintenance and operating expenditures for the dam and related infrastructures will increase local economic activity by about $2.1 million each year in Fannin County. This activity will support 24 direct and indirect jobs paying about $769,000 in labor income (see Table 5).

Table 5
Recurring Annual Local Economic Impacts of Dam, Pipeline and Related Infrastructure Operations in Fannin County

Description	Impact
Economic Activity	$2,137,000
Gross County Product	$1,346,000
Labor Income	$769,000
Employment	24
Property Income*	$486,000
Indirect Business Taxes**	$91,000

* Includes rents, royalties, dividends, and corporate profits.
** Includes property taxes, sales taxes, and fees for permits and licenses paid on secondary transactions from water district spending.
Sources: North Texas Municipal Water District, Author's estimates.

Section 5: Developmental Impacts of the Proposed Reservoir

In addition to the one-time and recurring impacts described above, the impoundment of a 16,641-acre reservoir in Fannin County would have substantial spillover benefits on the local economy. This section considers the impacts associated with recreational spending based at the reservoir and the economic and fiscal consequences for the region from attracting new permanent and weekend residents.

5.1 Impacts of recreational users

The “field of dreams” scenario often works for lakes. If you build a publicly accessible water recreation resource, visitors will use it. The North Texas region currently has many excellent reservoirs supporting water-based recreational activities. However, some of these reservoirs are so overcrowded that water accidents occur with increasing frequency. As the Dallas-Fort Worth (DFW) population continues to grow over the next 30 years, demand for water recreation sites will increase, and Fannin County is ideally situated to capture more than a fair share of this recreational activity.

Unfortunately, few studies offer specific guidance on estimating the magnitude of the economic impacts that will attend increased recreational visitors to Fannin County when the proposed reservoir is fully developed. However, in the mid-1990s, Texas A&M, working for the Texas Parks and Wildlife Department and the Sabine River Authority, surveyed anglers at Lake Fork to assess their levels of local spending. Over two-thirds of the survey respondents were non-local residents, with about one-third hailing from outside of Texas. Non-local angler-visitors to Lake Fork spent an estimated $14.5 million in Wood, Rains, and Hopkins counties during their fishing trips for food, lodging, and supplies. This level of spending encourages business development and supports jobs. While some of this employment will be seasonal, North Texas weather patterns permit water-based recreation on a year-round basis.

Other lake-based recreation activities will draw additional out-of-area visitors to the region. While we do not suggest that the new reservoir will soon enjoy Lake Fork’s national reputation as a fishing lake, when combined with non-angler spending it is estimated that non-local recreation visitors will add $16.7 million to $22 million in new spending for dining, food, retail goods, and lodging to the Fannin County economy. This spending will generate between $21.2 million and $28.2 million in economic activity, support 295 to 393 new jobs, and increase local labor income by $6.2 million to $8.3 million (see Table 6). Undoubtedly, bringing new recreational visitors to the area will present opportunities for businesses located in adjacent counties, especially Lamar County. However, given existing amenities and attractions in the City of Bonham, most of the recreational spending is expected to stay in Fannin County.

In addition to recreational spending by visitors to the reservoir, the designated mitigation area in the northern part of Fannin County will potentially be used for some type of recreational activities that would draw additional visitor spending to the area. However, the specific uses of the mitigation land have not been determined at the time of this analysis and therefore those potential impacts are not included here.

Table 6
Recurring Annual Local Economic Impacts of
Recreational Out-of-Area Visitor Spending

Description	Impact
Annual Spending: Recreational Visitors	\$16,748,000 to \$21,982,000
Economic Activity	\$21,176,000 to \$28,233,000
Labor Income	\$6,235,000 to \$8,344,000
Employment	295 to 393

Source: Author's estimates.

5.2 Impacts of new permanent and weekend residents

One trend clearly evident in north and northeast Texas is that counties with substantial reservoirs have enjoyed greater population growth than counties without these important amenities. Many recreational lake visitors eventually decide to move close to their favorite reservoirs. Carefully managed residential development can prove to be a tremendous economic boon for lake county economies.

Fannin County is well-positioned to take full advantage of opportunities to attract new permanent and weekend residents to the reservoir. The proposed dam, which will be on the north side of the reservoir, will be only 50 miles from McKinney and 80 miles from downtown Dallas. Already, spillover growth from the DFW Metroplex is reaching the Bonham area. Within reasonable travel time to big-city amenities, yet removed from most urban disamenities, we expect the proposed reservoir to attract at least 1,100 full- time resident households over and above anticipated growth for the area over the next 30 years. Recognizing the impacts of the Great Recession and sub-prime lending crisis has had on regional and national housing markets, the original assessment of potential growth will still hold true, since the reservoir will not be impounded until well after local housing markets have recovered. Therefore, new households will be expected to bring almost \$60 million in new income to the area. In addition, at least 2,100 new dwellings will be constructed in the area surrounding the reservoir as weekend/vacation homes and investment properties. The estimate of these weekender residences is likely understated. However, while relative proximity to the Metroplex will encourage permanent residents that same proximity will lower demand for weekend/vacation housing. Nonetheless, it is estimated that weekend and vacation resident will bring an equivalent of \$10 million in household income that will in turn be used for local purchases. In sum, and in keeping with our aforementioned approach of expressing spending estimates as a range of possibilities, we estimate new household spending from vacation and permanent lake-area residents will total about \$71 million to \$78 million per year.

Modeling the combined incomes of permanent residents and the proportional income of weekend residents using regionally based estimates of spending, the Fannin County economy will realize a net increase in economic activity of between $80.7 million and $89.2 million each year once full development is reached. This activity will support 517 to 572 permanent employment (jobs) paying $13.3 million to $14.7 million in labor income (see Table 7).

Table 7
Recurring Annual Local Economic Impacts of New Resident Spending

Description	Impact
Fannin County	
Annual Spending	$70,891,000 to $77,764,000
Economic Activity	$80,726,000 to $89,223,000
Labor Income	$13,332,000 to $14,735,000
Employment	517 to 572
Fannin, Hunt, Delta, Grayson, and Lamar counties	
Economic Activity	$105,294,000 to $116,378,000
Labor Income	$21,940,000 to $24,250,000
Employment	857 to 947

Source: Author's estimates.

It is likely that businesses located in Hunt, Lamar, Grayson, and Delta counties, as well as Fannin County, will offer goods and services to the new permanent and weekend residents. Including the economic activity that is likely to go to these other counties, spending by households drawn to the new reservoir will increase economic output in the broader region by $105 million to $116 million, boost local labor income by $22 million to $24 million, and support between 857 to 947 permanent jobs.

It should be strongly emphasized that the pace and quality of development will depend on many market-related factors. **One of the most critical factors will be the extent to which counties, cities, and towns adopt well-reasoned development plans to promote quality growth while also ensuring that infrastructure development and publicly-provided services keep pace with new demand.** Examples of infrastructure would include such things as electric services, roads, water services, and public safety and other municipal services.

5.3 Impacts of new housing construction

These projections assume that the new permanent and weekend resident households will be single-family units. This is consistent with most of the development trends experienced in other lake counties. Even if residential real estate demand shifts to the inclusion of multi-family properties, the costs of development, and hence the economic and fiscal impacts, will be within the range of possibilities projected below.

Because of recent housing market volatility, the estimates of housing prices have been retained from the 2007 study. Undoubtedly, this approach results in a more conservative estimate of the likely impacts of housing development near the new reservoir. The estimated average cost of land and improvements for permanent-resident dwellings will be about $127,000. Based on the findings of nationwide housing studies, vacation and weekend homes will likely be valued somewhat less than those of permanent residents. An average market value of $115,000 per weekend dwelling is assumed. About 25 percent of the housing values will represent land. Therefore, based on earlier estimates of the number of households that will eventually occupy the areas around the proposed reservoir, almost $288 million in new residential construction activity will be expected to occur primarily in Fannin County over a 30- year period. These construction activities will boost the local economy by about $432.5 million supporting almost 4,000 person-years of employment that will pay over $102 million in labor income (see Table 8).

Table 8
Local Economic Impacts of Housing Construction
(30-year development)

	Impact	
Description	**Total**	**Average Annual**[3]
Construction Spending	$287,805,000	$9,594,000
Economic Activity	$432,538,000	$14,418,000
Labor Income	$102,123,000	$3,404,000
Person-Years of Employment	3,997	133

Source: Author's estimates.

5.4 Business development and recruitment

One of the key attractions for new residents, including business people making location choices for plant sites, distribution centers, and other industrial land uses, is the presence of recreational amenities and quality-of-life features. These characteristics have become critical in the site selection process. Given Fannin County's existing locational advantages, the presence of a new reservoir providing a reliable source of water for industrial uses will enhance the county's ability to attract and retain businesses. To estimate the magnitude of the economic activity that could be gained through expanded business activities, projected water demand estimates from the Texas Water Development Board (TWDB)[4] and the previously described IMPLAN model are utilized.

Based on its latest published estimates, the TWDB expects manufacturing industry water use to rise in Fannin County by eight acre-feet per year between 2020 and 2030. Water used for steam electricity generation is expected to increase by 436 acre-feet per year. Livestock and irrigation uses are not expected to increase over this period, which is reasonable given the impact of the lake's impoundment on these land uses. Mining industry activities are also not expected to increase.[5] Municipal uses are expected to rise by 1,326 acre feet per year. While much of this

[3] Housing construction will not be evenly distributed across the period of development
[4] Though the TWBD estimates do not specifically include the proposed reservoir, they provide a reasonable basis for conservatively estimating future economic activity.
[5] Projected water usage for livestock and irrigation purposes are substantially lower than current usage estimates.

increase in municipal usage will be accounted for by the increase in households described earlier, some of the increase will be due to increased commercial and other non-manufacturing business activities not previously described in this analysis.

Based on year 2000 data for Fannin County and production input data from the IMPLAN model, we estimate the current economic value of goods production per acre-foot of water used for several product categories. Multiplying these values by the projected increase in water usage suggests that manufacturing, commercial,[6] and electricity generating activities will increase by $117.9 million annually in Fannin County. While there are many factors that drive economic development, without the water resources made available by the proposed reservoir, it is unlikely that Fannin County will see this increase in economic activity.

Increasing Fannin County's direct economic activity would also create spin-off indirect and induced economic impacts as described earlier in this report. However, two adjustments are required to improve the accuracy of estimating these indirect and induced impacts. Firstly, induced (household spending) impacts are not included in order to avoid double counting the impacts of permanent resident spending described above that would be employed by companies creating this new business activity. Secondly, current economic models of Fannin County do not adequately represent how the economy will operate 25 years from now. Therefore Rockwall County impact multipliers are used, which currently has a population about equal to TWBD's projected population for Fannin County in 2020.[7] Increasing Fannin County's industrial and commercial output by $117.9 million will result in $145 million in economic activity, boost area labor income by $48 million, and support over 1,600 jobs (see Table 9).

Table 9
Economic Impacts of New Industrial and Commercial Activities
(10-year increase after reservoir development)

Description	Annual Impact
New Direct Activity	$117,866,000
Economic Activity	$145,197,000
Labor Income	$48,111,000
Employment	1,607

Source: Authors' estimates.

Section 6: Local Fiscal Impacts

This section estimates some of the new tax revenues that will be enjoyed by counties and school districts adjusted for the loss of taxable land in the impoundment and mitigation areas. The analysis of foregone tax revenues from property inundation, environmental mitigation area, and

[6] No more than 20 percent of municipal water usage is assumed for commercial business activities.
[7] Local officials in Fannin County suggest that the TWBD population projections are substantially underestimated. While concurring with these officials, the TWBD data enhance the conservative nature of these estimates.

the redrawing of flood plain maps are based on the 2007 analysis with property valuations increased to reflect estimated average growth of valuations in Fannin County through 2011.

The Lower Bois d'Arc Creek Reservoir will be expected to cover more than 16,000 acres. (This does not include the proposed environmental mitigation area at Riverby Ranch.) As noted above, the reservoir will attract residential, commercial, and industrial property development, substantially boosting property tax revenues for local taxing jurisdictions. However, as NTMWD acquires property for the reservoir, local tax rolls will be reduced somewhat before much of the anticipated new development occurs. This analysis estimates potential tax losses for the county, the City of Bonham, and affected school districts in the near-term.

The area of land the NTMWD will acquire can generally be described as southwest of the proposed dam, at or below 545 feet above mean sea level. The affected land parcels are identified using Geographic Information System (GIS) data and software that was provided by the consulting engineers on the Lower Bois d'Arc Creek Reservoir project. Data are obtained from the Fannin County Appraisal District showing the size and taxable value in 2007 for each parcel that will lose land to the reservoir. This includes those parcels that will lose only a portion of their land to the lake and/or flood plain area.

In all, there are about 556 unique parcels at or below the 545-foot elevation level. Of these, we found taxable values for 502 parcels, leaving 54 without data. For those parcels not wholly within the land purchase area, aerial photography and tax records were used to assess the potential loss of taxable improvements on each parcel in the reservoir and flood plain area. For purposes of this analysis, no allowances were made for moving structures. If a structure is located within the 545 elevation line, it is considered lost for taxation purposes.

It is important to clarify that the estimates presented here represent taxable values and not market values. What's more, the assessed values are net of agricultural and homestead exemptions. It is assumed that any exemptions will continue after the reservoir land purchase.

For those parcels without valuation data from the Fannin County Appraisal District online database, aerial photography and GIS software were used to identify taxable improvements and land that NTMWD will purchase from each parcel. Land valuations for these parcels are based on the average taxable value of land for all other parcels, about $305 per acre including exemptions in 2007. Since 2007, taxable property values in Fannin County, like most areas, have been affected by the downturn in the real estate market. It is estimated that real property valuations net of new development have increased 0.67% per year since 2007 for an average taxable value of about $313 per acre. We assigned this estimated valuation to each school district based on their relative portion of land in the reservoir area.

There are two parcels without data that are treated differently. These two parcels include portions of the Legacy Ridge Country Club, comprising about 47 acres. Fiscal impact estimates for Fannin County, the City of Bonham, and the Bonham Independent School District (ISD) that include an estimated taxable value of the country club are presented below. However, it is possible that the country club will still be operationally viable once the flood plain lines are redrawn. Therefore, the actual impact on tax revenues may be substantially less than shown when the full value of the country club is removed from the tax rolls.

The findings presented below are estimates. There has been no independent verification of the accuracy of the Fannin County Appraisal District online database, nor has there been direct engagement in specific surveys to gauge the accuracy of the map images provided by the project engineers. These estimates should be used for planning purposes only. As property values will begin to rise based on new development near the new reservoir, the annual tax losses will diminish and turn to net new revenues for local taxing jurisdictions. Estimates of temporary tax losses are shown in Table 10. In addition to the inundation area, the Riverby Ranch has been acquired by NTMWD to serve as proposed environmental mitigation for the reservoir. See Attachment A for the 2012 Economic Impacts of the Riverby Ranching Operations. Prior to acquisition, this property had an appraised value of slightly more than $4 million, including improvements, and generated just under $78,000 per year in total property taxes, about $52,000 of which went to the Sam Rayburn ISD.

Table 10
Temporary Annual Tax Revenue Impacts of Land Acquisition for the Lower Bois d'Arc Creek Reservoir
(2011 valuation estimates, including mitigation area)

Entity	Value Before	Value After	Difference	Tax Rate	Temporary Tax Loss
Bonham ISD	$1,545,679	$1,206,037	$339,643	0.011505	$3,908
Including golf course	$2,593,067	$1,206,037	$1,387,030	0.011505	$15,958
Dodd City ISD	$3,429,167	$2,318,673	$1,110,493	0.01115	$12,382
Honey Grove ISD	$3,965,947	$2,114,933	$1,851,014	0.0135912	$25,158
Sam Rayburn ISD	$7,696,517	$1,550,066	$6,146,451	0.012039	$73,997
Fannin County	$16,641,590	$7,194,981	$9,446,608	0.006081	$57,445
Including golf course	$17,678,708	$7,194,981	$10,483,726	0.006081	$63,752
City of Bonham	$36,909	$29,571	$7,338	0.0067	$49
Including golf course	$1,074,027	$29,571	$1,044,456	0.0067	$6,998
Total Loss not/including golf course					**$172,938**
Total Loss including golf course					**$198,244**

Sources: Fannin County Appraisal District, North Texas Municipal Water District, Freese & Nichols, Author's estimates.

The taxable value of permanent and weekend resident housing at full development is estimated at $326.2 million[8], which would generate an estimated $5.9 million in county and school district revenues. Therefore, the net increase in tax revenues will be about $5.7 million at full development, of which $3.9 million will be enjoyed by school districts in Fannin County. Importantly, much of this gain in school district revenues will not be accompanied by a proportionate increase in students since a large percentage of the estimated valuations are for weekend or vacation residences. Area municipalities and townships could also benefit from

[8] The average value of homestead, senior citizen, disabled, veteran and other exemptions is estimated at 15 percent of total valuation.

increased property tax revenues depending on the degree to which their taxing jurisdictions are expanded to include land adjacent to the proposed reservoir (see Table 11).

Taxable retail sales in Fannin County will increase as new residents and visitors come to the area. Taking a very conservative approach, it is estimated that local sales tax revenues could increase by $303,000 or more per year. Hotel revenues for room rentals are expected to be at least $3.7 million per annum. Based on a local bed-tax rate of five percent, these expenditures will boost local tax receipts by an additional $183,000 annually. These estimates do not consider the additional taxable property value that will be created as stores, bait shops, hotels/resorts, restaurants, and other businesses locate around the lake.

Table 11
Recurring Annual Fiscal Impacts of New Housing Developments and Resident and Recreational Out-of-Area Visitor Spending

Description	Impact
Total Taxable Value of Housing (permanent & weekend residents)	$326,200,000
Reduction in Property Value due to Inundation and Mitigation**	($10,484,000)
Net gain in Taxable Property Values	$315,716,000
Estimated New County Property Tax Revenues	$1,920,000
Estimated New School District Property Tax Revenues	$3,910,000
Total Potential Municipal Sales Taxes (0.01 rate)*	$303,000
Hotel Occupancy Tax Revenues*	$183,000

* Value will be impacted by land annexation and business location decisions.
** Includes golf course.
Source: Author's estimates.

Section 7: Conclusions

The proposed Lower Bois d'Arc Reservoir will provide tremendous short-term economic gains to Fannin County that will certainly spill over to residents and businesses in surrounding counties as the dam and related infrastructures are constructed over a multi-year period. Construction spending for the dam and water transport infrastructure will add as much as $563 million to local economic activity and provide more than 5,500 person-years of employment.

Recurring operations supporting the dam and related infrastructure will create new opportunities for local businesses by adding $2.1 million in annual local economic activity and supporting about 24 jobs. Once impounded, the lake will attract substantial new private investment by hospitality firms anxious to provide services, meals, and specialty retail goods to the lake's recreational users. Out-of-area recreational users are projected to spend upwards of $22 million per year in the local economy. In addition, as seen with other Texas lakes, residents will be attracted to the region to take advantage of the new recreational amenities, bringing substantial new local spending to the area at full development. These new personal outlays will increase local economic activity by up to $89 million per year and up to about 570 jobs. The reservoir will provide water resources that will in turn support additional business development in Fannin County. Using conservative TWBD usage estimates, new industries attracted by the enhanced water resource will add $145 million in new economic activity in the county supporting 1,600 jobs. Any comparable industrial investment offering this magnitude of economic benefit would probably require exceptional incentive packages from state, county, and municipal governments. Construction of housing units for permanent and weekend residents will likely be spread over a 30-year period, providing long-term employment and business opportunities in the construction trades.

An expanded tax base will be another payoff from the ancillary development that will attend construction of the reservoir, allowing local governments to provide a broader range of public services while maintaining competitive tax rates. In sum, the economic opportunities supported by the proposed reservoir will promote sustainable development while diversifying the local job base.

ATTACHMENT A

Briefing Paper
The Economic Impacts of Riverby Ranch Operations
Prepared by Terry L. Clower
April 25, 2012

Briefing Paper

The Economic Impacts of Riverby Ranch Operations

Prepared by Terry L. Clower

April 25, 2012

The following reports the findings of the economic and fiscal impacts analysis of operations at the Riverby Ranch in Fannin County, Texas. The ranch has been purchased by the North Texas Municipal Water District as a designated environmental mitigation area to meeting statutory requirements related to the development of the Lower Bois d'Arc Creek Reservoir. Though the ranch has been purchased, it is currently being leased by previous owners and is still in operation. Operations at the ranch will likely continue unless the proposed reservoir is impounded. The loss of operations at Riverby Ranch, which largely consist of raising cattle, would somewhat offset the economic activity that would occur in the area during and after reservoir development. All figures are reported in 2011 dollars.

The following estimates focus on the economic impacts in Fannin County. Based on information provided by the previous owner/current executive of Riverby Ranch, many of the cattle trading activities currently based at Riverby would not cease, but would likely be transferred out of Fannin County once the mitigation plan is implemented. In addition, the fiscal impacts reported here are based on indirect spending activities and do not include the loss of taxable property value when the North Texas Municipal Water District purchased the ranch, which is addressed by payments in lieu of taxes by the Water District.

Our estimates of the economic and fiscal impacts of closing operations at Riverby Ranch are based on data provided by Riverby executives and analyzed using the IMPLAN economic input-output model developed by the Minnesota Implan Group (MIG, Inc.). This model is widely used in academic and professional research. Direct ranch spending data are not reported to protect data confidentiality.

- Based on current operations, Riverby Ranch creates $13.5 million in economic activity in Fannin County.
- This economic activity supports 264 jobs paying about $962,000 in salaries, wages, and benefits. However, most of these jobs are part-time positions employed during key ranching operations. It is likely that some of these jobs are itinerant in nature.
- Gross county product is boosted by less than $3 million suggesting the total impacts of Riverby Ranch operations have a modest impact on the local economy.
- Property income associated with the ranch operating would decrease by $1.6 million, once ranch operations cease.

State tax revenues would decline by about $244,000 per year and local tax jurisdictions would fall about $100,000,

The Economic and Fiscal Losses from Ceasing Operations at Riverby Ranch
Fannin County Impacts
2011 dollars

Description	Impact
Economic Impact	$13,524,000
Gross County Product (value added)	$2,935,000
Employment (full- and part- time)	264
Labor Income (salaries, wages, benefits)	$962,000
Property Income (rents, royalties, dividends, corporate profits)	$1,596,000
State taxes (sales taxes, fees, other business taxes)	$244,000
Local Taxes (property taxes, sales and use taxes, fees)*	$98,000

* Does not include direct property taxes paid by the ranch prior to being acquired by the North Texas Municipal Water District.

Sources: Riverby Ranch, IMPLAN, Author's estimates.

ATTACHMENT B

The Economic, Fiscal, and Developmental Impacts of the Proposed Lower Bois d'Arc Creek Reservoir Project: An Updated Assessment

Prepared by Terry L. Clower, Ph.D.
Bernard L. Weinstein
September 2007

The Economic, Fiscal, and Developmental Impacts of the Proposed Lower Bois d'Arc Creek Reservoir Project: An Updated Assessment

Prepared for:

The North Texas Municipal Water District

By:

Terry L. Clower, Ph.D.*
Bernard L. Weinstein

September 2007

Executive Summary

This report updates the findings of our 2004 analysis of the economic, developmental, and fiscal impacts of the Lower Bois d'Arc Creek reservoir that will be developed by the North Texas Municipal Water District.

- Construction of the dam to impound the proposed Lower Bois d'Arc Creek Reservoir, the intake pump station, and other related expenditures will cost about $100 million. In addition, construction spending for other related infrastructure in Fannin County, including a water intake pump station, transport pipeline and related facilities will add another $181 million to local spending for the reservoir. In total, current estimates call for infrastructure spending in Fannin County to be between $267 million and $295 million over a four to five year period. Depending on exact expenditures, local economic activity will increase between $303 million and $335 million during the construction phase of the reservoir development. This activity will support in the range of 1,600 to over 1,760 person-years of employment with associated salaries and wages of between $53.6 million and $59.2 million.

- Including infrastructure development that will occur in Collin County, total water transmission and treatment facilities associated with the Lower Bois d'Arc Creek Reservoir will cost in the range of $365 million to $403 million boosting economic activity in Fannin and Collin counties by a combined $536 million to $593 million, supporting over 4,000 person-years of employment and paying upwards of $200 million in salaries and wages.

- After construction of the dam and pipeline is completed, on-going impacts from the operation and maintenance of these infrastructures will support about 20 full-time-equivalent direct and indirect jobs and spur about $4 million in new economic activity per year.

- Once the lake is impounded, new recreational spending will arrive in Fannin County as visitors come to fish, boat, and participate in other water-recreation activities. These visitors will bring $16 million to $21 million in new annual spending to the local economy.

- The lake will also attract many new residents to Fannin County. We estimate that over a 30-year period at least 1,100 new permanent households will be established around the lake. An additional 2,100 residences will likely be built as vacation/weekend/second homes. These new households will be in addition to any other growth projected for Fannin County. The construction of these homes will bring an average of over 133 jobs per year to the local economy over the development period.

- The reservoir will also support new industrial and commercial activities beyond those described in the hospitality industry. Using Texas Water Development Board usage estimates, we project that $139 million in new economic activity in Fannin County supporting over 1,600 permanent jobs could be made possible by the availability of a new reliable water resource.

- The pace and quality of development will depend on many market-related factors. One of the most critical factors will be the extent to which counties, cities, and towns adopt well-reasoned development plans to promote quality growth while also ensuring that infrastructure development and publicly-provided services keep pace with new demand. Examples of infrastructures would include such things as electric services, roads, water services, and public safety and other municipal services.

- Spending by new residents in the local economy will increase economic activity in Fannin County by $67 million to $74 million each year. Our analysis also suggests that economic activity in the larger region including Fannin, Hunt, Delta, and Lamar counties will rise by as much as $91 million per year in response to having these new residents living near the proposed reservoir. This activity will support well over 700 permanent jobs paying about $17 million in annual salaries and wages.

- Once developed, the proposed reservoir will enhance the region’s attractiveness as a business location. As a recreational amenity, the lake will enhance the quality of life features of the region, which are an increasingly important factor in business site location decisions.

- Local taxing jurisdictions will enjoy not only substantial temporary gains in revenues from business activities related to construction of the dam, pipelines and related infrastructure, and new housing, they will also see new revenues based on increased property values and spending by visitors and residents. Property taxes on new housing alone will add $1.9 million to county tax revenues net of any losses due to the lake impoundment and related environmental mitigation. Similarly, net gains in area school district revenues will exceed $5 million per year at full development. Local taxes on retail sales will generate at least $290,000 per year with an additional $175,000 per year provided by hotel occupancy taxes.

Table ES1

Temporary Local Economic Impacts of Construction Of the Lower Bois d'Arc Creek Reservoir Dam

Description	Impact
Dam Construction, Pipeline Construction, Pump Station and other infrastructure Impacted counties: Fannin. Construction period: 4-5 years.	
Construction costs	$ 267,279,000 to $ 295,414,000
Total economic activity	$ 302,931,000 to $ 334,819,000
Total salaries and wages	$ 53,579,000 to $ 59,219,000
Total person-years of employment	1,596 to 1,764
Property Income*	$ 14,773,000 to $ 16,328,000
Indirect Business Taxes**	$ 2,663,000 to $ 2,944,000

* Includes rents, royalties, dividends, and corporate profits. ** Includes property taxes, sales taxes, and fees for permits and licenses paid on secondary transactions from water district spending. Sources: North Texas Municipal Water District, authors' estimates.

Table ES1 -- continued

Temporary Local Economic of Pipeline, Treatment Plant, and Related Infrastructure Construction

Description	Impact
Pipeline, Storage, and Treatment Facilities Construction Impacted counties: Fannin, Collin. Construction period: 3-4 years.	
Construction costs	$ 365,001,000 to $ 403,422,000
Total economic activity	$ 536,540,000 to $ 593,018,000
Total salaries and wages	$ 180,658,000 to $ 199,674,000
Total person-years of employment	4,122 to 4,556
Other property income*	$ 53,308,000 to $ 58,919,000
Indirect business taxes**	$ 12,147,000 to $ 13,426,000

* Includes rents, royalties, dividends, and corporate profits. ** Includes property taxes, sales taxes, and fees for permits and licenses paid on secondary transactions from water district spending. Sources: North Texas Municipal Water District, authors' estimates.

Table ES2

Recurring Annual Local Economic Impacts
(2007 dollars)

Description	Impact
Dam, Pump Station, Pipeline, and Treatment Plant Operations Impacted counties: Fannin, Collin	
Total economic activity	$ 3,966,000
Total salaries and wages	$ 825,000
Total full-time-equivalent employment	20
Recreational Visitor Spending	
Total annual spending	$ 16,000,000 to $ 21,000,000
Total economic activity	$ 20,230,000 to $ 26,972,000
Total salaries and wages	$ 5,957,000 to $ 7,972,000
Total full-time-equivalent employment	295 to 393
Resident Spending Permanent and Weekend/Vacation Residents: Fannin, Lamar, Hunt, Delta	
Total economic activity	$ 82,303,000 to $ 90,967,000
Total salaries and wages	$ 17,150,000 to $ 18,955,000
Total full-time-equivalent employment	701 to 775
New Industrial and Commercial Activities Based on Projected Water Usage	
Total economic activity	$ 138,710,000
Total salaries and wages	$ 45,961,000
Total full-time-equivalent employment	1,607

Source: Authors' estimates

ES3

Recurring Annual Fiscal Impacts of New Housing Developments and Resident and Recreational Out-of-Area Visitor Spending+

Description	Impact	
Total taxable value of housing (permanent and weekend residents)	$	326,200,000
Reduction in property value due to inundation and mitigation	($	10,524,000)
Net gain in taxable property values	$	315,676,000
Estimated new county property tax revenues	$	1,894,000
Estimated new school district property tax revenues	$	5,118,000
Total potential* municipal sales taxes (0.01 rate)	$	290,000
Hotel occupancy tax revenues*	$	175,000

+ at buildout * Value will be impacted by land annexation and business location decisions.
Source: Authors' estimates

Section 1: Introduction

Addressing future water needs for the North Texas Municipal Water District's service area has led to the consideration of developing several new water supplies. One proposal is for a reservoir to be located along the Lower Bois d'Arc Creek northeast of the City of Bonham in Fannin County. The following report updates the findings of our 2004 analysis of the economic, fiscal, and developmental impacts of this proposed reservoir.

Our estimates of the economic impacts of the reservoir and related economic activity are based on the IMPLAN input-output economic modeling system developed by the Minnesota IMPLAN Group. The modeled impacts include the direct effects of spending for construction activities and consumption spending, the indirect effects of local vendors providing goods and services to the primary firms, and the induced impacts of employees of these firms spending a portion of their earnings in the local economy.

We begin with an economic overview of Fannin County and then proceed to measure the new employment, income, spending, and tax revenues that will attend the construction and operations of the dam and related transportation, storage, and treatment facilities. We then explore the "ancillary" development likely to occur in conjunction with the dam, in particular the construction of new homes and recreationally based businesses. New and recurring income, employment, and economic activity associated with this ancillary development are estimated. Finally, we examine the impact of the proposed project on revenues to local taxing jurisdictions.

Section 2: Economic overview of Fannin County.

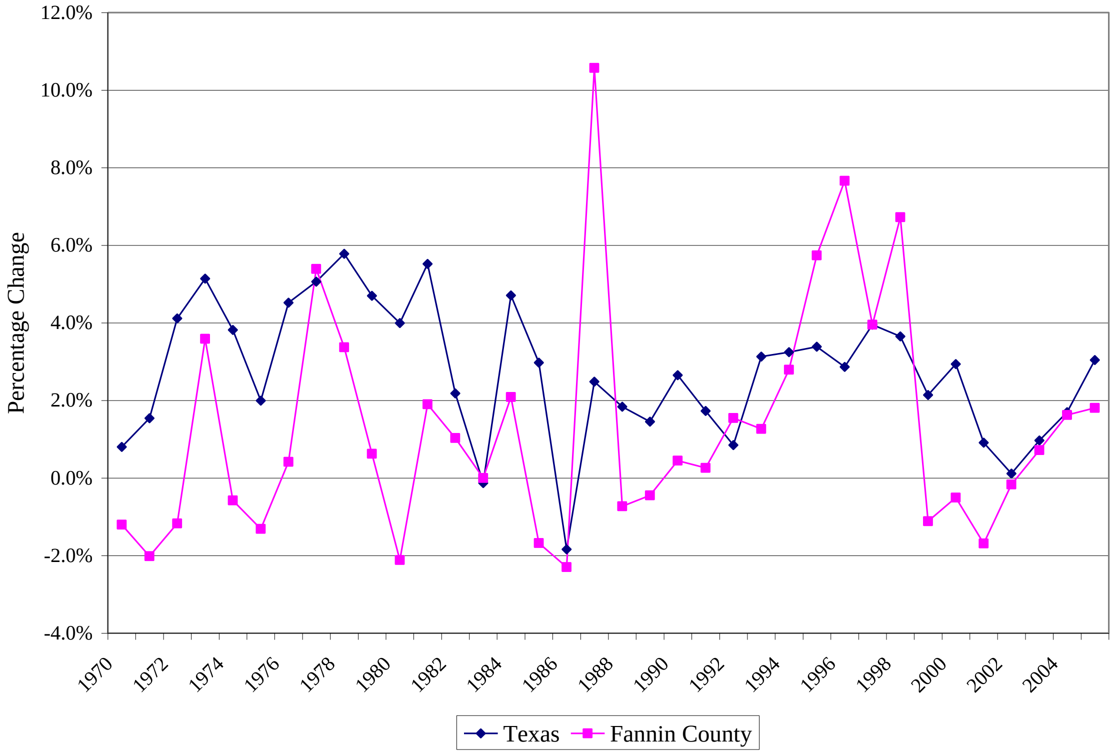
Like many rural counties in Texas, Fannin County saw its historical peak of population and economic activity around the turn of the 20th century. The 1900 census showed a population of 51,793. Cotton and corn production were the chief crops in an economy dominated by agricultural production. Later in the 20th century, dairy operations rose in prominence, but the county suffered tremendous economic losses during the depression years and after World War II. Children of farmers sought their fortunes elsewhere. By 1970, the population had dropped to 22,705. However, after 1970 the population stabilized and began to slowly increase. Today Fannin County is home to over 33,000 residents and during the decade of the 1990s actually grew faster than the state as a whole (26 percent increase versus 22.8 percent increase) as spillover growth from Dallas' northern suburbs reached the county.

As can be seen in Figure 1, year-over-year employment change in Fannin County has not seen consistent growth as shown for the state. With the exception of 1986 and 1994-1997, the county has lagged state economic performance, sometimes dramatically. These data suggest that one critical economic development strategy for Fannin County should be to diversify the economic base, particularly toward industries with greater stability over time.

The proposed reservoir offers several economic development opportunities for Fannin County. In addition to the substantial economic activity that would be generated by construction projects related to the reservoir over a multi-year period, the new lake would attract recreational users whose spending, in turn, would spur investment in new hospitality venues. By supporting new residents and hosting new recreation-based industries, the proposed reservoir offers an excellent diversification opportunity for Fannin County.

Figure 1

Year-to-Year Percentage Change
Total Employment State of Texas and Fannin County
1970-2005



Source: US Department of Commerce.

Section 3: Economic impacts of dam and related infrastructure construction.

In this section we examine the economic impacts of the construction of the proposed Lower Bois d'Arc Creek Reservoir dam and related infrastructure. These estimates are based on the latest cost projections for the facilities expressed in current year (2007) dollars.

Economic impact assessments for the dam and related infrastructure construction projects are examined in two models. The first looks at the impacts that will likely remain in Fannin County. However, based on the size of the development projects, businesses and residents of nearby counties will also benefit from the economic activity associated with the construction of the dam. For purposes of this analysis, we have included an estimate of the total impacts that will likely occur in a wider economic area defined by Fannin, Delta, Lamar, and Hunt counties.

The most recent estimates call for expenditures on dam construction to be about $100 million. In addition, related infrastructure including transport pipeline, a water intake pump station, and related facilities add about $181 million to construction expenditures. Total expenditures for the Lower Bois d'Arc Creek reservoir and related infrastructure in Fannin County will be between $267 million and $295 million over a four to five year period. Based on the relative presence, or absence, of industries providing materials and supporting services to dam construction projects, some of the economic activity will "leak" out of the local area. Even so, these expenditures will increase total economic activity in Fannin County by $303 million to $335 million (see Table 1). This new activity will create over 1,500 person years of employment that will increase local labor income (salaries, wages, and benefits) by somewhere between $53.5 million and $59 million. In addition, property incomes in the form of rent, royalties, corporate profits, and dividends will increase by $14 million to $16 million. Business taxes from indirect transactions will boost state and local tax revenues by $2.7 million to $2.9 million.

Looking at the expanded economic region defined by Fannin, Lamar, Delta, and Hunt counties, the impacts are slightly larger reflecting these additional counties' abilities to attract a portion of the jobs and business activity related to the development of the reservoir. Including the spillover to these adjacent counties, total economic activity associated with the construction of the Lower Bois d'Arc Creek reservoir dam and other infrastructure rises to between $330 million to over $364 million during the four to five year period. Total labor income paid in the four-county region will increase to $76 to $84 million through the creation of between 2,200 and 2,400 total temporary jobs. Property income will also rise to between $21.7 million and $24 million, while state and local government will see between $4 million and $4.5 million in revenue from indirect business taxes including sales taxes, property taxes, and fees for permits and licenses.

Table 1

Temporary Local Economic Impacts of Construction
Of the Lower Bois d'Arc Creek Reservoir Dam

Description	Impact
Dam Construction, Pipeline Construction, Pump Station and other infrastructure Impacted counties: Fannin. Construction period: 4-5 years.	
Construction costs	$ 267,279,000 to $ 295,414,000
Total economic activity	$ 302,931,000 to $ 334,819,000
Total salaries and wages	$ 53,579,000 to $ 59,219,000
Total person-years of employment	1,596 to 1,764
Property Income*	$ 14,773,000 to $ 16,328,000
Indirect Business Taxes**	$ 2,663,000 to $ 2,944,000
Dam Construction, Pipeline Construction, Pump Station and other infrastructure Impacted counties: Fannin, Hunt, Lamar, Delta. **Construction period: 4-5 years.**	
Total economic activity	$ 329,871,000 to $ 364,595,000
Total salaries and wages	$ 76,275,000 to $ 84,304,000
Total person-years of employment	2,240 to 2,476
Property Income*	$ 21,745,000 to $ 24,033,000
Indirect Business Taxes**	$ 4,093,000 to $ 4,524,000

* Includes rents, royalties, dividends, and corporate profits. ** Includes property taxes, sales taxes, and fees for permits and licenses paid on secondary transactions from water district spending. Sources: North Texas Municipal Water District, authors' estimates.

Property owners for the land that will be consumed by the lake and the additional acreage that may be set aside for flood easements and environmental mitigation purposes will be compensated. These payments to land owners represent a transfer of income to the local economy supporting new spending in the region.

In addition to construction activities in Fannin County, Collin County will see a share of the economic benefits of the reservoir development including pipeline, terminal storage facilities and a water treatment plant. These infrastructure components will be located in either Fannin County or Collin County. These facilities will cost between $365 million and $403 million to build. This spending, which includes the Fannin County spending described above, will generate between $536 million and $593 million in economic activity in the Fannin/Collin Counties region during the development phase. Between 4,122 and 4,556 person-years of employment will be supported and labor income will rise by $180 million to $200 million (see Table 2). Property income will rise between $53 million and $59 million. Finally, state and local governments will gain an estimated $12 million to $13.4 million in taxes and fees.

Table 2

Temporary Impacts of Transmission and Treatment Infrastructure Construction

Description	Impact
Pipeline, Storage, and Treatment Facilities Construction Impacted counties: Fannin, Collin. Construction period: 3-4 years.	
Construction costs	$ 365,001,000 to $ 403,422,000
Total economic activity	$ 536,540,000 to $ 593,018,000
Total salaries and wages	$ 180,658,000 to $ 199,674,000
Total person-years of employment	4,122 to 4,556
Other property income*	$ 53,308,000 to $ 58,919,000
Indirect business taxes**	$ 12,147,000 to $ 13,426,000

* Includes rents, royalties, dividends, and corporate profits. ** Includes property taxes, sales taxes, and fees for permits and licenses paid on secondary transactions from water district spending. Sources: North Texas Municipal Water District, authors' estimates.

Section 4: On-going economic impacts of dam and pipeline operations

Once the dam and pipeline are built, on-going operations and maintenance of these infrastructures will continue to provide a modest number of jobs and a minor boost to local economic activity. Recurring maintenance and operating expenditures for the dam and related infrastructures are expected to increase local economic activity by about $4 million each year in Fannin and Collin counties combined. This activity will support 20 full-time-equivalent (FTE) direct and indirect jobs paying about $825,000 in annual wages and salaries (see Table 2).

Table 2

Recurring Annual Local Economic Impacts of Dam,
Pipeline and Related Infrastructure Operations
(Fannin and Collin Counties)

Description	Impact
Total economic activity	$ 3,966,000
Total salaries and wages	$ 825,000
Total full-time-equivalent employment	20
Indirect state and local business taxes	$ 151,000

Source: Authors' estimates

Section 5: Developmental impacts of the proposed reservoir

In addition to the one-time and recurring impacts described above, the impoundment of a 16,526 acre reservoir in Fannin County would have substantial spillover benefits on the local economy. In this section we consider the impacts that will follow new recreational spending based at the reservoir and the economic and fiscal consequences for the region from attracting new permanent and weekend residents.

5.1 Impacts of recreational users

The "field of dreams" scenario often works for lakes. If you build a publicly accessible water recreation resource, visitors use it. The north Texas region currently has many excellent reservoirs supporting water-based recreational activities. However, some of these reservoirs are so overcrowded that water accidents occur with increasing frequency. As the DFW population continues to grow over the next 30 years, demand for water recreation sites will increase, and Fannin county is ideally situated to capture more than a fair share of this recreational activity.

Unfortunately, few studies offer specific guidance on estimating the magnitude of the economic impacts that will attend increased recreational visitors to Fannin County when the proposed reservoir is fully developed. However, in the mid-1990s, Texas A&M, working for the Texas Parks and Wildlife Department and the Sabine River Authority, surveyed anglers at Lake Fork to assess their levels of local spending. Over two-thirds of the survey respondents were non-local residents, with about one-third hailing from outside of Texas. Non-local angler-visitors to Lake Fork spent an estimated $14.5 million in Wood, Rains, and Hopkins counties during their fishing trips for food, lodging, and supplies. This level of spending encourages business development and supports jobs. While some of this employment will be seasonal, north Texas weather patterns permit water-based recreation on a year-round basis.

Other lake-based recreation activities will draw additional out-of-area visitors to the region. We are not suggesting that the proposed reservoir will rise to Lake Fork's national reputation as a fishing lake, but when combined with non-angler spending, we estimate that non-local recreation visitors will add $16 million to $21 million in new spending for dining, food, retail goods, and lodging to the Fannin County economy. This spending will generate between $20.2 million and $26.9 million in economic activity, support 300 to 400 new jobs, and increase local earnings by $6 million to $7.9 million (see Table 3). Undoubtedly, bringing new recreational visitors to the area will present opportunities for businesses located in adjacent counties, especially Lamar County. However, given existing amenities and attractions in the City of Bonham, we expect that most of the recreational spending will stay in Fannin County.

Table 3

Recurring Annual Local Economic Impacts of Recreational Out-of-Area Visitor Spending

Description	Impact
Total annual spending: recreational visitors	$ 16,000,000 to $ 21,000,000
Total economic activity	$ 20,230,000 to $ 26,972,000
Total salaries and wages	$ 5,957,000 to $ 7,972,000
Total full-time-equivalent employment	295 to 393

Source: Authors' estimates

5.2 Impacts of new permanent and weekend residents

One trend clearly evident in north and northeast Texas is that counties with substantial reservoirs have enjoyed greater population growth than counties without these important amenities. Many recreational lake visitors eventually decide to move close to their favorite reservoirs. Carefully managed residential development can prove to be a tremendous economic boon for lake county economies.

Fannin County is well-positioned to take full advantage of opportunities to attract new permanent and weekend residents to the reservoir. The proposed dam, which will be on the north end of the reservoir, will be only 50 miles from McKinney and 80 miles from downtown Dallas. Already, as indicated earlier, spillover growth from the Dallas-

Fort Worth Metroplex is reaching the Bonham area. Within reasonable reach of big-city amenities, yet removed from most urban disamenities, we expect the proposed reservoir to attract at least 1,100 full-time resident households over and above anticipated growth for the area over the next 30 years. Though this may not seem like a huge number of new households, at least by urban development standards, these new households will bring $57 million in new income to the area.

In addition, at least 2,100 new dwellings will be constructed in the area surrounding the reservoir as weekend/vacation homes and investment properties. Our estimate of these weekender residences is likely understated. However, we caution that while relative proximity to the Metroplex will encourage permanent residents, it will lower demand for weekend/vacation housing. Nonetheless, we estimate that weekend and vacation resident will bring an equivalent of $9.6 million in household income that will be used for local purchases.

Modeling the combined incomes of permanent residents and the proportional income of weekend residents using regionally based estimates of spending, we find the Fannin County economy will realize a net increase of between $77 million and $85 million each year once full development is reached. This activity will support 517 to 572 permanent jobs paying $12.8 million to $14 million in salaries and wages (see Table 4).

It is likely that businesses located in Hunt, Lamar, and Delta counties, as well as Fannin County, will offer goods and services to the new permanent and weekend residents. Including the economic activity that is likely to go to these other counties, spending by households drawn to the new reservoir will increase economic output in the broader region by $82.3 million to $91 million, boost local income by $17 million to $19 million, and support between 701 to 775 permanent jobs.

We strongly emphasize that the pace and quality of development will depend on many market-related factors. **One of the most critical factors will be the extent to which counties, cities, and towns adopt well-reasoned development plans to promote quality growth while also ensuring that infrastructure development and publicly-provided services keep pace with new demand.** Examples of infrastructures would include such things as electric services, roads, water services, and public safety and other municipal services.

Table 4

Recurring Annual Local Economic Impacts of New Resident Spending

Description	Impact
Fannin County Impacts	
Total annual spending	$ 67,724,000 to $ 74,290,000
Total economic activity	$ 77,119,000 to $ 85,237,000
Total salaries and wages	$ 12,736,000 to $ 14,077,000
Total full-time-equivalent employment	517 to 572
Fannin, Hunt, Delta, and Lamar County Impacts	
Total economic activity	$ 82,303,000 to $ 90,967,000
Total salaries and wages	$ 17,150,000 to $ 18,955,000
Total full-time-equivalent employment	701 to 775

Source: Authors' estimates

5.3 Impacts of new housing construction

In our projections we have assumed that the new permanent and weekend resident households will be single-family units. This is consistent with most of the development trends experienced in other lake counties. Even if residential real estate demand shifts to the inclusion of multi-family properties, the costs of development, and hence the economic and fiscal impacts, will be within the range of possibilities projected below.

Because of recent housing market volatility, we have retained the estimates of housing prices from our earlier study. Undoubtedly, this approach results in a more conservative estimate of the likely impacts of housing development near the new reservoir.

We estimate the average cost of land and improvements for permanent-resident dwellings will be about $127,000. Based on the findings of nationwide housing studies, vacation and weekend homes will likely be valued somewhat less than those of permanent residents. We assume an average market value of $115,000 per weekend dwelling. About 25 percent of the housing values will represent land; therefore, based on our earlier estimates of the number of households that will eventually occupy the areas around the proposed reservoir, we expect almost $288 million in new residential construction activity to occur primarily in Fannin county over a 30 year period. These construction activities will boost the local economy by about $14.5 million per year, on average,[1] support an average of 133 long-term FTE jobs, and boost local income by $3.4 million (see Table 5).

Table 5

Local Economic Impacts of Housing Construction
(30-year development)

Description	Impact: Total	Impact: Average Annual
Construction spending	$ 287,805,000	$ 9,594,000
Total economic activity	$ 432,538,000	$ 14,418,000
Total salaries and wages	$ 102,123,000	$ 3,404,000
Total full-time-equivalent employment	3,997	133

Source: Authors' estimates

[1] Housing construction will not be evenly distributed across the period of development.

5.4 Business development and recruitment

One of the key attractions for new residents, including business people making location choices for plant sites, distribution centers, and other industrial land uses, is the presence of recreational amenities and quality-of-life features. These characteristics have become critical in the site selection process. Given Fannin County's existing locational advantages, the presence of the new reservoir providing a reliable source of water for industrial uses will enhance the county's ability to attract and retain businesses. To estimate the magnitude of the economic activity that could be gained through expanded business activities, we utilized projected water demand estimates from the Texas Water Development Board (TWDB)[2] and the previously described IMPLAN model.

Based on its latest published estimates, the TWDB expects manufacturing industry water use to rise in Fannin County by 8 acre feet per year between 2020 and 2030. Water used for steam electricity generation is expected to increase by 436 acre feet per year. Livestock and irrigation uses are not expected to increase over this period, which is reasonable given the impact of the lake's impoundment on these land uses. Mining industry activities are also not expected to increase.[3] Municipal uses are expected to rise by 1,326 acre feet per year. While much of this increase in municipal usage will be accounted for by the increase in households described earlier, some of the increase will be due to increased commercial and other non-manufacturing business activities not previously described in this analysis.

[2] Though the TWBD estimates do not specifically include the proposed reservoir, they provide a reasonable basis for conservatively estimating future economic activity.

[3] Projected water usage for livestock and irrigation purposes are substantially lower than current usage estimates.

Using 2000 usage data for Fannin County and adjusted commodity production estimates from IMPLAN,[4] we estimated the current economic value of production per acre foot of water used by use-category. Multiplying these values by projected increase in water usage suggests that manufacturing, commercial,[5] and electricity generating activities will increase by $112.6 million annually in Fannin County. While there are many factors that drive economic development, without the water resources made available by the proposed reservoir, it is unlikely that Fannin County will see this increase in economic activity.

Increasing Fannin County's direct economic activity would also create spin-off indirect and induced economic impacts as described earlier in this report. However, two adjustments are required to improve the accuracy of estimating these indirect and induced impacts. First, we will not include the induced (household spending) impacts to avoid double counting the impacts of permanent resident spending described above that would be employed through this new business activity. Secondly, current economic models of Fannin County do not adequately represent how the economy will operate 25 years from now. We therefore used impact multipliers for Rockwall County, which currently has a population about equal to TWBD's projected population for Fannin County in 2020. [Local officials in Fannin County suggest that the TWBD population projections are substantially underestimated. We concur with these officials; however, using the TWBD data enhances the conservative nature of our estimates.] Increasing Fannin County's industrial and commercial output by $112.6 million will result in $138.7 million in

[4] Adjusted for the loss of the local meat packing operation.
[5] We assumed that no more than 20 percent of municipal water usage is for commercial business activities.

economic activity, boost area labor income by $46 million, and support over 1,600 jobs (see Table 6).

Table 6

Economic Impacts of New Industrial and Commercial Activities
(10-year increase after reservoir development)

Description	Annual Impact
New Direct Activity	$ 112,610,000
Total economic activity	$ 138,710,000
Total salaries and wages	$ 45,961,000
Total full-time-equivalent employment	1,607

Source: Authors' estimates

Section 6: Local fiscal impacts

In this section, we estimate some of the new tax revenues that will be enjoyed by counties and school districts. We will also consider the impacts on local property taxes from the loss of taxable land in the lake impoundment and mitigation areas.

Taxable value of permanent and weekend resident housing at full development is estimated at $326.2 million[6]. Of course, some diminution of taxable values will occur as a result of land inundation and environmental mitigation. Most of the land to be inundated is agricultural. Fannin County assess taxable values for agricultural land according to the nature of the land, the use of the land, and irrigation status. These valuations range from $65 per acre for native grasslands that are not irrigated to $323 per acre for irrigated land or land in horticultural uses. We have assumed that of the 16,526 acres that will be inundated and the estimated 30,000 acres that may be required for environmental mitigation, 50 percent is irrigated crop land valued at $323 per acre for tax

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[6] The average value of homestead, senior citizen, disabled, veteran and other exemptions is estimated at 15 percent of total valuation.

purposes, 30 percent is valued at $157 per acre, and that 20 percent is improved land at $88 per acre. (Typically irrigated land is not used for environmental irrigation; therefore, our approach will tend to overstate potential tax losses.) Therefore, the inundation of land and mitigation areas for the reservoir will remove $10.5 million in taxable value from the local tax rolls. Therefore, the net increase in taxable value will be $315.7 million, an increase of 22 percent over Fannin County 2003 total taxable property values. This increase in valuation will generate about $1.9 million per year to the county and over $5 million per year to area school districts under current law. Importantly, much of this gain in school district revenues will not be accompanied by a proportionate increase in students since a large percentage of the estimated valuations are for weekend or vacation residences. Area municipalities and townships could also benefit from increased property tax revenues depending on the degree to which their taxing jurisdictions are expanded to include land adjacent to the proposed reservoir (see Table 7).

Taxable retail sales in Fannin County will increase as new residents and visitors come to the area. Taking a very conservative approach, we estimate that local sales tax revenues could increase by $290,000 or more per year. Hotel revenues for room rentals are expected to be at least $3.5 million per annum. Based on a local bed-tax rate of 5 percent, these expenditures will boost local tax receipts by an additional $175,000 annually. Our estimates do not consider the additional taxable property value that will be created as stores, bait shops, hotels/resorts, restaurants, and other businesses locate around the lake.

Table 7

Recurring Annual Fiscal Impacts of New Housing Developments and Resident and Recreational Out-of-Area Visitor Spending

Description	Impact
Total taxable value of housing (permanent and weekend residents)	$ 326,200,000
Reduction in property value due to inundation and mitigation	($ 10,524,000)
Net gain in taxable property values	$ 315,676,000
Estimated new county property tax revenues	$ 1,894,000
Estimated new school district property tax revenues	$ 5,118,000
Total potential* municipal sales taxes (0.01 rate)	$ 290,000
Hotel occupancy tax revenues*	$ 175,000

* Value will be impacted by land annexation and business location decisions. Source: Authors' estimates

Section 7: Conclusions

The proposed Lower Bois d'Arc Creek Reservoir will provide tremendous short-term economic gains to Fannin County that will certainly spill over to residents and businesses in surrounding counties as the dam and related infrastructures are constructed over a multi-year period. Construction spending for the dam and transport infrastructure will add over $267 million to local economic activity and provide more than 1,600 person-years of employment. The dam will also create new opportunities for local businesses by adding $4 million in annual local economic activity and supporting about 20 permanent jobs.

Once impounded, the lake will attract substantial new private investment by hospitality firms anxious to provide services, meals, and specialty retail goods to the lake's recreational users. Out-of-area recreational users are projected to spend $16 million to $21 million per year in the local economy. In addition, as seen with other Texas lakes, residents will be attracted to the region to take advantage of the new recreational amenities, bringing substantial new local spending to the area at full development. These new personal outlays will increase local economic activity by over $80 million per year and support more than 700 permanent jobs. The reservoir will provide water resources that will support additional business development in Fannin County. Using conservative TWBD usage estimates, $138.7 million in new economic activity would be supported in the county adding an additional 1,600 jobs to area payrolls. Any comparable industrial investment offering this magnitude of economic benefit would probably require exceptional incentive packages from state, county, and municipal governments. Construction of housing units for permanent and weekend residents will likely be spread over a 30-year period providing long-term job and business opportunities in the construction trades.

An expanded tax base will be another payoff from the ancillary development that will attend construction of the reservoir, allowing local governments to provide a broader range of public services while maintaining competitive tax rates. In summary, the economic opportunities supported by the proposed reservoir will promote sustainable development while diversifying the local job base.

ATTACHMENT C

The Economic, Fiscal, and Developmental Impacts of the Proposed Lower Bois d'Arc Creek Reservoir Project

Prepared by Terry L. Clower, Ph.D.
Bernard L. Weinstein
September 2004

The Economic, Fiscal, and Developmental Impacts of the Proposed Lower Bois d'Arc Reservoir Project

Prepared for:

The North Texas Municipal Water District

By:

Terry L. Clower, Ph.D.*
Bernard L. Weinstein

September 2004

* Professor and Assistant Professor, Institute of Applied Economics, University of North Texas. Views expressed by the authors are theirs alone and do not necessarily reflect those of the university or its Board of Regents.

Executive Summary

- Construction of the dam to impound the proposed Lower Bois d'Arc Reservoir and intake pump station will cost between $181 million and $200 million. Depending on exact expenditures, local economic activity will increase between $231 million and $256 million during the four to five year project. This activity will support in the range of 2,000 to almost 2,300 person-years of employment with associated salaries and wages of between $60.3 million and $66.7 million.

- The proposed pipeline, storage, and facilities to treat water from the Lower Bois d'Arc Reservoir will cost in the range of $233 million to $257 million boosting economic activity in Fannin and Collin counties by a combined $320 million to $354 million, supporting over 2,000 person-years of employment and paying upwards of $104 million in salaries and wages.

- After construction of the dam and pipeline is completed, on-going impacts from the operation and maintenance of these infrastructures will support about 20 full-time-equivalent direct and indirect jobs and spur about $3.7 million in new economic activity per year.

- Once the lake is impounded, new recreational spending will arrive in Fannin County as visitors come to fish, boat, and participate in other water-recreation activities. These visitors will bring $15 million to $20 million in new annual spending to the local economy.

- The lake will also attract many new residents to Fannin County. We estimate that over a 30-year period at least 1,100 new permanent households will be established around the lake. An additional 2,100 residences will likely be built as vacation/weekend/second homes. These new households will be in addition to any other growth projected for Fannin County. The construction of these homes will bring an average of over 133 jobs per year to the local economy over the development period.

- The reservoir will also support new industrial and commercial activities beyond those described in the hospitality industry. Using Texas Water Development Board usage estimates, we project that $139 million in new economic activity in Fannin County supporting over 1,600 permanent jobs could be made possible by the availability of a new reliable water resource.

- The pace and quality of development will depend on many market-related factors. One of the most critical factors will be the extent to which counties, cities, and towns adopt well-reasoned development plans to promote quality growth while also ensuring that infrastructure development and publicly-provided services keep pace with new demand. Examples of infrastructures would include such things as electric services, roads, water services, and public safety and other municipal services.

- Spending by new residents in the local economy will increase economic activity in Fannin County by $63 million to $69 million each year. Our analysis also suggests that economic activity in the larger region including Fannin, Hunt, Delta, and Lamar counties will rise by as much as $85 million per year in response to having these new residents living near the proposed reservoir. This activity will support well over 700 permanent jobs paying about $16 million in annual salaries and wages.

- Once developed, the proposed reservoir will enhance the region's attractiveness as a business location. As a recreational amenity, the lake will enhance the quality of life features of the region, which are an increasingly important factor in business site location decisions.

- Local taxing jurisdictions will enjoy not only substantial temporary gains in revenues from business activities related to construction of the dam, pipelines and related infrastructure, and new housing, they will also see new revenues based on increased property values and spending by visitors and residents. Property taxes on new housing alone will add $1.9 million to county tax revenues net of any losses due to the lake impoundment and related environmental mitigation. Similarly, net gains in area school district revenues will approach $5 million per year at full development. Local taxes on retail sales will generate at least $290,000 per year with an additional $175,000 per year provided by hotel occupancy taxes.

Table ES1

Temporary Local Economic Impacts of Dam, Pipeline, and Related Infrastructure Construction

Description	Impact
Dam Construction Impacted counties: Fannin. Construction period: 4-5 years.	
Construction costs	$ 181,070,000 to $ 200,130,000
Total economic activity	$ 225,859,000 to $ 249,634,000
Total salaries and wages	$ 56,286,000 to $ 62,211,000
Total person-years of employment	1,937 to 2,141
Dam Construction Impacted counties: Fannin, Hunt, Lamar, Delta. **Construction period: 4-5 years.**	
Total economic activity	$ 231,393,000 to $ 255,750,000
Total salaries and wages	$ 60,339,000 to $ 66,690,000
Total person-years of employment	2,069 to 2,287

Sources: North Texas Municipal Water District, authors' estimates.

Table ES1 -- continued

Temporary Local Economic Impacts of Dam, Pipeline, and Related Infrastructure Construction

Description	Impact
Pipeline, Storage, and Treatment Facilities Construction Impacted counties: Fannin, Collin. Construction period: 3-4 years.	
Construction costs	\$ 233,035,000 to \$ 257,670,000
Total economic activity	\$ 319,982,000 to \$ 353,664,000
Total salaries and wages	\$ 94,334,000 to \$ 104,264,000
Total person-years of employment	2,009 to 2,220

Sources: North Texas Municipal Water District, authors' estimates.

Table ES2

Recurring Annual Local Economic Impacts
(2004 dollars)

Description	Impact
Dam, Pump Station, Pipeline, and Treatment Plant Operations Impacted counties: Fannin, Collin	
Total economic activity	\$ 3,726,000
Total salaries and wages	\$ 773,000
Total full-time-equivalent employment	20
Recreational Visitor Spending	
Total annual spending	\$ 15,000,000 to \$ 20,000,000
Total economic activity	\$ 18,871,000 to \$ 25,160,000
Total salaries and wages	\$ 5,577,000 to \$ 7,437,000
Total full-time-equivalent employment	295 to 393
Resident Spending Permanent and Weekend/Vacation Residents: Fannin, Lamar, Hunt, Delta	
Total economic activity	\$ 76,775,000 to \$ 84,857,000
Total salaries and wages	\$ 15,998,000 to \$ 17,682,000
Total full-time-equivalent employment	701 to 775
New Industrial and Commercial Activities Based on Projected Water Usage	
Total economic activity	\$ 138,710,000
Total salaries and wages	\$ 45,961,000
Total full-time-equivalent employment	1,607

Source: Authors' estimates

ES3

Recurring Annual Fiscal Impacts of New Housing Developments and Resident and Recreational Out-of-Area Visitor Spending+

Description	Impact	
Total taxable value of housing (permanent and weekend residents)	$	326,200,000
Reduction in property value due to inundation and mitigation	($	11,921,000)
Net gain in taxable property values	$	314,279,000
Estimated new county property tax revenues	$	1,886,000
Estimated new school district property tax revenues	$	4,902,000
Total potential* municipal sales taxes (0.01 rate)	$	290,000
Hotel occupancy tax revenues*	$	175,000

+ at buildout * Value will be impacted by land annexation and business location decisions.
Source: Authors' estimates

Section 1: Introduction

Addressing future water needs for the North Texas Municipal Water District's service area has led to the consideration of developing several new water supplies. One proposal is for a reservoir to be located along the Lower Bois d'Arc Creek just northeast of the City of Bonham in Fannin County. The following reports our findings of an analysis of the economic, fiscal, and development impacts of this proposed reservoir.

Our estimates of the economic impacts of the reservoir and related economic activity are based on the IMPLAN input-output economic modeling system developed by the Minnesota IMPLAN Group. The modeled impacts include the direct effects of spending for construction activities and consumption spending, the indirect effects of local vendors providing goods and services to the primary firms, and the induced impacts of employees of these firms spending a portion of their earnings in the local economy. All costs and impacts are expressed in constant 2004 dollars.

We begin with an economic overview of Fannin County and then proceed to measure the new employment, income, spending, and tax revenues that will attend the construction and operations of the dam and related transportation, storage, and treatment facilities. We then explore the "ancillary" development likely to occur in conjunction with the dam, in particular the construction of new homes and recreationally based businesses. New and recurring income, employment, and economic activity associated with this ancillary development are estimated. Finally, we examine the impact of the proposed project on revenues to local taxing jurisdictions.

Section 2: Economic overview of Fannin County.

Like many rural counties in Texas, Fannin County saw its historical peak of population and economic activity around the turn of the 20th century. The 1900 census showed a population of 51,793. Cotton and corn production were the chief crops in an economy dominated by agricultural production. Later in the 20th century, dairy operations rose in prominence, but the county suffered tremendous economic losses during the depression years and after World War II. Children of farmers sought their fortunes elsewhere. By 1970, the population had dropped to 22,705. However, after 1970 the population stabilized and began to slowly increase. Today Fannin County is home to about 32,000 residents and during the decade of the 1990s actually grew faster than the state as a whole (26 percent increase versus 22.8 percent increase) as spillover growth from Dallas' northern suburbs reached the county. Total goods and services produced in the county currently exceed $1.1 billion each year. The three largest non-government industries, by value of output, include plastics products manufacturing, production of non-ferrous wire, and automobile dealerships.[1]

As can be seen in Figure 1, year-over-year employment change in Fannin County has not seen consistent growth as shown for the state. With the exception of 1986 and 1994-1997, the county has lagged state economic performance, sometimes dramatically. These data suggest that one critical economic development strategy for Fannin County should be to diversify their economic base, particularly toward industries with greater stability over time.

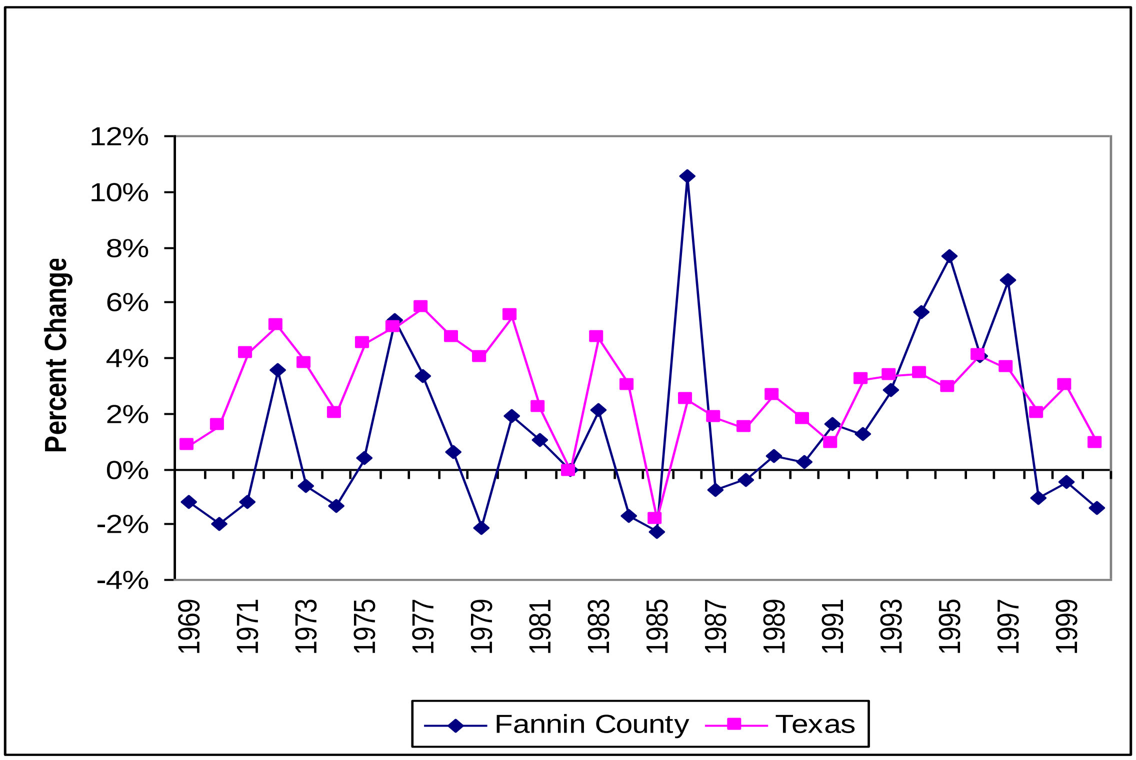
The proposed reservoir offers several economic development opportunities for Fannin County. In addition to the substantial economic activity that would be generated

[1] Data are based on 1999 IMPLAN modeling output.

by construction projects related to the reservoir over a multi-year period, the new lake would attract recreational users whose spending, in turn, would spur investment in new hospitality venues. By supporting new residents and hosting new recreation-based industries, the proposed reservoir offers an excellent diversification opportunity for Fannin County.

Figure 1

Year-to-Year Percentage Change
Total Employment State of Texas and Fannin County
1969-2001



Source: US Department of Commerce.

Section 3: Economic impacts of dam and related infrastructure construction.

In this section we examine the economic impacts of the construction of the proposed Lower Bois d'Arc Reservoir dam and related infrastructure. These estimates are based on the latest cost projections for the facilities expressed in current year (2004) dollars.

Economic impact assessments for the dam and reservoir construction projects are examined in two models. The first looks at the impacts that will likely remain in Fannin County. However, based on the size of the development projects, businesses and residents of nearby counties will also benefit from the economic activity associated with the construction of the dam. For purposes of this analysis, we have included an estimate of the total impacts that will likely occur in a wider economic area defined by Fannin, Delta, Lamar, and Hunt counties.

Constructing the dam for the Lower Bois d'Arc Reservoir and intake pump station is expected to cost between $181 million and $200 million and take four to five years to complete. Based on the relative presence, or absence, of industries providing materials and supporting services to dam construction projects, some of the economic activity will "leak" out of the local area. Even so, the construction of the dam and intake pump station will generate between $226 and $250 million in economic activity in Fannin County over the construction period. This activity will support somewhere between 1,940 and 2,140 person years[2] of employment paying $56 million to $62 million in earnings. (See Table 1.)

Looking at the expanded economic region defined by Fannin, Lamar, Delta, and Hunt counties, the impacts are slightly larger reflecting these additional counties' abilities to attract a portion of the jobs and business activity related to the dam and intake pump station construction. The expanded region should see an overall increase in economic

[2] One person employed in one full-time-equivalent job for one year. In this case, we expect an average of about 400 jobs per year for the 5-year construction period.

activity totaling between $231 million and $256 million accompanied by an increase in area earnings of $60 million to 66.7 million and a gain of between 2,069 and 2,287 person years of employment.

Property owners for the land that will be consumed by the lake and the additional acreage that may be set aside for flood easements and environmental mitigation purposes will be compensated. These payments to land owners represent a transfer of income to the local economy.

In examining the impacts of the construction and development of pipeline, storage, and treatment facilities accompanying the impoundment of the new reservoir, we use an economic region defined by Fannin and Collin counties. (At the time of this analysis, a final determination of the precise location or route of the facilities has not been made). Capital expenditures to build water transfer and treatment facilities are expected to range from $233 million to $257 million and take three to four years to complete. These expenditures will boost the Fannin-Collin counties area economic activity by $320 million to $353.7 million, boost local earnings during the construction period by $94 million to $104 million, and create 2,000 to 2,200 person-years of employment (see Table 1).

Table 1

Temporary Local Economic Impacts of Dam, Pipeline, and Related Infrastructure Construction

Description	Impact
Dam Construction Impacted counties: Fannin. Construction period: 4-5 years.	
Construction costs	$ 181,070,000 to $ 200,130,000
Total economic activity	$ 225,859,000 to $ 249,634,000
Total salaries and wages	$ 56,286,000 to $ 62,211,000
Total person-years of employment	1,937 to 2,141
Dam Construction Impacted counties: Fannin, Hunt, Lamar, Delta. **Construction period: 4-5 years.**	
Total economic activity	$ 231,393,000 to $ 255,750,000
Total salaries and wages	$ 60,339,000 to $ 66,690,000
Total person-years of employment	2,069 to 2,287
Pipeline, Storage, and Treatment Facilities Construction Impacted counties: Fannin, Collin. Construction period: 3-4 years.	
Construction costs	$ 233,035,000 to $ 257,670,000
Total economic activity	$ 319,982,000 to $ 353,664,000
Total salaries and wages	$ 94,334,000 to $ 104,264,000
Total person-years of employment	2,009 to 2,220

Sources: North Texas Municipal Water District, authors' estimates.

Section 4: On-going economic impacts of dam and pipeline operations

Once the dam and pipeline are built, on-going operations and maintenance of these infrastructures will continue to provide a modest number of jobs and a minor boost to local economic activity. Recurring maintenance and operating expenditures for the dam and related infrastructures are expected to increase local economic activity by $3.7 million each year in Fannin and Collin counties combined. This activity will support 20 full-time-equivalent (FTE) direct and indirect jobs paying about $770,000 in annual wages and salaries (see Table 2).

Table 2

Recurring Annual Local Economic Impacts of Dam, Pipeline and Related Infrastructure Operations (Fannin and Collin Counties)

Description	Impact
Total economic activity	$ 3,726,000
Total salaries and wages	$ 773,000
Total full-time-equivalent employment	20
Indirect state and local business taxes	$ 141,000

Source: Authors' estimates

Section 5: Developmental impacts of the proposed reservoir

In addition to the one-time and recurring impacts described above, the impoundment of a 22,702 acre reservoir in Fannin County would have substantial spillover benefits on the local economy. In this section we consider the impacts that will follow new recreational spending based at the reservoir and the economic and fiscal consequences for the region from attracting new permanent and weekend residents.

5.1 Impacts of recreational users

The "field of dreams" scenario often works for lakes. If you build a publicly accessible water recreation resource, visitors use it. The north Texas region currently has many excellent reservoirs supporting water-based recreational activities. However, some of these reservoirs are so overcrowded that water accidents occur with increasing frequency. As the DFW population continues to grow over the next 30 years, demand for water recreation sites will increase, and Fannin county is ideally situated to capture more than a fair share of this recreational activity.

Unfortunately, few studies offer specific guidance on estimating the magnitude of the economic impacts that will attend increased recreational visitors to Fannin County when the proposed reservoir is fully developed. However, in the mid-1990s, Texas A&M, working for the Texas Parks and Wildlife Department and the Sabine River Authority, surveyed anglers at Lake Fork to assess their levels of local spending. Over two-thirds of the survey respondents were non-local residents, with about one-third hailing from outside of Texas. Non-local angler-visitors to Lake Fork spent an estimated $14.5 million in Wood, Rains, and Hopkins counties during their fishing trips for food, lodging, and supplies. This level of spending encourages business development and supports jobs. While some of this employment will be seasonal, north Texas weather patterns permit water-based recreation on a year-round basis.

Other lake-based recreation activities will draw additional out-of-area visitors to the region. We are not suggesting that the proposed reservoir will rise to Lake Fork's national reputation as a fishing lake, but when combined with non-angler spending, we estimate that non-local recreation visitors will add $15 million to $20 million in new spending for dining, food, retail goods, and lodging to the Fannin County economy. This spending will generate between $15.2 million and $20.2 million in economic activity, support 300 to 400 new jobs, and increase local earnings by $5.6 to $7.4 million (see Table 3). Undoubtedly, bringing new recreational visitors to the area will present opportunities for businesses located in adjacent counties, especially Lamar County. However, given existing amenities and attractions in the City of Bonham, we expect that most of the recreational spending will stay in Fannin County.

Table 3

Recurring Annual Local Economic Impacts of Recreational Out-of-Area Visitor Spending

Description	Impact
Total annual spending: recreational visitors	$ 15,000,000 to $ 20,000,000
Total economic activity	$ 18,871,000 to $ 25,160,000
Total salaries and wages	$ 5,577,000 to $ 7,437,000
Total full-time-equivalent employment	295 to 393

Source: Authors' estimates

5.2 Impacts of new permanent and weekend residents

One trend clearly evident in north and northeast Texas is that counties with substantial reservoirs have enjoyed greater population growth than counties without these important amenities. Many recreational lake visitors eventually decide to move close to their favorite reservoirs. Carefully managed residential development can prove to be a tremendous economic boon for lake county economies.

Fannin County is well-positioned to take full advantage of opportunities to attract new permanent and weekend residents to the reservoir. The proposed dam, which will be on the north side of the reservoir, will be only 50 miles from McKinney and 80 miles from downtown Dallas. Already, as indicated earlier, spillover growth from the Dallas-Fort Worth Metroplex is reaching the Bonham area. Within reasonable reach of big-city amenities, yet removed from most urban disamenities, we expect the proposed reservoir to attract at least 1,100 full-time resident households over and above anticipated growth for the area over the next 30 years. Though this may not seem like a huge number of new households, at least by urban development standards, these new households will bring $57 million in new income to the area.

In addition, at least 2,100 new dwellings will be constructed in the area surrounding the reservoir as weekend/vacation homes and investment properties. Our estimate of these weekender residences is likely understated. However, we caution that while relative proximity to the Metroplex will encourage permanent residents, that proximity will lower demand for weekend/vacation housing. Nonetheless, we estimate that weekend and vacation resident will bring an equivalent of $9 million in household income that will be used for local purchases.

Modeling the combined incomes of permanent residents and the proportional income of weekend residents using regionally based estimates of spending, we find the Fannin County economy will realize a net increase of between $72 million and $79.5 million each year once full development is reached. This activity will support 517 to 572 permanent jobs paying $11.9 million to $13.1 million in salaries and wages (see Table 4).

It is likely that businesses located in Hunt, Lamar, and Delta counties, as well as Fannin county, will offer goods and services to the new permanent and weekend residents. Including the economic activity that is likely to go to these other counties, spending by households drawn to the new reservoir will increase economic output in the broader region by $76.8 million to $84.9 million, boost local income by $16 million to $17.7 million, and support between 701 to 775 permanent jobs.

We strongly emphasize that the pace and quality of development will depend on many market-related factors. **One of the most critical factors will be the extent to which counties, cities, and towns adopt well-reasoned development plans to promote quality growth while also ensuring that infrastructure development and publicly-provided services keep pace with new demand.** Examples of infrastructures would include such things as electric services, roads, water services, and public safety and other municipal services.

Table 4

Recurring Annual Local Economic Impacts of New Resident Spending

Description	Impact
Fannin County Impacts	
Total annual spending	$ 63,175,000 to $ 69,300,000
Total economic activity	$ 71,939,000 to $ 79,512,000
Total salaries and wages	$ 11,881,000 to $ 13,132,000
Total full-time-equivalent employment	517 to 572
Fannin, Hunt, Delta, and Lamar County Impacts	
Total economic activity	$ 76,775,000 to $ 84,857,000
Total salaries and wages	$ 15,998,000 to $ 17,682,000
Total full-time-equivalent employment	701 to 775

Source: Authors' estimates

5.3 Impacts of new housing construction

In our projections we have assumed that the new permanent and weekend resident households will be single-family units. This is consistent with most of the development trends experienced in other lake counties. Even if residential real estate demand shifts to the inclusion of multi-family properties, the costs of development, and hence the economic and fiscal impacts, will be within the range of possibilities projected below. We estimate the average cost of land and improvements for permanent-resident dwellings will be about $127,000. Based on the findings of nationwide housing studies, vacation and weekend homes will likely be valued somewhat less than those of permanent residents. We assume an average market value of $115,000 per weekend dwelling. About 25 percent of the housing values will represent land; therefore, based on our earlier estimates of the number of households that will eventually occupy the areas around the proposed reservoir, we expect almost $288 million in new residential construction activity to occur primarily in Fannin county over a 30 year period. These construction activities will boost the local economy by about $13.5 million per year, on average,[3] support an average of 133 long-term FTE jobs, and boost local income by $3.2 million (see Table 5).

Table 5

Local Economic Impacts of Housing Construction
(30-year development)

Description	Impact Total	Impact Average Annual
Construction spending	$ 287,805,000	$ 9,594,000
Total economic activity	$ 403,487,000	$ 13,450,000
Total salaries and wages	$ 95,264,000	$ 3,175,000
Total full-time-equivalent employment	3,997	133

Source: Authors' estimates

5.4 Business development and recruitment

One of the key attractions for new residents, including business people making location choices for plant sites, distribution centers, and other industrial land uses, is the presence of recreational amenities and quality-of-life features. These characteristics have become critical in the site selection process. Given Fannin County's existing locational advantages, the presence of the new reservoir providing a reliable source of water for industrial uses will enhance the county's ability to attract and retain businesses. To estimate the magnitude of the economic activity that could be gained through expanded business activities, we utilized projected water demand estimates from the Texas Water Development Board (TWDB)[4] and the previously described IMPLAN model.

[3] Housing construction will not be evenly distributed across the period of development.
[4] Though the TWBD estimates do not specifically include the proposed reservoir, they provide a reasonable basis for conservatively estimating future economic activity.

Based on its latest published estimates, the TWDB expects manufacturing industry water use to rise in Fannin County by 8 acre feet per year between 2020 and 2030. Water used for steam electricity generation is expected to increase by 436 acre feet per year. Livestock and irrigation uses are not expected to increase over this period, which is reasonable given the impact of the lake's impoundment on these land uses. Mining industry activities are also not expected to increase.[5] Municipal uses are expected to rise by 1,326 acre feet per year. While much of this increase in municipal usage will be accounted for by the increase in households described earlier, some of the increase will be due to increased commercial and other non-manufacturing business activities not previously described in this analysis.

Using 2000 usage data for Fannin County and adjusted commodity production estimates from IMPLAN,[6] we estimated the current economic value of production per acre foot of water used by use-category. Multiplying these values by projected increase in water usage suggests that manufacturing, commercial,[7] and electricity generating activities will increase by \$112.6 million annually in Fannin County. While there are many factors that drive economic development, without the water resources made available by the proposed reservoir, it is unlikely that Fannin County will see this increase in economic activity.

Increasing Fannin County's direct economic activity would also create spin-off indirect and induced economic impacts as described earlier in this report. However, two adjustments are required to improve the accuracy of estimating these indirect and induced

[5] Projected water usage for livestock and irrigation purposes are substantially lower than current usage estimates.
[6] Adjusted for the loss of the local meat packing operation.
[7] We assumed that no more than 20 percent of municipal water usage is for commercial business activities.

impacts. First, we will not include the induced (household spending) impacts to avoid double counting the impacts of permanent resident spending described above that would be employed through this new business activity. Secondly, current economic models of Fannin County do not adequately represent how the economy will operate 25 years from now. We therefore used impact multipliers for Rockwall County, which currently has a population about equal to TWBD's projected population for Fannin County in 2020. [Local officials in Fannin County suggest that the TWBD population projections are substantially underestimated. We concur with these officials; however, using the TWBD data enhances the conservative nature of our estimates.] Increasing Fannin County's industrial and commercial output by $112.6 million will result in $138.7 million in economic activity, boost area labor income by $46 million, and support over 1,600 jobs (see Table 6).

Table 6

Economic Impacts of New Industrial and Commercial Activities
(10-year increase after reservoir development)

Description	Annual Impact
New Direct Activity	$ 112,610,000
Total economic activity	$ 138,710,000
Total salaries and wages	$ 45,961,000
Total full-time-equivalent employment	1,607

Source: Authors' estimates

Section 6: Local fiscal impacts

In this section, we estimate some of the new tax revenues that will be enjoyed by counties and school districts. We will also consider the impacts on local property taxes from the loss of taxable land in the lake impoundment and mitigation areas.

Taxable value of permanent and weekend resident housing at full development is estimated at $326.2 million[8]. Of course, some diminution of taxable values will occur as a result of land inundation and environmental mitigation. Most of the land to be inundated is agricultural. Fannin County assess taxable values for agricultural land according to the nature of the land, the use of the land, and irrigation status. These valuations range from $65 per acre for native grasslands that are not irrigated to $323 per acre for irrigated land or land in horticultural uses. We have assumed that of the 52,700 acres that will be either inundated or in the mitigation area, 50 percent is irrigated crop land valued at $323 per acre for tax purposes, 30 percent is valued at $157 per acre, and that 20 percent is improved land at $88 per acre. Therefore, the inundation of land and mitigation areas for the reservoir will remove $11.9 million in taxable value from the local tax rolls. Therefore, the net increase in taxable value will be $314.3 million, an increase of 22 percent over Fannin County 2003 total taxable property values. This increase in valuation will generate about $1.9 million per year to the county and almost $5 million per year to area school districts under current law. Importantly, much of this gain in school district revenues will not be accompanied by a proportionate increase in students since a large percentage of the estimated valuations are for weekend or vacation residences. Area municipalities and townships could also benefit from increased property tax revenues depending on the degree to which their taxing jurisdictions are expanded to include land adjacent to the proposed reservoir (see Table 7).

Taxable retail sales in Fannin County will increase as new residents and visitors come to the area. Taking a very conservative approach, we estimate that local sales tax

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[8] The average value of homestead, senior citizen, disabled, veteran and other exemptions is estimated at 15 percent of total valuation.

revenues could increase by $290,000 or more per year. Hotel revenues for room rentals are expected to be at least $3.5 million per annum. Based on a local bed-tax rate of 5 percent, these expenditures will boost local tax receipts by an additional $175,000 annually. Our estimates do not consider the additional taxable property value that will be created as stores, bait shops, hotels/resorts, restaurants, and other businesses locate around the lake.

Table 7

Recurring Annual Fiscal Impacts of New Housing Developments and Resident and Recreational Out-of-Area Visitor Spending

Description	Impact
Total taxable value of housing (permanent and weekend residents)	$ 326,200,000
Reduction in property value due to inundation and mitigation	($ 11,921,000)
Net gain in taxable property values	$ 314,279,000
Estimated new county property tax revenues	$ 1,886,000
Estimated new school district property tax revenues	$ 4,902,000
Total potential* municipal sales taxes (0.01 rate)	$ 290,000
Hotel occupancy tax revenues*	$ 175,000

* Value will be impacted by land annexation and business location decisions. Source: Authors' estimates

Section 7: Conclusions

The proposed Lower Bois d'Arc Reservoir will provide tremendous short-term economic gains to Fannin County that will certainly spill over to residents and businesses in surrounding counties as the dam and related infrastructures are constructed over a multi-year period. Construction of the dam will add over $225 million to local economic activity and provide more than 1,900 person-years of employment. The dam will also create new opportunities for local businesses by adding $3 million in annual local economic activity and supporting about 20 permanent jobs.

Once impounded, the lake will attract substantial new private investment by hospitality firms anxious to provide services, meals, and specialty retail goods to the lake's recreational users. Out-of-area recreational users are projected to spend $15 million to $20 million per year in the local economy. In addition, as seen with other Texas lakes, residents will be attracted to the region to take advantage of the new recreational amenities, bringing substantial new local spending to the area at full development. These new personal outlays will increase local economic activity by over $75 million per year and support more than 500 permanent jobs. The reservoir will provide water resources that will support additional business development in Fannin County. Using conservative TWBD usage estimates, $138.7 million in new economic activity would be supported in the county adding an additional 1,600 jobs to area payrolls. Any comparable industrial investment offering this magnitude of economic benefit would probably require exceptional incentive packages from state, county, and municipal governments. Construction of housing units for permanent and weekend residents will likely be spread over a 30-year period providing long-term job and business opportunities in the construction trades.

An expanded tax base will be another payoff from the ancillary development that will attend construction of the reservoir, allowing local governments to provide a broader range of public services while maintaining competitive tax rates. In sum, the economic opportunities supported by the proposed reservoir will promote sustainable development while diversifying the local job base.

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