US Army Corps
of Engineers®
Fort Worth District

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Draft Environmental Impact Statement

Lake Ralph Hall Regional Water Supply Reservoir Project

Volume I

DRAFT ENVIRONMENTAL IMPACT STATEMENT
LAKE RALPH HALL

Lead Agency: Department of the Army
U.S. Army Corps of Engineers
Fort Worth District

Project Location: Fannin County, Texas

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ABSTRACT

The U.S. Army Corps of Engineers (USACE), Fort Worth District, as lead federal agency, has prepared this Draft Environmental Impact Statement (DEIS) to analyze potential impacts from the proposed Lake Ralph Hall project located in Fannin County, Texas. The DEIS is being prepared in compliance with the National Environmental Policy Act of 1969 (NEPA), the Council on Environmental Quality (CEQ) Regulations for Implementing the Procedural Provisions of NEPA (40 Code of Federal Regulations [CFR] 1500-1508), and the USACE Procedures for Implementing NEPA (33 CFR 325 Appendix B and 230).

The project proponent, Upper Trinity Regional Water District (UTRWD), submitted an application to the USACE for a Department of the Army permit under Section 404 of the Clean Water Act (CWA), to discharge dredged and fill material into waters of the United States for the purpose of constructing the proposed Lake Ralph Hall project, including the construction of the dam, reservoir, and a pipeline. Based on a review of the applicant's proposal, the USACE determined that the proposed Lake Ralph Hall project constitutes a major Federal action that has the potential to significantly affect the quality of the human environment and that preparation of an EIS is required.

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ES1.1 Executive Summary

ES1.1 Introduction and Background

The United States Army Corps of Engineers (USACE) has prepared this Draft Environmental Impact Statement (DEIS) to analyze the direct, indirect and cumulative effects for the proposed Lake Ralph Hall project located in Fannin County, Texas (**Figure ES-1**).

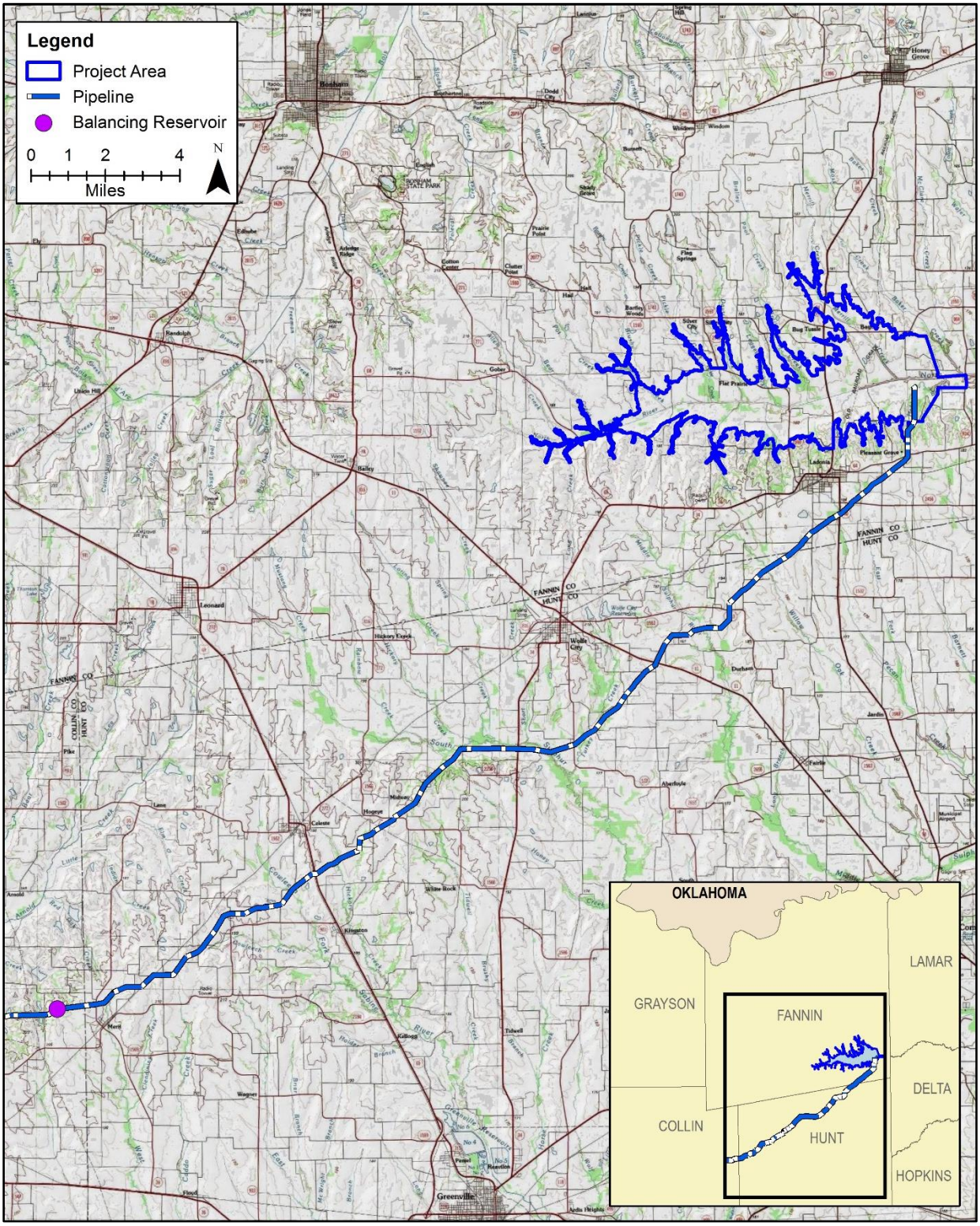
In October 2006, the project proponent, Upper Trinity Regional Water District (UTRWD), submitted an application to the USACE for a Department of the Army permit under Section 404 of the Clean Water Act (CWA), to discharge dredged and fill material into waters of the United States (US) for the purpose of constructing the proposed Lake Ralph Hall project, including the construction of the dam, reservoir, and a pipeline. Based on a review of the applicant's proposal, the USACE determined that the proposed Lake Ralph Hall project constitutes a major Federal action that has the potential to significantly affect the quality of the human environment and that preparation of an EIS is required. A Notice of Intent (NOI) for the Lake Ralph Hall EIS was published in the *Federal Register* on October 17, 2008 (Vol. 73, No. 2028, p. 61827-61828).The USACE is the federal agency that prepared this DEIS in compliance with the National Environmental Policy Act (NEPA) of 1969, as amended, the Council on Environmental Quality (CEQ) Regulations for Implementing the Procedural Provisions of the NEPA (40 Code of Federal Regulations [CFR] 1500-1508) and the USACE Procedures for Implementing NEPA (33 CFR 230). This DEIS also addresses the requirements of the US Environmental Protection Agency's (EPA) Section 404(b)(1) guidelines (40 CFR 230) and the USACE's NEPA Implementation Procedures for the Regulatory Program (33 CFR 325 Appendix B) and Public Interest Review at 33 CFR 320.4. The USACE, Fort Worth District, Regulatory Division is the lead agency responsible for preparation of the DEIS. As specified at 33 CFR 320.1(a)(4), the USACE is neither a proponent nor opponent of any permit proposal. The instant action is not being funded by the USACE. The USACE has prepared this DEIS through the assistance of a third party contractor as described at 40 CFR 1506.6(c) and clarified in 1983 guidance from the CEQ in 48 Fed. Reg. 34263 and will use the Final EIS in rendering a final permit decision.

The USACE also requested that agencies with statutory authority over, or special expertise relative to, the proposed project participate in the NEPA process as cooperating agencies (40 CFR 1501.6 and 1508.5). The EPA, US Fish and Wildlife Service (USFWS), US Forest Service (USFS), Texas Commission on Environmental Quality (TCEQ), Texas Parks and Wildlife Department (TPWD) and the Texas Historical Commission (THC) have engaged as cooperating agencies for this DEIS.

ES2.1 Purpose and Need

The purpose of the proposed Lake Ralph Hall is to provide additional raw water supplies to meet the growing demands from its wholesale customers and the proposed lake is one strategy to provide that additional water while providing additional security in the event supply from any of its other sources is interrupted. UTRWD identified economic benefits from recreational use, residential and commercial development and protected natural areas as well as environmental benefits due to reductions in soil losses due to erosion.

Figure ES- 1: Project Location



Based on the information provided by UTRWD and the additional needs analysis and its supporting information, USACE defines the overall project purpose as:

> **To provide approximately 34,050 AF of additional, reliable, firm annual yield through a regional project to meet a portion of existing and projected future municipal and industrial water demands by 2024 within UTRWD's defined regional planning area.**

This statement incorporates a number of terms requiring definition. The term "reliable" refers to water supplies having a high degree of certainty as to their amount and long term availability. "Firm annual yield" refers to the hydrologic availability of this water supply including times of drought, as defined by UTRWD and is reflected in hydrologic modeling of the various river basins and UTRWD's water system. "Regional" recognizes the status of UTRWD as a current regional provider which must serve its Members and Customers in accordance with existing agreements and contracts which have been reviewed and accepted by USACE to support the project need. This Overall Project purpose statement will be used to identify, evaluate, and screen alternatives in this EIS.

In summary, the Lake Ralph Hall project is intended to provide UTRWD with additional firm yield to address only a portion of the increasing demands for water from those Members and Customers previously identified. Details about the Purpose and Need are discussed in **Chapter 1**.

ES3.1 Alternatives Analyzed in Detail

ES1.3.1 No Action Alternative

The No Action Alternative is a required consideration of NEPA. It also has consideration in the 404(b)(1) guidelines as defined at 40 CFR 230.10(a)(1)(i). A variety of options exist within the No Action alternative and can include permit denial, construction of an alternative that does not involve a regulated discharge under Section 404 of the Clean Water Act, and alternatives that are unavailable to the applicant (even if they require Federal action (permits)). Each of these scenarios result in no permit being issued by USACE.

The No Action Alternative is the most likely alternative to be implemented in the absence of the Proposed Action due to denial of the permit. Unmet water supply needs of UTRWD and its members and customers are projected to begin in 2024. UTRWD and its members and customers would respond to these unmet demands by seeking other water supply and management strategies incrementally, particularly, seeking temporary/emergency water supply contracts, developing local groundwater supplies (by individual UTRWD members and customers only), and implementing mandatory water use restrictions. To achieve mandatory water use restrictions, UTRWD would limit the quantity of water it delivers to its members and customers based on its available supplies. Its members and customers would then be forced to limit the amount of water they deliver to their retail customers by (1) placing demand limits on their customers, (2) imposing a moratorium or otherwise limiting new customer connections to their system, or (3) a combination of both.

ES1.3.2 Lake Ralph Hall – Applicant Preferred Alternative

The proposed Lake Ralph Hall project would include the construction of an earth-filled dam embankment across the valley of the North Sulphur River with a concrete uncontrolled principal spillway located adjacent to the existing channel of the river and an excavated unlined earthen channel emergency spillway located within the embankment on the northern floodplain of the river. The embankment placed would vary between 566 feet and 568 feet North American Vertical Datum of 1988 (NAVD88) to account for anticipated settlement of the embankment thus providing an effective elevation of 566 feet NAVD88 after settlement and would adjoin the existing ground surface on both ends of the structure. Current studies indicate the proposed Lake Ralph Hall reservoir would have a conservation pool storage capacity of approximately 160,235 AF (at an elevation of 551.0 feet above msl), and at that capacity, the surface area of the reservoir would be approximately 7,605 acres. However, it is anticipated that the storage volume is somewhat larger due to continued erosion that has occurred during the permitting and planning period. The maximum depth of the reservoir at the dam would be approximately 90 feet. The firm annual yield of the proposed project would be approximately 34,050 AF/year.

UTRWD intends to divert raw water from the proposed project reservoir and operate it as part of UTRWD's overall water supply system. Raw water would be conveyed from the proposed Lake Ralph Hall project directly to the Tom Harpool WTP adjacent to Lewisville Lake and the Tom Taylor WTP through discharge to Lewisville Lake via a proposed raw water transfer pipeline. Through this inter-basin transfer, UTRWD would provide water to towns and cities in Collin, Cooke, Dallas, Denton, Grayson, and Wise Counties within the Trinity River Basin. The proposed Lake Ralph Hall project would divert raw water for municipal, industrial, and agricultural purposes, with ancillary benefits of in-place recreational uses and impeding continued erosion and environmental degradation of the North Sulphur River channel. The proposed Lake Ralph Hall project would also require the relocation and/or abandonment of state and county roads and the reconstruction of the State Highway (SH) 34 Bridge that crosses the North Sulphur River within the proposed project footprint.

ES1.3.3 Alternatives Dismissed from Detailed Consideration

Other alternatives were evaluated but not carried forward for detailed consideration. Alternatives include water supplied from new (undeveloped) reservoirs, including Upper Bois d'Arc Creek Reservoir, Marvin Nichols Reservoir, George Parkhouse Lake South, George Parkhouse Lake North, and Lake Fastrill; securing supplies from Lake Texoma, Toledo Bend Reservoir, Wright Patman Lake, Lake Livingston/Joe Pool Lake/Trinity River Basin, Oklahoma, additional Dallas Water Utilities Supply, the Gulf of Mexico, Cypress Creek Basin, groundwater imports and precipitation enhancement. These potential alternatives were not carried forward for detailed consideration in the DEIS because of the inability to meet purpose and need, unacceptable environmental impacts, reliability, cost, and/or institutional constraints including the need to secure agreements with other wholesale water providers. The alternatives analysis, including a description of each of the alternatives dismissed and the justification for their dismissal, is discussed in detail in **Chapter 2**.

ES4.1 Summary of Impacts and Proposed Mitigation

Environmental consequences of the preferred alternative were analyzed for each resource area. The primary major impacts of the proposed project are conversion of land to reservoir, impacts to streams and wetlands, and changes in visual aesthetics. Primary minor impacts include impacts to the Caddo National Grasslands, noise, air quality, transportation, recreation, habitat, cultural resources, paleontological resources, and socioeconomics. **Table ES-2**, included at the end of this **Executive Summary**, summarizes the potential impacts for each resource that would be affected by the implementation of the Proposed Action and No Action Alternative, as well as Applicant-proposed mitigation and monitoring. A detailed discussion of the impacts can be found in **Chapter 4,** and details about proposed mitigation can be found in **Chapter 5**.

ES5.1 Coordination and Consultation

ES1.5.1 Public Participation and Scoping

Public participation for the DEIS began with the scoping process and involved actively soliciting input from the public and interested federal, state, and local agencies about the Proposed Action. On March 14, 2008, the USACE published and distributed a Public Notice to inform interested parties about the proposed Lake Ralph Hall, to solicit comments relevant to the Section 404 permit application, and to inform the public of an upcoming scoping meeting.

The USACE held an informal public scoping meeting on April 15, 2008, at the Fannindel High School in Ladonia, Fannin County, Texas. The purpose of this meeting was to disseminate information about the proposed lake project and its potential effects on the human environment and seek public comment on the applicant's proposal and assist the agency in determining whether the proposed project would significantly affect the quality of the human environment. A total of 255 comments were received from 41 individual commenters. The most common topics of comments concerned effects on properties and displacements of residents, mitigation design, water quality, number of alternatives, visual aesthetics, and sedimentation. A detailed breakdown of the comments received can be found in **Chapter 6**.

The availability of the DEIS will be announced through public notice, including a Notice of Availability (NOA) in the *Federal Register*, letters to interested parties, and notices in the print and broadcast news media. The notice is intended to solicit comments not only on the NEPA document but substantive comments on the Proposed Action. The document will be made available for public and agency review and comment for a 45-day period. In addition, a public hearing will be held with the date and location specified in the NOI and public notices.

ES1.5.2 Consultation and Coordination with Federal, State, and Local Government Agencies

Specific regulations require the USACE to coordinate and consult with federal, state, and local agencies concerning the potential for a proposed action and alternatives to affect sensitive environmental and human resources. The USACE Fort Worth District initiated these coordination and consultation activities through the scoping process. In addition, the District invited interested agencies to serve as cooperating agencies for preparation of the DEIS. The EPA, USFWS, USFS,

THC, TPWD, and TCEQ are serving as cooperating agencies. Coordination meetings held with federal, state, and local agencies are shown in **Table ES-1**. More information about agency coordination can be found in **Chapter 6**.

Table ES- 1: Coordination Meetings held with Federal, State, and Local Government Agencies

Date	Agencies	Topics
November 4, 2008	USACE, EPA, USFWS, TPWD, TCEQ, USFS, UTWRD	DEIS scope, alternatives, environmental consequences, mitigation
February 2009	USACE, USFWS, TPWD, TCEQ, UTRWD	Habitat assessment
April 21, 2009	Fannin County Historical Commission	Historic Resources
September 2009	USACE, EPA, USFWS, TPWD, TCEQ, UTRWD	Site visit/review and validation of water impact metrics and scoring for both aquatic and terrestrial resources
March 8, 2011	USACE, EPA, USFWS, TPWD, TCEQ, UTWRD	Mitigation Plan
May 5, 2015	USFWS, USACE, EPA, TPWD, TCEQ	Mitigation Plan
October 1, 2015	USACE, USFWS, TPWD, UTRWD	Site Visit
January 9, 2017	USACE, EPA, USFWS, TWPD, UTRWD	Mitigation Plan

ES1.5.3 Tribal Government-to-Government Consultation

In compliance with NHPA and USACE Policy Guidance Letter No. 57 (Indian Sovereignty and Government-to-Government Relations with Indian Tribes) the USACE is required to establish regular and meaningful consultation and collaboration with Native American tribal governments on development of regulatory policies that could significantly or uniquely affect their communities. The USACE Fort Worth District initiated consultation with Native American tribes by sending letters dated May 2, 2017, to federally recognized tribes (as identified below). The Caddo Nation of Oklahoma and the Choctaw Nation of Oklahoma requested consulting party status by phone. The USACE invited the Caddo Nation of Oklahoma and the Choctaw Nation of Oklahoma to be Consulting Parties to the Programmatic Agreement (PA).

- Caddo Nation of Oklahoma
- Choctaw Nation of Oklahoma
- Comanche Nation of Oklahoma
- Tonkawa Tribe of Oklahoma

ES6.1 Summary of Impacts

For the purposes of analysis for this project, the intensity of impacts was described using the following terms:

- No effect: No discernable or measurable effect.

- Negligible: Effects would be at the lowest levels of detection, barely measurable, with no perceptible consequences.
- Minor: Effects result in a detectable change, but the change would be slight.
- Moderate: Effects would result in a clearly detectable change, with measurable effects.
- Major: Effects would be readily apparent with substantial consequences.

These terms are utilized specifically in relation to each resource unless otherwise noted. Additionally, all effects are considered adverse unless otherwise stated as beneficial. A summary of direct and indirect impacts is shown in **Table ES-2**.

Table ES- 2: Summary of Direct and Indirect Impacts by Resource or Impact Issue and Recommended Monitoring and Mitigation

Resource/Impact Issue	No Action Alternative	Proposed Action Alternative	Proposed Mitigation
Land Use	Present trends in land use would continue and remain predominantly rural and undeveloped. UTRWD has purchased a little over half of the project area.	Effects would be major due to the inundation of more than 7,000 acres including retirement of approximately 1,600 acres of agricultural lands. Land use of lands surrounding the reservoir could change to residential and commercial development. Effects associated with the pipeline would be minor since existing land use could continue after construction. The proposed balancing reservoir would convert approximately 4.5 acres of grassland to a reservoir. Overall land use impacts would be major.	No mitigation is required for this resource.
Ownership	UTRWD has purchased a little over half of the project area.	UTRWD has purchased a little over half of the project area- the remainder (including one residence) would be purchased prior to construction. Impacts would be moderate.	No mitigation is required for this resource.
Public Lands	Impacts to public lands are anticipated to be negligible. Increased water restrictions could result in changes to parklands due to limited watering capabilities.	Approximately 300 acres of Federal land, currently administered by the U.S. Forest Service, would be acquired by the applicant and converted to open water as a result of the proposed project. The impact to public lands with the project would be major, but would be reduced through compensatory mitigation acreage.	UTRWD is working with the USFS relative to a land exchange to offset these effects.
Physiography	No Effect	No Effect	No mitigation is required for this resource.

Resource/Impact Issue	No Action Alternative	Proposed Action Alternative	Proposed Mitigation
Topography	Topography of the proposed project area would be altered by continued erosion in the North Sulphur River and its tributaries. These impacts are considered to be major.	The topography of the proposed project area would be flooded. Area to be modified topographically will be in excess of 8,000 acres for all associated project features. Sediment yield to the reservoir over a 50-year period is between 2,570 ac-ft and 3,700 ac-ft. Flooding a portion of the river basin and some tributaries as well as the development of the dam would occur. Erosion along the proposed shoreline could alter topography. Impacts to topography are considered to be moderate. Impacts to topography from the pipeline are anticipated to be negligible.	No mitigation is required for this resource.
Geology	Geologic formations within the North Sulphur River channel and tributaries would continue to erode.	Construction of the Proposed Action would slow erosion within the North Sulphur River and its tributaries. Along the pipeline alignment, the original characteristics of the surficial material would be permanently altered by construction activities. Impacts would be moderate and beneficial.	No mitigation is required for this resource.
Geologic Hazards	No Effect	No Effect	No mitigation is required for this resource.
Mineral Resources	No Effect	The proposed pipeline alignment would be precluded from any future surface mineral resource use. Oil and gas could potentially be produced using direction drilling technology. Impacts would be minor.	No mitigation is required for this resource.

Resource/Impact Issue	No Action Alternative	Proposed Action Alternative	Proposed Mitigation
Soils	Soils within the proposed project area could be altered by continued erosion in the North Sulphur River.	Impacts to soils would include excavation, transport, and compaction during construction. Other impacts within the proposed reservoir footprint would include inundation of the soils within the conservation pool and periodic flooding of the soils within the littoral zone. Tributaries and contributing watersheds above the reservoir are anticipated to experience some decrease in erosion rates due to lowering of channel gradients from the halting of North Sulphur River channel degradation behind the dam. During construction of the Lake Ralph Hall Raw Water Pipeline Alignment at least 384 acres of existing soils would be disturbed. Impacts would be major.	Sediment and Erosion Control Plan
Prime Farmland	Continued erosion in the North Sulphur River and its tributaries, prime farmland could be impacted.	Impacts to prime farmland would include inundation of approximately 1,168 acres of prime farmland and 1,131 acres of farmland of statewide importance. Impacts would be major.	Prime Farmland soils found in areas of proposed water supply reservoirs are exempt from restrictions under the Farmland Protection Policy Act (FPPA).
Groundwater	Substantial increases in groundwater usage in the UTRWD service area.	No impacts to groundwater quantity or quality within the project area are expected. Impacts would be negligible.	No mitigation is required for this resource.
Surface Water – Hydrology	The North Sulphur River and some of its major tributaries would continue to deepen and widen as a result of erosion.	Reduced flow of the North Sulphur River would occur immediately downstream of the proposed Lake Ralph Reservoir to Baker Creek. Impacts would be major.	Restoration of abandoned river channel and aquatic resources; Directional Drilling During Construction of Pipeline at Stream Crossings; Restoration of Stream Contours, Stabilization of Stream Banks; Revegetation of Disturbed Areas After Pipeline Construction
Surface Water – Water Quality	Surface water quality would remain similar to the existing conditions.	Downstream site calculations indicate a slight increase in pollutant concentrations due to decreased flow. Impacts would be minor.	Stormwater Pollution Prevention Plan (SWPPP) and Texas Pollution Discharge Elimination System (TPDES) General Permit During Construction

Resource/Impact Issue	No Action Alternative	Proposed Action Alternative	Proposed Mitigation
Surface Water – Floodplains	Floodplains would remain similar to the existing conditions.	Floodplains would remain similar to the existing conditions in that there are no active floodplains within the project area. The proposed impoundment would restore some floodplain function to the headwaters of the North Sulphur River and tributaries above the proposed conservation pool elevation. Impacts would be negligible.	No mitigation is required for this resource.
Surface Water – Wetlands and Other Waters of the U.S.	Development of on channel stock ponds as well as actions taken to halt soil erosion and tributary degradation is expected to continue.	The proposed reservoir project site would result in impacts including fill and inundation of 445,488 lineal feet of ephemeral stream channel, 55,570 lineal feet of intermittent stream channel, and approximately 56.19 acres of on-channel impoundments. Approximately 325.11 acres of stream channel would be excavated, inundated, or filled within the conservation pool, embankment/dam, and spillway area. A total of eight acres of lacustrine fringe wetlands would be impacted within the conservation pool, embankment, and spillway area. The Lake Ralph Hall Raw Water Pipeline Alignment has 59 stream crossings with 11,893 linear feet of stream impacts and 0.4 acres of stock tanks potentially impacted within the 100-ft ROW. Impacts are considered to be major but would be reduced through mitigation.	Implement *Mitigation Plan for Impacts to Aquatic Resources and Terrestrial Habitats*

Resource/Impact Issue	No Action Alternative	Proposed Action Alternative	Proposed Mitigation
Air Quality	No substantial changes in air quality within the immediate Lake Ralph Hall study area are anticipated. There could be a slight decrease in air quality within the region due to minor projected population growth and associated development and land use changes.	During the construction phase of the project, temporary impacts to air quality would increase due to local fugitive dust levels and diesel powered heavy construction equipment. To the extent that visitation to the area is increased and boats are operated for fishing and other recreation, there would be a corresponding increase in emissions. Minor, temporary impacts to air quality are anticipated during construction.	Implement Best Management Practices (BMP) During Construction
Noise	Slight increase in ambient noise levels caused by the projected population growth and associated development and land use changes.	During the construction, no noise impacts are anticipated for Ladonia residents but single residences located at each end of the dam embankment would be subjected to noise levels in the 55-dbA range. There would be a corresponding increase in noise levels to the extent that visitation to the area is increased and boats are operated for fishing and other recreation. Construction of the bridge for SH 34 and improvement of portions of CR 3444 would generate construction noise near four noise receptors located within 1,600 feet of the road/bridge. Increase in noise levels would be expected over the length of the pipeline in the areas where construction is occurring. Impacts associated with the project are considered to be minor.	BMPs would be implemented to reduce potential impacts.

Resource/Impact Issue	No Action Alternative	Proposed Action Alternative	Proposed Mitigation
Recreation	No impacts to recreation in the area.	The Ladonia Fossil Park would no longer be accessible for fossil hunters. Recreational impacts are considered to be minor. No causal recreational benefits have been identified associated with the reservoir, although such development is likely to occur and could represent minor beneficial impacts. Approximately 300 acres of Federal land (Caddo National Grasslands- Ladonia Unit), currently administered by the U.S. would be converted as a result of the proposed project and reduce hunting opportunities. USFS also anticipates an increase in visitation and administrative burden. These impacts are considered moderate.	UTRWD will relocate fossil park. UTRWD is currently coordinating with the USFS. No other mitigation is required for this resource.
Visual Resources	No immediate impacts to visual resources.	During construction of the proposed dam and embankment the viewshed of travelers along FM 1550, FM 904, and SH 34 would be affected as the construction would be visible from the roadway. Impacts to visual resources related to construction of the proposed dam, reservoir, and principal and emergency spillways would be 'moderate' and end once construction activities are completed. After construction, the visual resource contrast rating for the Build Alternative would be 'strong'. The form, line, color, and texture of the environment would all change noticeably under the proposed project.	No mitigation is planned for this resource.

Resource/Impact Issue	No Action Alternative	Proposed Action Alternative	Proposed Mitigation
Biological Resources - Habitat	The North Sulphur River and its major tributaries would continue to erode and degrade habitat surrounding these areas.	Minimal loss of moderate quality vegetative resources is anticipated as a result of the proposed project. The reservoir would help stabilize the North Sulphur River watershed by reducing habitat loss and conversion from currently on-going severe erosion. The reservoir would also create and enhance habitat for local and migratory wildlife through the anticipated creation of at least eight acres of fringe wetlands along the proposed reservoir shoreline. Mudflats may also be created in shallow flooded areas, especially in the upstream portion of the reservoir. The potential vegetated impact area includes agricultural production and woody areas. Approximately 300 acres of Federal land (Caddo National Grasslands- Ladonia Unit), currently administered by the U.S. Forest Service, would be acquired by the applicant and converted to open water as a result of the proposed project Overall, although the type of vegetation communities to be impacted are common and degraded, because of the large size of the area to be converted to another and more uncommon type, the effects would be considered major.	Implement *Mitigation Plan for Impacts to Aquatic Resources and Terrestrial Habitats;* Re-Vegetate Disturbed Areas After Pipeline Construction
Biological Resources - Wildlife	Current conditions of the North Sulphur River would continue to exist.	Moderate impacts are anticipated with inundation of degraded and moderate habitat.	All Requirements Regarding Migratory Birds Would be Met Prior to Construction

Resource/Impact Issue	No Action Alternative	Proposed Action Alternative	Proposed Mitigation
Biological Resources – Aquatic Biota	Current conditions of the North Sulphur River would continue to exist.	The existing aquatic biota community would change from intermediate stream species to a community more adapted for a lacustrine habitat. Impacts would be moderate. Impacts to aquatic organisms in pools with decreasing levels would occur between the proposed Lake Ralph Hall dam and the Cooper Gage. Models indicate almost no change to reaches below the Cooper Gage. Impacts would be moderate. Overall impacts from pipeline construction to aquatic biota would be none to minimal.	Implement *Mitigation Plan for Impacts to Aquatic Resources and Terrestrial Habitats*
Biological Resources – Invasive Species	Current conditions of the North Sulphur River would continue to exist.	Invasive terrestrial plant species may invade disturbed areas during construction. Aquatic invasive species (e.g., zebra mussel) may spread to Lake Ralph Hall if recreational boating is allowed. Impacts would be moderate.	No mitigation is required for this resource.
Threatened and Endangered Species	No impacts to threatened or endangered species.	The state listed timber rattlesnake and four state listed mollusks have the potential to be impacted during construction of Lake Ralph Hall and the Raw Water Pipeline Alignment. Impacts would be minor.	Contractors would be advised of potential occurrence of timber rattlesnake and to avoid harming species. Directional drilling during construction of the pipeline at stream crossings.
Traffic and Transportation	Land use changes within the region are expected to occur as a result of long-term population growth and associated development pressure. This growth may result in an increase in traffic on the local and regional transportation network.	The Proposed Action includes adjustments to alignment and grade, partial or complete abandonment, and relocation of roads. During construction of the dam and reservoir, congestion would increase in the immediate area. Impacts would be minor.	All construction vehicles would be equipped with backup alarms, two-way radios, and 'slow moving vehicle' signs when appropriate. Routing and scheduling construction vehicles to avoid conflicts with other traffic.

Resource/Impact Issue	No Action Alternative	Proposed Action Alternative	Proposed Mitigation
Hazardous Materials	No change to the existing conditions.	One listing in the conservation pool boundary. It is recommended that the property be inspected and potential water quality contaminants removed prior to inundation. One listing outside conservation pool but inside project area not anticipated to be an issue. Three sites identified near the proposed pipeline footprint. The site limits should be verified prior to construction and avoided. Impacts would be minor.	Inspection and Removal of Contaminants at Identified Sites if Needed
Cultural Resources – Historic	Impacts to historic resources, if any, would be minor.	Due to a lack of access, not all properties within the area of potential effects (APE) were surveyed. None of the resources surveyed were recommended as eligible for the National Register of Historic Places (NRHP) or recommended for intensive-level study. Impacts are currently anticipated to be minor, but further study is required.	Implement Programmatic Agreement
Cultural Resources – Archeological	Continued erosion of the North Sulphur River channel and its major tributaries could expose archeological resources.	Survey covered approximately 15 percent of the Proposed Action. A total of 17 archeological sites were recorded with five sites recommended for further testing or further definition of the deposit. One site, the Merrill Family Cemetery, was recommended to be avoided. Impacts would be major.	Implement Programmatic Agreement
Paleontological Resources	Continued erosion of the North Sulphur River would continue to expose fossils. The Ladonia Fossil Park would remain in the current location and allow for continued fossil hunting.	Paleontological resources in the inundation footprint would no longer be accessible. The Ladonia Fossil Park would no longer be accessible for fossil hunters. Impacts would be major.	Relocate Fossil Park

Resource/Impact Issue	No Action Alternative	Proposed Action Alternative	Proposed Mitigation
Socioeconomics	The No Action Alternative could displace and/or slow growth in the area. The impacts of displaced growth could be considered major, affecting planning, urban service costs, and public satisfaction with local government.	Socioeconomic impacts of Lake Ralph Hall would be minor and positive, in the long-term. Impact includes losses in both sales and property tax revenue from the inundation of the land.	Loss of property taxes would be reduced through an arrangement reached between UTRWD and Fannin County.
Environmental Justice and Protection of Children	Current water distribution operations would be expected to have the same effects on populations of concern as the general population, including the potential for water restrictions and higher water costs.	Adverse impacts on environmental justice populations within the study area would be minor.	No mitigation is required for this resource.
Climate Change	The No Action Alternative would not have any direct impact on the climate, and would not contribute to climate change.	Climate Change and greenhouse gas (GHG) impacts are anticipated to be minor to negligible.	No mitigation is required for this resource.

Acronyms and Abbreviations

AAI	All Appropriate Inquiries
AD	Adequate Data
ACS	American Community Survey
AF	Acre-Feet
AF/MO	Acre-Feet Per Month
AF/YR	Acre-Feet Per Year
AHS	American Hospital Directory
ALS	Advanced Life Support
AMSL	Above Mean Sea Level
APA	Applicant's Preferred Alternative
APE	Area of Potential Effects
ASTM	American Society of Testing and Materials
BDC	Bois d'Arc Creek
BEG	Bureau of Economic Geology
BG	Block Group
BLM	Bureau of Land Management
BMP	Best Management Practice
CA	California
CADSWES	Center for Advanced Decision Support for Water and Environmental Systems
CALF	Closed and Abandoned Landfill Inventory
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
cfs	Cubic Feet per Second
CO	Carbon Monoxide
CR	County Roads
CRMWA	Canadian River Municipal Water Authority
CS	Concern for Screening Level
CWA	Clean Water Act
CZMA	Coastal Zone Management Act
dbA	A-Weighted Sound Levels
DEIS	Draft Environmental Impact Statement
DFW	Dallas-Fort Worth International Airport
DHHS	Department of Health and Human Services
DL	Federally Delisted
DO	Dissolved Oxygen
DRMC	Denton Regional Medical Center
DWU	Dallas Water Utilities
E	State Listed Endangered
EA	Environmental Assessment
EIS	Environmental Impact Statement
EJ	Environmental Justice
EMS	Emergency Medical Services
EPA	Environmental Protection Agency
EO	Executive Order

ESA	Endangered Species Act
FCU	Functional Capacity Units
FISD	Fannindel Independent School District
FHWA	Federal Highway Administration
FM	Farm to Market
FONSI	Finding of No Significant Impact
FPPA	Farmland Protection Policy Act
FRSTX	Federal Registry System
FS	Fully Supporting
FTE	Full Time Employee
FWSD	Fresh Water Supply District
GCD	Groundwater Conservation District
GHG	Greenhouse Gas
GIS	Geographic Information System
GMA	Groundwater Management Areas
GPCD	Gallons per Capita per Day
gpm	Gallons per Minute
GTUA	Greater Texoma Utility Authority
HB	House Bill
HE	Harvey Economics
HQ	Habitat Quality
HU	Habitat Units
IH	Interstate Highway
IPP	Initially Prepared Plan
ISD	Independent School District
ISO	Insurance Service Office
LBCR	Lower Bois d'Arc Creek Reservoir
LD	Limited Data
LE	Federally Listed Endangered
LEDPA	Least Environmentally Damaging Practicable Alternative
LRH	Lake Ralph Hall
LT	Federally Listed Threatened
LT/SA	Federally Threatened by Similarity of Appearance
MAG	Modeled Available Groundwater
MBTA	Migratory Bird Treaty Act
MCM	Medical Center of McKinney
mgd	Millions of Gallons per Day
MG/YR	Millions of Gallons per Year
MOA	Memorandum of Agreement
MPH	Miles per Hour
MSL	Mean Sea Level
MSWLF	Municipal Solid Waste Landfill Site
MUA	Municipal Utility Authority
NAAQS	National Ambient Air Quality Standards
NAVD88	North American Vertical Datum of 1988
NC	No Concern

NCTCOG	North Central Texas Council of Governments
NEPA	National Environmental Policy Act of 1969
NETMWD	Northeast Texas Municipal Water District
NGVD	National Geodetic Vertical Datum
NHPA	National Historic Preservation Act
NLCD	National Land Cover Dataset
NOx	Nitrogen Oxides
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
NRNWR	Neches River National Wildlife Refuge
NSRCEM	North Sulphur River Channel Evolution Model
NTMWD	North Texas Municipal Water District
NWI	National Wetland Inventory
OH-	Hydroxide Ions
OK	Oklahoma
OTHM	Official Texas Historical Marker
OWRB	Oklahoma Water Resource Board
PA	Programmatic Agreement
PGMA	Priority Groundwater Management Area
PIA	Primary Impact Area
PIR	Public Interest Review
PM	Particulate Matter
RCUs	Resource Capacity Units
RFFA	Reasonably Foreseeable Future Action
ROC	Region of Comparison
ROI	Region of Influence
ROW	Right-of-Way
RRC	Texas Railroad Commission
RWRS	Raw Water Reliability Study
SAAM	Stream Attribute Assessment Methodology
SAL	State Antiquities Landmark
SB	Senate Bill
SH	State Highway
SHPO	State Historic Preservation Office
SIA	Secondary Impact Area
SJRA	San Jacinto River Authority
SMU	Southern Methodist University
SOx	Sulfur Oxides
SRA	Sabine River Authority of Texas
SRBA	Sulphur River Basin Authority
SRMWD	Sulphur River Municipal Water District
SRMVC	Sam Rayburn Memorial Veterans Center
STIP	State Transportation Improvement Program
SU	Standard Units
SUD	Special Utility District
SWAMPIM	Stream Watershed Assessment and Measurement Protocol Interaction Model

SWANCC	Solid Waste Agency of Northern Cook County
SWPPP	Stormwater Pollution Prevention Plan
T	State Listed Threatened
TAC	Texas Administrative Code
TARL	Texas Archeological Research Laboratory
TCEQ	Texas Commission on Environmental Quality
TCOG	Texoma Council of Governments
TDA	Texas Department of Agriculture
TDS	Total Dissolved Solids
TEA	Texas Education Agency
THC	Texas Historical Commission
TMDL	Total Maximum Daily Load
TNRCC	Texas Natural Resource Conservation Commission
TPDES	Texas Pollution Discharge Elimination System
TPWD	Texas Parks and Wildlife Department
TRA	Trinity River Authority
TRWD	Tarrant Regional Water District
TSLA	Texas State Library and Archives
TSS	Total Suspended Solids
TSSWCB	Texas State Soils and Water Conservation Board
TWDB	Texas Water Development Board
TX	Texas
US	United States
USACE	United States Army Corps of Engineers
USC	United States Code
USCB	United States Census Bureau
USDA	United States Department of Agriculture
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service
USGCRP	United States Global Change Research Program
USGS	United States Geological Survey
UTRWD	Upper Trinity Regional Water District
VOCs	Volatile Organic Compounds
WAM	Water Availability Model
WDA	Workforce Development Area
WHAP	Wildlife Habitat Appraisal Procedure
WMA	Wildlife Management Area
WRAP	Water Rights Analysis Package
WSC	Water Supply Corporation
WTP	Water Treatment Plant
°C	Degrees Celsius
µg	Micrograms

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1.0 Purpose and Need

1.1 Introduction

The United States Army Corps of Engineers (USACE) has prepared this Draft Environmental Impact Statement (DEIS) to analyze the direct, indirect and cumulative effects for the proposed Lake Ralph Hall project located in Fannin County, Texas. The proposed Lake Ralph Hall project would be located north of the City of Ladonia, Texas (**Figure 1-1**). The site map illustrates the boundaries for the proposed project and the conservation pool within Lake Ralph Hall (**Figure 1-2**). The project boundary includes property to be purchased and managed by the applicant adjacent to the proposed conservation pool. The proposed project lies along the North Sulphur River in the North Sulphur River Watershed of the Sulphur River Basin. The North Sulphur River Basin is bounded on the north by the Red River Basin, the Trinity River Basin to the west, the Sabine and Cypress River Basins to the south, and by the Texas/Arkansas border to the east (**Figure 1-3**). Five lakes are located within Fannin County: 1) Coffee Mill Lake; 2) Lake Crockett; 3) Lake Bonham; 4) Valley Lake; and 5) Lake Fannin. These five lakes are located in the northern portion of the county. Jim Chapman Lake is located south and east of the project area in Hopkins and Delta Counties. **Figure 1-4** depicts the locations of the streams and other waterbodies in the vicinity of the proposed Lake Ralph Hall reservoir project.

The project proponent, Upper Trinity Regional Water District (UTRWD), submitted an application to the USACE for a Department of the Army permit under Section 404 of the Clean Water Act (CWA), to discharge dredged and fill material into waters of the United States (US) for the purpose of constructing the proposed Lake Ralph Hall project, including the construction of the dam, reservoir, and a pipeline. Based on a review of the applicant's proposal, the USACE determined that the proposed Lake Ralph Hall project constitutes a major Federal action that has the potential to significantly affect the quality of the human environment and that preparation of an EIS is required.

The USACE is the federal agency that prepared this DEIS in compliance with the National Environmental Policy Act (NEPA) of 1969, as amended, the Council on Environmental Quality (CEQ) Regulations for Implementing the Procedural Provisions of the NEPA (40 Code of Federal Regulations [CFR] 1500-1508) and the USACE Procedures for Implementing NEPA (33 CFR 230). This DEIS also addresses the requirements of the US Environmental Protection Agency's (EPA) Section 404(b)(1) guidelines (40 CFR 230) and the USACE's NEPA Implementation Procedures for the Regulatory Program (33 CFR 325 Appendix B) and Public Interest Review at 33 CFR 320.4. The USACE, Fort Worth District, Regulatory Division is the lead agency responsible for preparation of the DEIS. As specified at 33 CFR 320.1(a)(4), the USACE is neither a proponent nor opponent of any permit proposal. The instant action is not being funded by the USACE. The USACE has prepared this DEIS through the assistance of a third party contractor as

described at 40 CFR 1506.6(c) and clarified in 1983 guidance from the CEQ in 48 Fed. Reg. 34263 and will use the Final EIS in rendering a final permit decision.

The USACE also requested that agencies with statutory authority over, or special expertise relative to, the proposed project participate in the NEPA process as cooperating agencies (40 CFR 1501.6 and 1508.5). The EPA, US Fish and Wildlife Service (USFWS), US Forest Service (USFS), Texas Commission on Environmental Quality (TCEQ), Texas Parks and Wildlife Department (TPWD) and the Texas Historical Commission (THC) have engaged as cooperating agencies for this DEIS.

Figure 1-1: Project Location Map

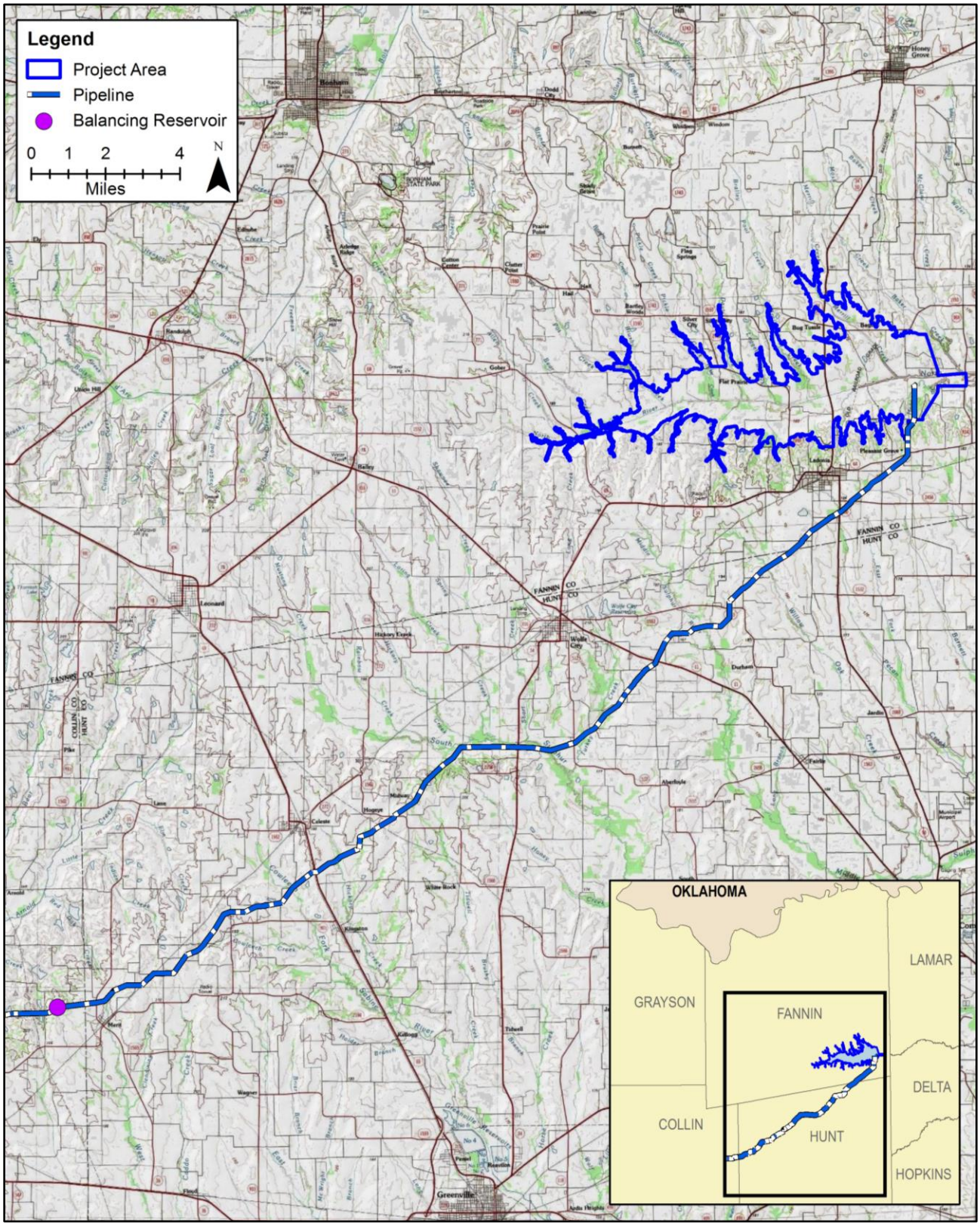


Figure 1-2: Project and Conservation Pool Boundaries

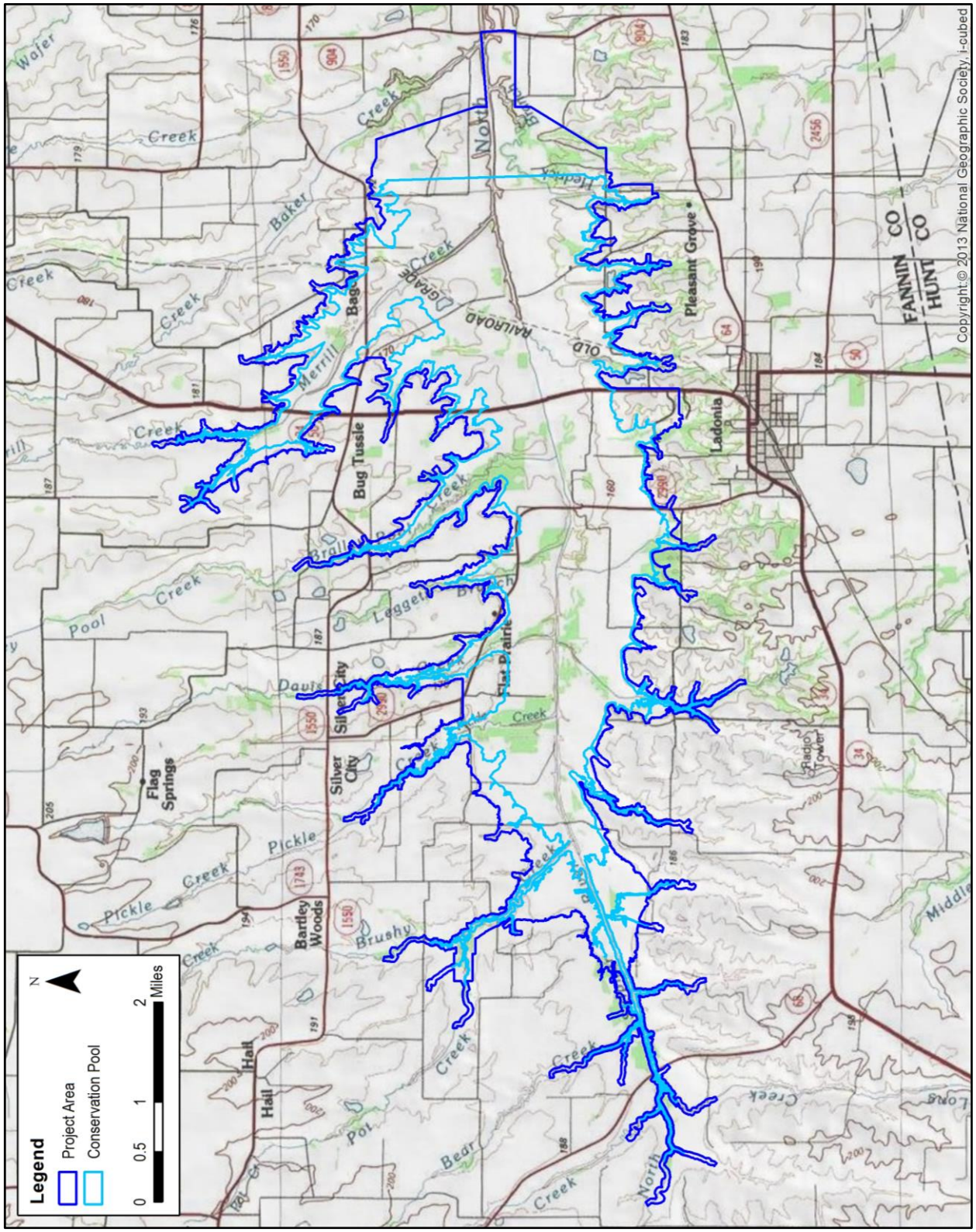
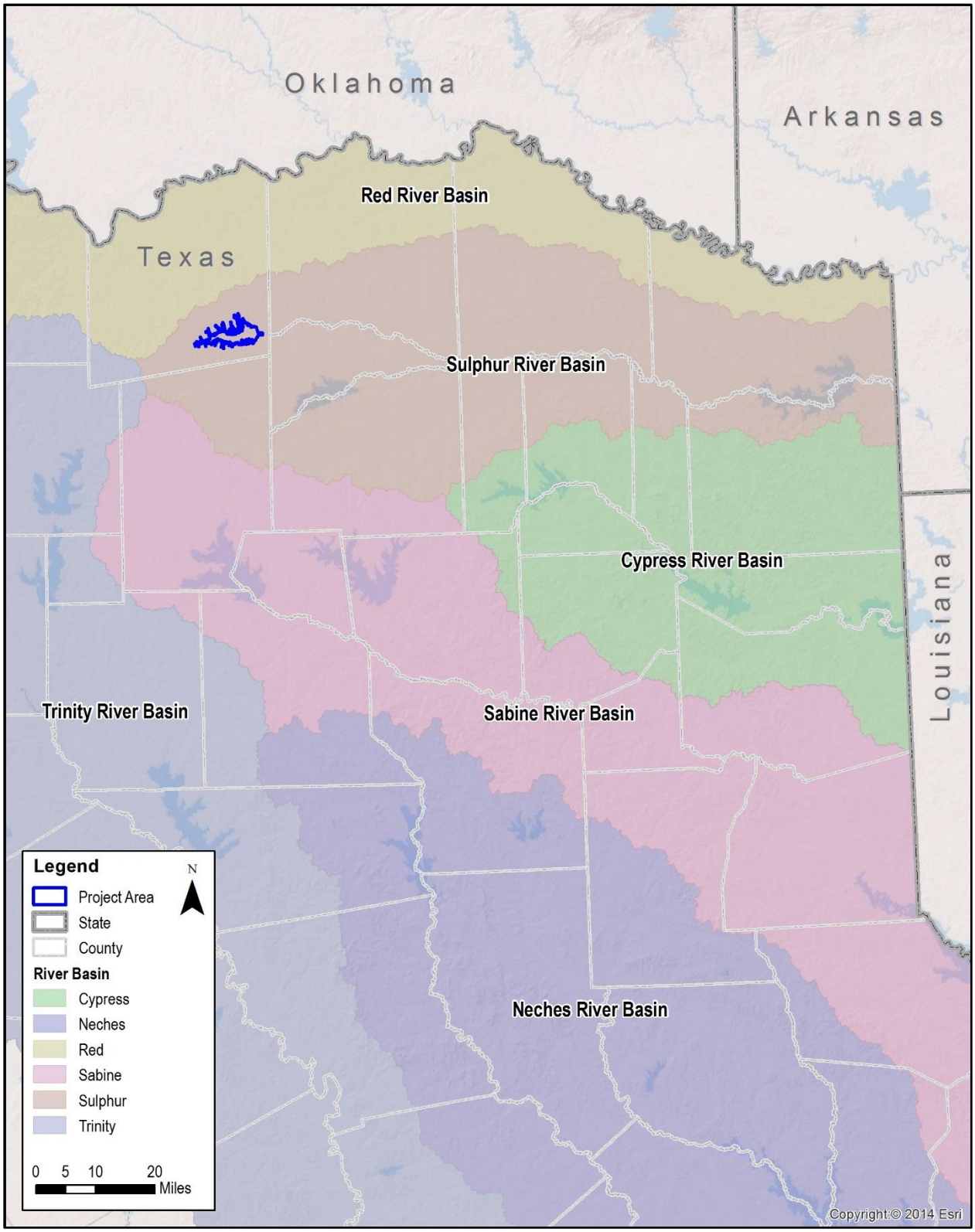
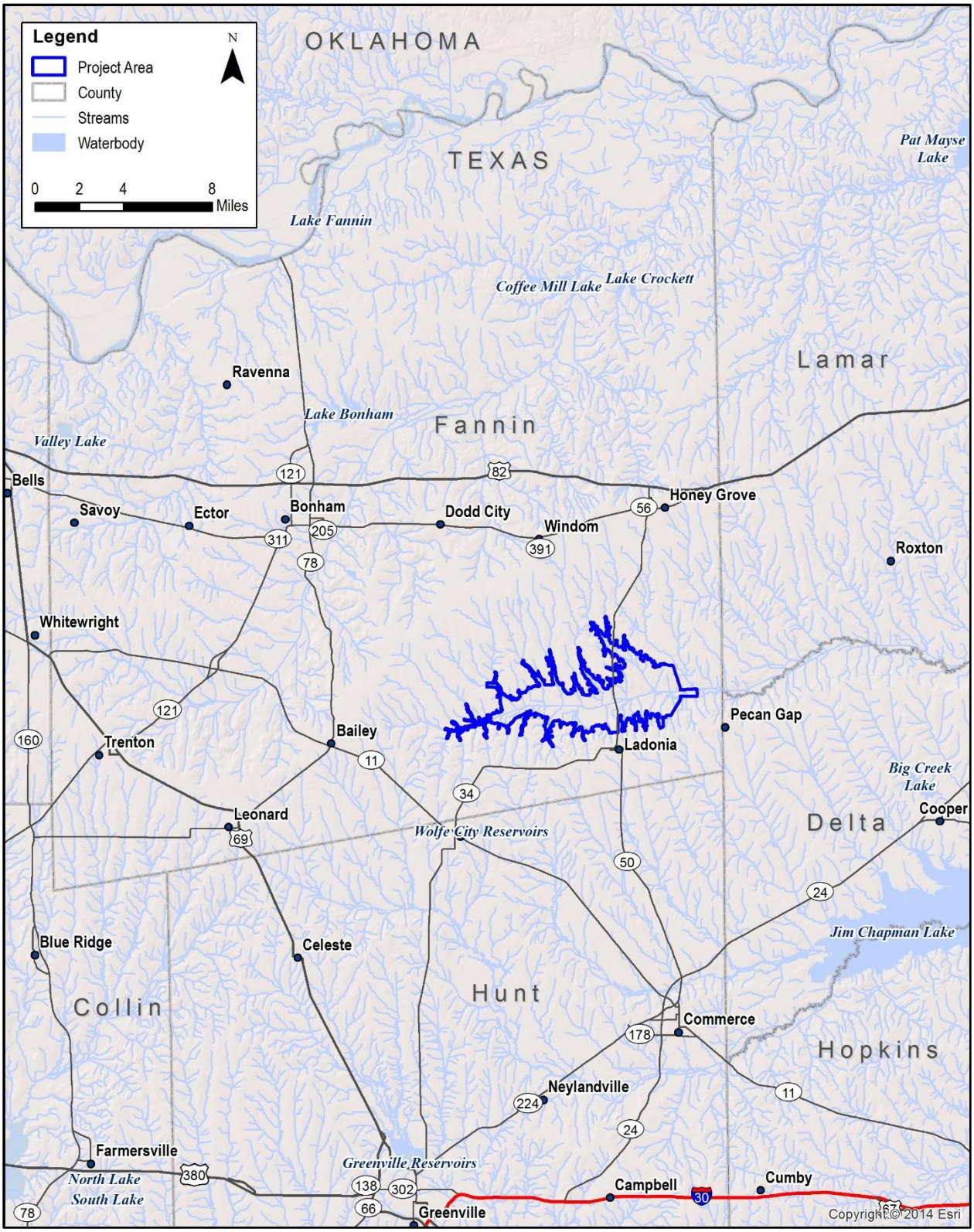


Figure 1-3: River Basins



Source: TWDB

Figure 1-4: Streams and Waterbodies



Source: National Hydrography Dataset

1.2 Authorizing Actions

UTRWD submitted an application to USACE on October 30, 2006, (USACE Project #200300336) for a Department of the Army permit under Section 404 of the CWA. This permit would authorize UTRWD to discharge approximately 650,000 cubic yards of dredged and fill material into approximately 33 acres of waters of the US and inundate approximately 8,500 acres in total with approximately 325 acres of that total being waters of the US associated with the construction and operation of the proposed Lake Ralph Hall project. The proposed Lake Ralph Hall project has obtained a Permit to Appropriate State Water from the TCEQ under Section 11.121 of the Texas Water Code, and Title 30, Chapters 288, 295, 297, and 299 of the Texas Administrative Code (TAC). Federal, State and local permits and approvals required for UTRWD to construct and operate the proposed Lake Ralph Hall project are shown in **Table 1-1** and **Table 1-2**.

Table 1-1: Other Environmental Permits

Federal	
US Army Corps of Engineers	Clean Water Act Section 404 Permit
	Rivers and Harbors Act of 1899 Section 14 (408) Permission (Issued February 15, 2017)
State of Texas	
Texas Commission on Environmental Quality	Permit to Appropriate State Water (Issued December 11, 2013)
	Clean Water Act Section 401 (Surface Water Quality) Certification
	Texas Pollutant Discharge Elimination System Permit

Table 1-2: Other Requirements and/or Approvals

Federal	
US Environmental Protection Agency	EIS Review
US Fish and Wildlife Service	Endangered Species Act Review
	Fish and Wildlife Coordination Act
	Migratory Bird Treaty Act
US Forest Service	Land Exchange
State of Texas	
Texas Department of Transportation	Approval for roadway relocations, abandonment, and bridge reconstruction
Texas Historical Commission	Section 106 of the National Historic Preservation Act
	Native American Graves Protection and Repatriation Act
	Archaeological Resource Protection Act
	American Indian Religious Freedom Act
	Texas Antiquities Code
Texas Parks and Wildlife Department	Habitat
	State Species of Concern
Local	
Fannin County	Approval for county road realignment, abandonment, and conversion
	Approval for stream channel modifications under the National Flood Insurance Program

1.3 Organization of the EIS

This DEIS complies with CEQ's EIS requirements (40 CFR 1502.10) and USACE's requirements (33 CFR 325 Appendix B for NEPA). **Chapter 1.0** provides descriptions of the purpose and need for the actions, the role of USACE in the EIS process, and the required regulatory actions for the proposed Lake Ralph Hall project. **Chapter 2.0** describes the alternatives including the proposed Action and the No Action Alternative. **Chapter 3.0** describes the affected environment. **Chapter 4.0** describes the direct, indirect, and cumulative impacts associated with the project alternatives and possible mitigation to minimize or compensate for impacts; and any residual adverse effects following implementation of mitigation. **Chapter 5.0** summarizes public participation and the scoping process, and the consultation and coordination undertaken to prepare the DEIS. **Chapter 6.0** presents the list of preparers and reviewers. **Chapter 7.0** provides the list of references. **Chapter 8.0** contains the glossary and **Chapter 9.0** contains the index. For those aspects of the analysis that warrant more substantial disclosure and to provide the reader with important information, appendices are also included. Copies of supporting documents will be available for public review at USACE Fort Worth's District Office located in Fort Worth, Texas and online at the following address: http://www.swf.usace.army.mil/Missions/Regulatory/Permitting/ProposedLakeRalphHall.aspx.

1.4 Project Proponent and Permit Applicant

UTRWD was created by Texas Legislature in 1989 as a non-profit governmental enterprise that provides certain utility services on a wholesale basis. The impetus for UTRWD came from 25 cities and water utilities in Denton County, Texas located immediately north of the City of Dallas. These cities and utilities, with support from the Dallas Water Utilities (DWU), recognized that while Denton County was in the Dallas planning area, they would be best served by creating an independent entity that would provide long term, dependable water supply from surface water sources. UTRWD has 26 Directors on its Board of Directors, made up of 20 from cities and towns, four from special districts, and two from Denton County. It is headquartered in Lewisville within Denton County.

This special district offers the following services to its Members and Customers:

- Wholesale treated water supply planning, development, delivery, conservation and reuse;
- Regional wastewater treatment, water reclamation, and water reuse;
- Non-potable water for irrigation purposes;
- Household hazardous waste collection; and
- Watershed protection.

Members and Customers may voluntarily choose which of these services they wish to avail themselves. UTRWD recoups service costs solely on the basis of services utilized. The focus of this DEIS is limited to the UTRWD water services only. Once a Member or Customer chooses to avail themselves of UTRWD's water services, they are obligated to pay their portion for all new sources of supply for the District. UTRWD considers its total water supply to be available to all Members and Customers and individual entities cannot choose the projects that they will or will not pay for as the supply system is developed.

The distinction between Members and Customers relates mostly to the time period when each contract was signed. Members are those entities which entered into participation contracts within the statutory period during the formative stages of UTRWD and Customers are those entities which signed contracts after that time period until the present. Each Member may appoint a representative to the Board of Directors. Customers are represented by a single, at-large representative appointed by Denton County. In terms of treated water service, both Members and Customers have long term contracts with the UTRWD which obligates UTRWD to provide sufficient water to meet that Member's or Customer's future needs. These contracts are renewable by the Member or Customer. UTRWD is legally obligated to provide treated wholesale water to retail water providers within UTRWD's planning area, including Denton County and small portions of Dallas, Collin, Grayson,

Wise and Cooke counties to the extent that Denton County Customers' service areas extend outside the County.[1]

UTRWD's current and potential wholesale water Customers are listed in **Table 1-3**. A service area map of UTRWD Members, Customers and Prospective Customers is shown in **Figure 1-5**.

Table 1-3: Upper Trinity Regional Water District Wholesale Water Members, Customers and Prospective Customers

UTRWD Members and Customers	
Argyle WSC • City of Argyle* City of Aubrey* Cross Timbers WSC • Town of Bartonville* • City of Copper Canyon* • Town of Double Oak* City of Celina* City of Corinth* Denton County FWSD No. 1A (Castle Hills)* Denton County FWSD No. 7* Denton County FWSD No. 8A Denton County FWSD No. 9 Denton County FWSD No. 10 Denton County FWSD No. 11A	Town of Flower Mound* City of Highland Village* City of Justin* City of Krum* Lake Cities of Municipal Utility Authority (MUA)* • Town of Hickory Creek • City of Lake Dallas • City of Shady Shores City of Lincoln Park* Mustang Special Utility District (SUD)* • City of Cross Roads • City of Krugerville • City of Oak Point* Northlake City of Sanger*
Prospective Customers	
Ladonia Pilot Point*	Ponder* Prosper*

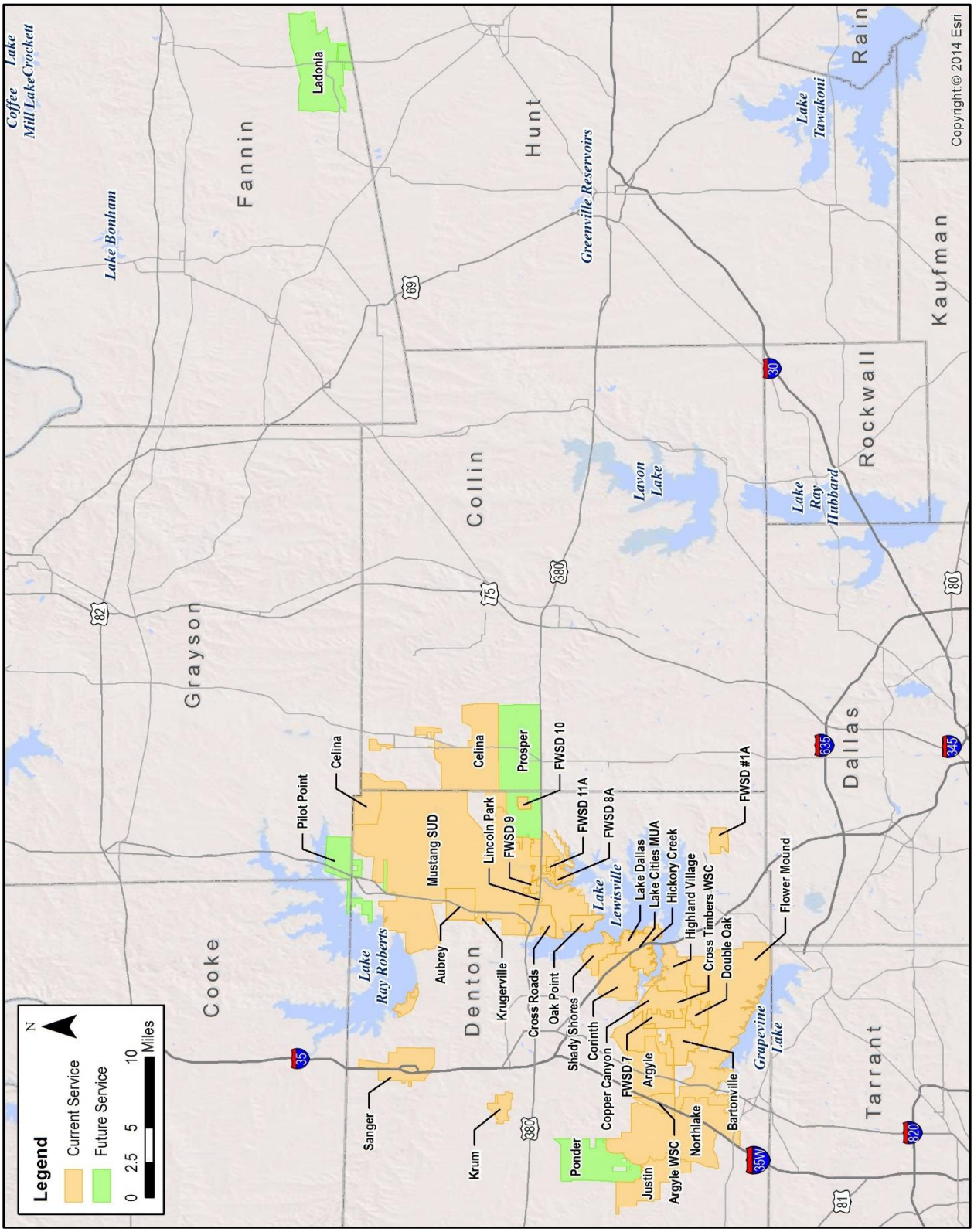
Notes: (1) * indicates a Member; Indented indicates an indirect Customer, their water is provided by UTRWD through the entity above.
(2) WSC indicates Water Supply Corporation
(3) FWSD indicates Fresh Water Supply District
(4) MUA indicates a Municipal Utility Authority
(5) SUD indicates Special Utility District
(6) The list of Prospective Customers is restricted to those entities that have a contractual relationship with UTRWD for future water service and have an explicit expression to participate. There will likely be other entities that receive water from UTRWD in the future, but they are not included in this EIS.

(7) Ponder, Prosper and Pilot Point are UTRWD Members who currently do not receive any water from UTRWD as they are outside UTRWD's current water delivery area. Once an extension of the water transmission system allows UTRWD to provide service to these Members, they plan to purchase water from UTRWD, therefore they are included as prospective customers.

Source: Upper Trinity Regional Water District, 2015.

[1] Texas State Bill SB 1657 from legislative session 74(R). The bill was signed on June 12, 1995 and went into effect on September 28, 1995. House Bill No. 3112, codified as Chapter 1053, Regular Session, 71st Legislature (1989), effective June 16, 1989, provides a definition of "Basic Service Area" to mean "the geographic area in the corporate limits of all participating members, all contract members, and all customers and the areas that are served by those members and customers". Section 24 of HB 3112, titled "Rights of Basic Service Area", provides "This Basic Service Area has the primary right to water or wastewater treatment capacity and to water supply in each classification that the District secured under permit from the state agency that has jurisdiction".
Senate Bill No. 1657, codified in Chapter 494, Regular Session, 74th Texas Legislature (1995), effective August 28, 1995, provides "The boundaries of the district are coterminous with the boundaries of the county, plus the entire area in the boundaries of any contract member or participating member, a portion of whose incorporated limits is partially in the boundaries of the county as those boundaries existed on the effective date of this Act, and including the area within the boundaries of the City of Irving, Dallas County, Texas."

Figure 1-5: UTRWD Members, Customers and Prospective Customers



Source: Upper Trinity Regional Water District and Public Utility Commission of Texas, 2015

1.5 UTRWD's Proposed Lake Ralph Hall Reservoir Project

The proposed Lake Ralph Hall project would include the construction of an earth-filled dam embankment across the valley of the North Sulphur River with a concrete uncontrolled principal spillway located adjacent to the existing channel of the river and an excavated unlined earthen channel emergency spillway located within the embankment on the northern floodplain of the river. The embankment placed would vary between 566 feet and 568 feet North American Vertical Datum of 1988 (NAVD88) to account for anticipated settlement of the embankment thus providing an effective elevation of 566 feet NAVD88 after settlement and would adjoin the existing ground surface on both ends of the structure. Current studies indicate the proposed Lake Ralph Hall reservoir would have a conservation pool storage capacity of approximately 160,235 acre-feet (AF) (at an elevation of 551.0 feet above MSL), and at that capacity, the surface area of the reservoir would be approximately 7,605 acres. However, it is anticipated that the storage volume is somewhat larger due to continued erosion that has occurred during the permitting and planning period. The maximum depth of the reservoir at the dam would be approximately 90 feet. The firm annual yield of the proposed project would be approximately 34,050 AF/year.

TCEQ Water Use Permit No. 5821 authorizes UTRWD to impound up to 180,000 AF in the proposed Lake Ralph Hall. UTRWD seeks additional water supplies with a firm yield of 34,050 AF/year when the proposed project would be operated as part of UTRWD's overall water supply system. Raw water would be conveyed from the proposed Lake Ralph Hall reservoir in the Sulphur River Basin via inter-basin transfer directly to the existing Tom Harpool Water Treatment Plant (WTP) located adjacent to Lewisville Lake in the Trinity River Basin or directly into Lewisville Lake for use at the existing Thomas E. Taylor Regional WTP via a proposed raw water transfer pipeline (see **Figure 1-6**).

The existing Irving Pipeline includes a balancing reservoir (see **Figure 1-6**), located approximately one-mile west of Merit, Texas. The balancing reservoir provides a hydraulic grade break between the Jim Chapman Raw Water Pump Station and the Irving Booster Pump Station (see **Figure 1-6**) located near Princeton, TX. This hydraulic break is necessary for stable operation of the two pump stations.

Although the Lake Ralph Hall Raw Water Pipeline will discharge at the same hydraulic gradient as the Irving Balancing Reservoir, a 4.5-acre balancing reservoir is proposed as part of the project. This reservoir is proposed to be located near the existing Irving Balancing Reservoir (see **Figure 1-6**). The size of the reservoir in terms of surface impacts is unknown until more detailed design is completed, however it is not anticipated to be more than the existing Irving Balancing Reservoir.

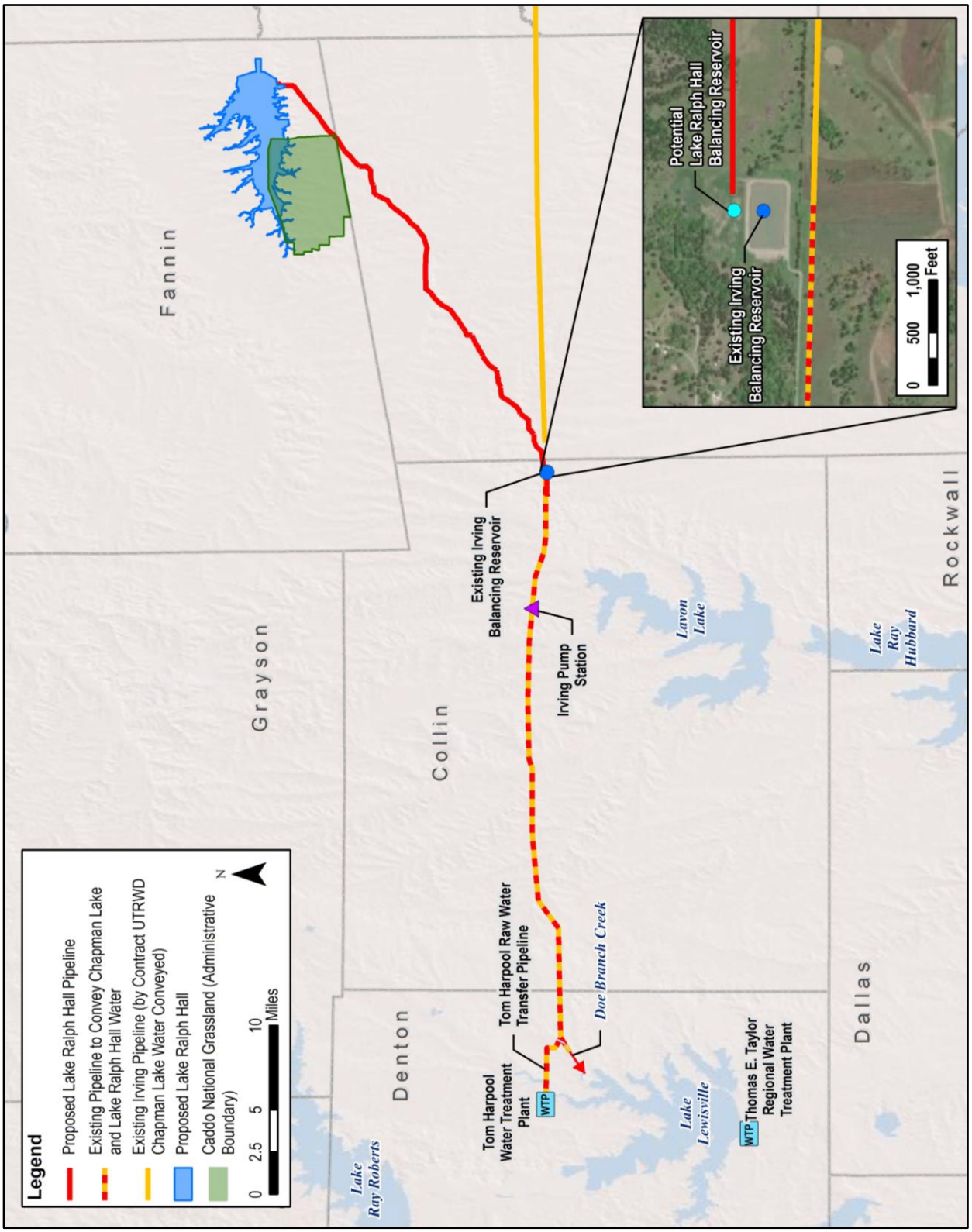
The proposed Lake Ralph Hall Raw Water Pipeline will be 48 inches in diameter and, from the lake, it will travel southwest for approximately 32 miles to connect to Irving's Jim Chapman

Pipeline downstream of Irving's existing Balancing Reservoir (see **Figure 1-6**).[2] The connection will be a "tee connection" into the existing pipeline with valves on each branch to allow isolation to facilitate maintenance. The installed capacity of the Irving Jim Chapman Pipeline is 80 million gallons per day (mgd). The proposed Lake Ralph Hall project includes provisions to make improvements to the existing Irving pump station to increase its pumping capabilities. After completion of these improvements it is projected that the Irving pump station and pipeline system will have a capacity of 104 mgd.

With these improvements to Irving's existing pump station there will be adequate capacity to carry all water authorized from proposed Lake Ralph Hall. These improvements will be contained to the interior of the existing pump station thus averting any environmental impacts.

[2] Further details on the Lake Ralph Hall Raw Water Pipeline are presented in Chapter 4.

Figure 1-6: Lake Ralph Hall Raw Water System Location Map



Source: Upper Trinity Regional Water District, 2015

The actual use of water from Lake Ralph Hall will vary from day to day depending on the following factors:

1. The actual water supply usage by UTRWD Members and Customers;
2. The availability of water from Lake Ralph Hall and UTRWD's other water supply sources; and
3. The capability and operational status of water conveyance and treatment infrastructure.

Through this inter-basin transfer, UTRWD would provide water to towns and cities in Collin, Cooke, Dallas, Denton, Grayson, and Wise Counties within the Trinity River Basin. The proposed project would divert and use up to 34,050 AF (on a firm yield basis) of water per year for municipal, industrial, agricultural and recreational purposes of use, as authorized by Water Use Permit No. 5821, and impeding continued erosion and environmental degradation of the North Sulphur River channel.

The proposed Lake Ralph Hall reservoir project would also require roadway adjustments to alignment and grade and/or abandonment of State, county, and local roads within the proposed project footprint (see **Figure 1-7**). State Highway 34 crosses the project boundary near the east/west center of the proposed Lake Ralph Hall. The construction of two bridges over separate portions of the proposed lake will require realignment of the existing highway in order to maintain access during construction. The adjustments made to SH 34 will consist of a new parallel alignment to the west of the existing roadway north and south of the North Sulphur River and north and south of Merrill Creek. The new roadway will consist of two 12-foot wide lanes with two 10-foot wide shoulders. The proposed roadway will connect back to the existing roadway north and south of the project boundaries. All ROW necessary for the construction of the new alignment and the bridge structures will be dedicated to TxDOT by UTRWD prior to construction.

The proposed Lake Ralph Hall Bridge will be approximately 6,000-foot in length with an overall deck width of 46' to accommodate two-12' wide lanes (one lane in each direction) with 10' wide shoulders. The proposed Merrill Creek Bridge will be approximately 625' in length with an overall deck width of 46' to accommodate two-12' wide lanes (one lane in each direction) with 10' wide shoulders.

In order to successfully implement the proposed Lake Ralph Hall, key roads would require adjustments to alignment and grade (Figure 4-8 and Table 4-10). The following County Roads would be abandoned or partially abandoned as a result of the impoundment of the proposed Lake Ralph Hall; FM 2990, CR 1550, CR 3360, CR 3365, CR 3370, CR 3380, CR 3600, CR 3605, CR 3610, and CR 3640. SH 34 and CR 3444 would require vertical adjustment. A short segment of CR 3640 would be adjusted vertically and/or horizontally. County Roads 3443 and 3444 would be re-aligned horizontally and vertically and would include new drainage culverts and a 24-foot road surface with drainage swales on both sides.

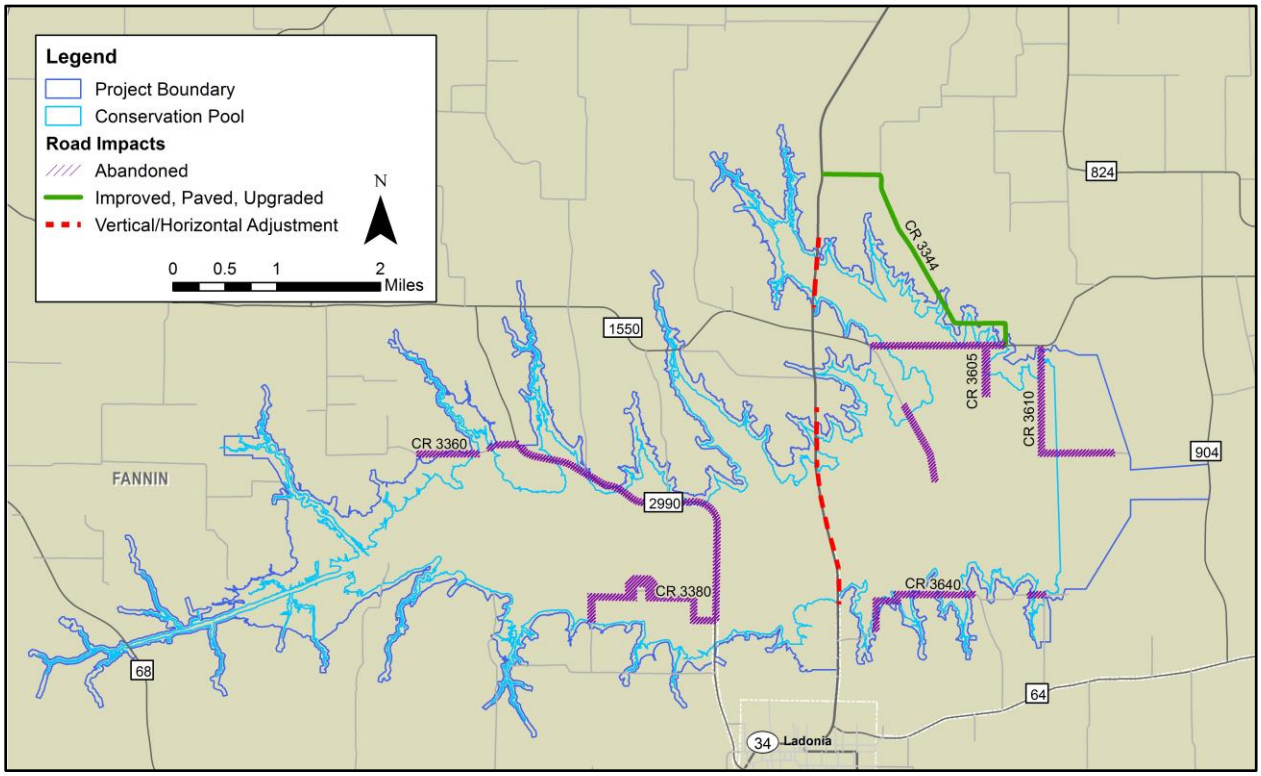
1.5.1 Scope of Federal Control and Responsibility over the Proposed Action and Alternatives

USACE's control and responsibility over actions proposed with the project comprise activities in waters of the US and their associated actions. This "scope of action" includes those activities that result in the fill of waters of the US and other associated activities in waters as well as uplands for construction of the dam and its facilities. The raw water transfer pipeline from Lake Ralph Hall to Lewisville Lake in waters of the US and adjacent upland areas, and waters of the US that would be filled as a result of relocating roads and their adjacent uplands, are included in the defined actions. However, for NEPA disclosure and public interest review purposes, activities beyond the USACE's control and responsibility associated with the listed actions are also included in the DEIS to ensure complete consideration of the project and its effects. This DEIS describes the proposed construction and operation of the Lake Ralph Hall project, including UTRWD's environmental protection measures; identifies alternatives to the Proposed Action; and describes the direct, indirect and cumulative effects ("scope of effects") resulting from each alternative to the relevant resource factors.

1.6 Need for Action

Understanding the need for a proposal is important in supporting the definition of a project's purpose. It provides the information to allow a determination of the legitimate factors to be included in the project purpose and reflecting the objective(s) of the applicant. UTRWD summarized its need for the proposed Lake Ralph Hall project in its Section 404 permit submittal to the USACE in October 2006. UTRWD's 404 permit application included an analysis of water supplies and future demands. UTRWD stated that population and resulting water demand growth was very rapid in its service area, and a five-fold increase in demands by the year 2060 was expected.

Figure 1-7: Lake Ralph Hall Roadway Impacts



Source: Proposed Modifications to State and County Roads Due to the Effects of the Proposed Lake Ralph Hall Technical Memorandum August 2018.

Based on an assessment of current and anticipated supplies, UTRWD believes that water demands will exceed supplies before the year 2030 and that the shortfall will grow considerably by 2060. The UTRWD also pointed out the need for additional security/reliability in its water supplies in case one or more of the existing supplies become unavailable. UTRWD updated its water supply-demand data in a Raw Water Reliability Study (RWRS) in 2010; this revision of the previous data did not alter the UTRWD's assessment that it would be short of water supply before 2030. The proposed Lake Ralph Hall project was also evaluated as part of the Region C Regional Planning Group under the auspices of the Texas Water Development Board (TWDB) in 2001, updated in 2006 and again in 2011. That state process compared water supplies and projected demands for cities, towns and water user groups and confirmed UTRWD's need for the proposed Lake Ralph Hall project.

The applicant's need for additional water supplies was independently analyzed by USACE through supply and demand evaluations in preparation of this DEIS in accordance with 40 CFR 1506.5(a). These analyses and their conclusions are summarized later in this document. Questions which were key factors targeted in the independent analysis of the applicant's need included:

1. What current supplies does UTRWD have available and how dependable are they for meeting long term needs?

2. What are reasonable projections of water demands UTRWD can be expected to meet in the long term future? For the purposes of this DEIS, the year 2060 was selected for the forecasting horizon. The year 2060 was selected as a reference because water demand projections, including surface water demand projections and modeled available groundwater are traditionally reported by each groundwater conservation district and the Region C Water Planning Group for each decade up to 2060.

1.6.1 UTRWD's Existing Water Supplies and Water Supply System

Apart from the Lake Ralph Hall water right, UTRWD does not own any water rights; it obtains supplies through contracts with various water rights holders. UTRWD currently obtains its raw water from four sources: 1) a contract with DWU; 2) a contract with the City of Commerce; 3) a contract with the City of Denton and; 4) a reuse permit from the State of Texas related to Jim Chapman Lake (Commerce contract water). UTRWD also has a contract with the City of Irving to purchase their excess water; however, Irving's demand is currently greater than its supply and no water has ever been available to UTRWD through this contract. **Table 1-4** provides a summary of the UTRWD water supply as well as the other supply sources for their Members and Customers through 2060.

Table 1-4: UTRWD Current and Future Water Supply Summary, 2010-2060 (AF)

Source	2010	2020	2030	2040	2050	2060
Dallas Contract	11,200	11,200	11,200	11,200	11,200	11,200
Commerce Contract	16,100	16,100	16,100	16,100	16,100	16,100
Chapman Lake Reuse	9,700	9,700	9,700	9,700	9,700	9,700
Additional Chapman Lake Reuse	6,400	6,400	6,400	6,400	6,400	6,400
Denton Contract	2,200	0	0	0	0	0
UTRWD Total	**45,600**	**43,400**	**43,400**	**43,400**	**43,400**	**43,400**
Non-UTRWD Sources[1]	40,500	42,100	49,000	51,300	53,700	56,200
Total	**86,100**	**85,500**	**92,400**	**94,700**	**97,100**	**99,600**

[1] Includes groundwater, DWU supplies to named entities and others, City of Fort Worth supplies and North Texas Water District supplies.

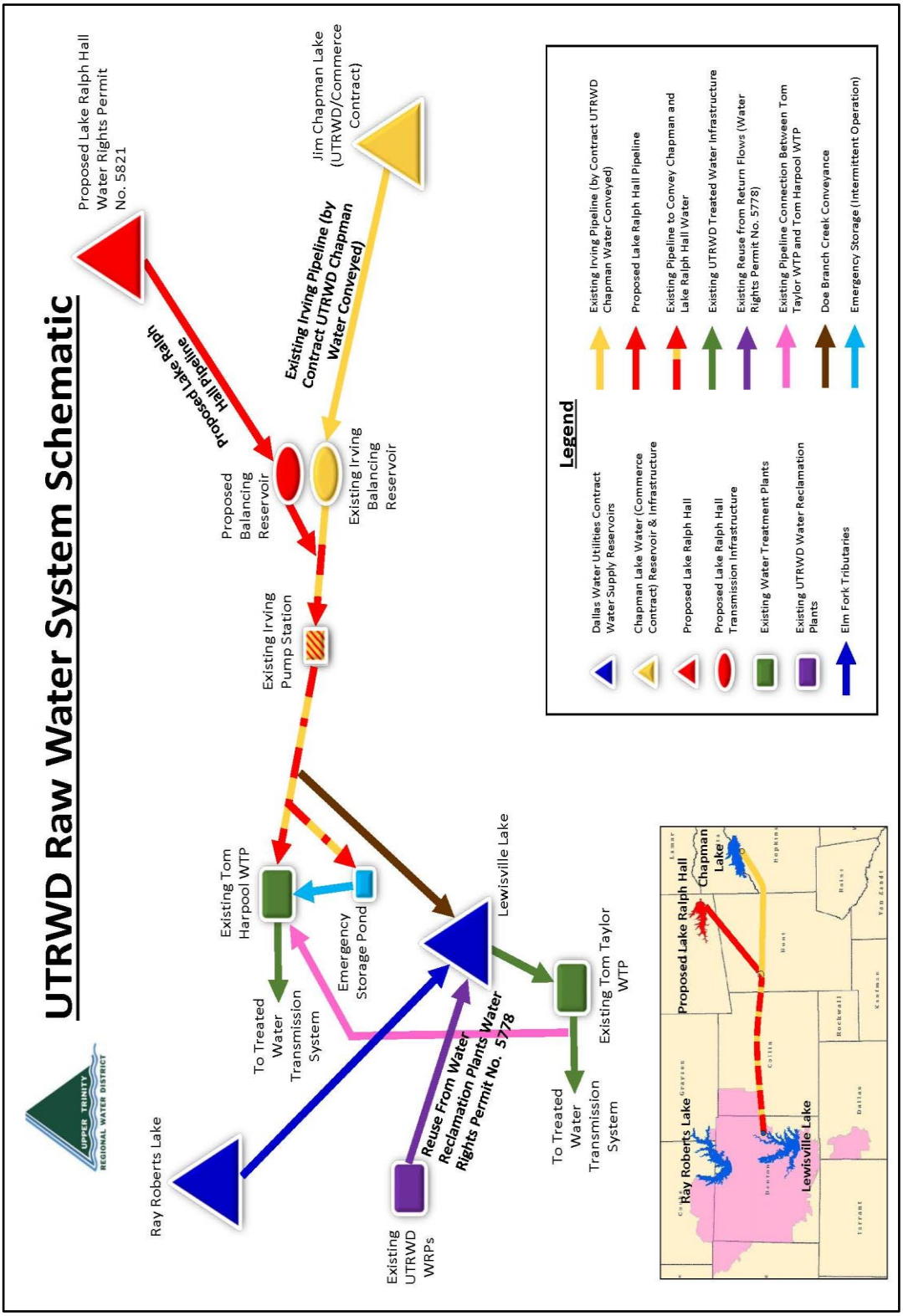
UTRWD withdraws its contract water from Lewisville Lake into its Thomas E. Taylor Regional WTP (**Figure 1-8 and 1-9**). The Tom Harpool WTP obtains its raw water from Jim Chapman Lake via the City of Irving's pipeline. The Jim Chapman Lake has an emergency storage pond located approximately one-third of a mile south-east of the Tom Harpool WTP (see **Figures 1-8 and 1-9**). The capacity of the emergency storage pond is 174 million gallons (or 534.18 AF). When Irving's raw water pipeline is not operational (planned maintenance, breakdown, etc.), the Tom Harpool plant's ability to supply water from Jim Chapman Lake to its Customers is restricted to the treated water provided by a connection to the Thomas E. Taylor Regional WTP and limited on-site raw water emergency storage (see **Figure 1-8 and 1-9**).[3]

Releases from Ray Roberts Lake are controlled by the USACE and primarily relate to environmental releases and flood control. Additional releases are made for Denton and Dallas for diversion at Lewisville Lake. No releases are made for UTRWD and UTRWD has no direct control over these releases. Conveyance losses between Ray Roberts and Lewisville Lake are negligible; but under any circumstance are not caused by UTRWD.

Certain elements of Irving's Jim Chapman Pipeline system will be critical to conveying Lake Ralph Hall water to UTRWD's water treatment plants (the Thomas E. Taylor WTP and the Tom Harpool WTP). Those critical elements are the Irving Booster Pump Station and approximately thirty miles of the Irving Pipeline downstream of the Lake Ralph Hall Pipeline connection point.

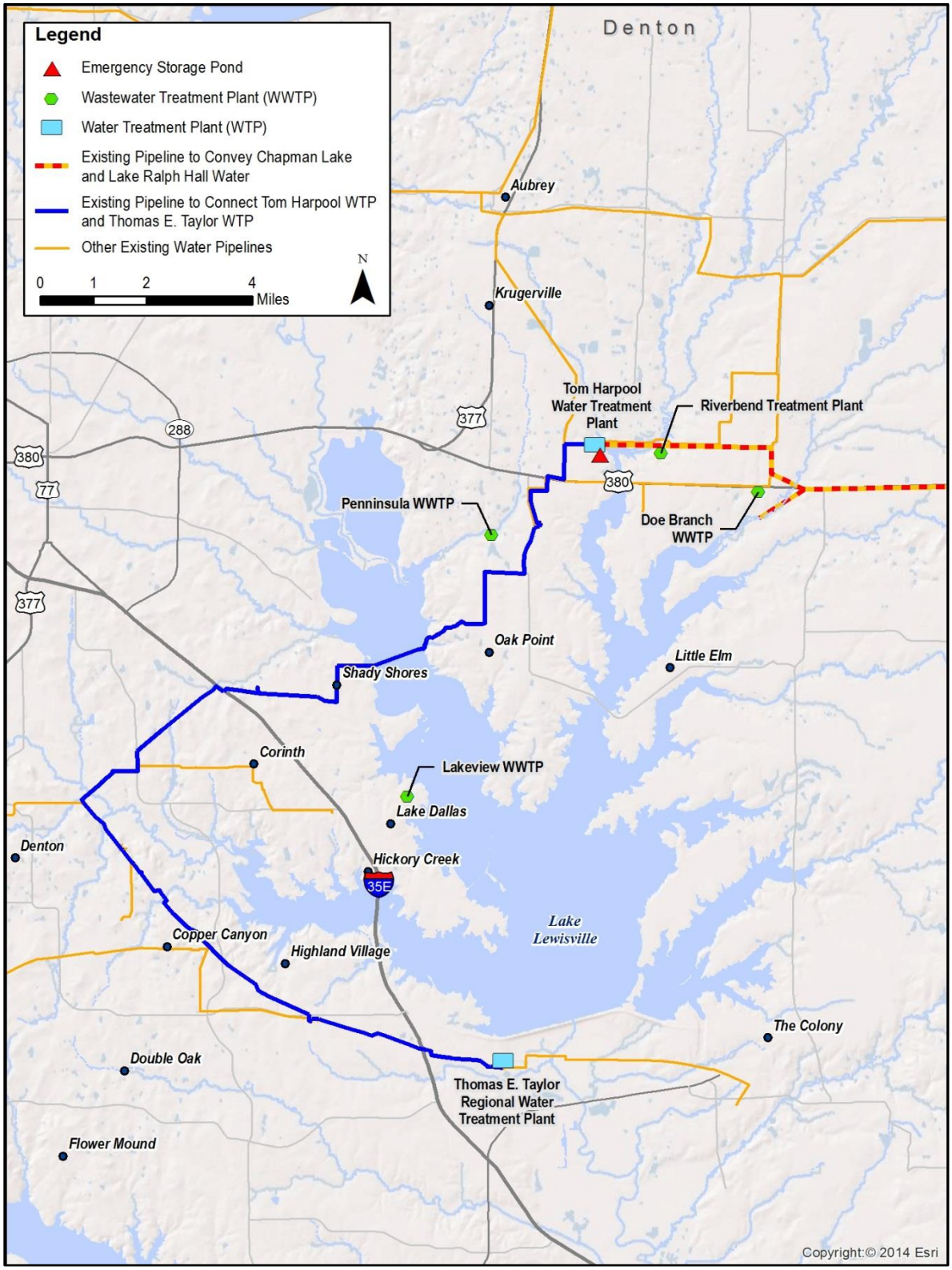
[3] Additionally, the reuse of Chapman Lake water would be available until the Chapman Lake water stored in the Harpool Emergency pond is depleted.

Figure 1-8: UTRWD Raw Water System Schematic



Source: Upper Trinity Regional Water District, 2015.

Figure 1-9: Water Treatment Location Map



Source: Upper Trinity Regional Water District, 2015.

Operational issues with any segment of the Irving Pipeline downstream of the connection point with the Lake Ralph Hall Pipeline would also interrupt transfers of Lake Ralph Hall water to UTRWD's treatment plants.

Likewise, a complete interruption of operation of Irving's pump station would similarly interrupt transfers from Lake Ralph Hall, but Irving's pump station has redundant pumping equipment making full scale interruption highly unlikely. The Irving Pump Station has transferred water for UTRWD for 12 years without interruption. In case of an interruption of transfers from Lake Ralph Hall and Jim Chapman Lake, UTRWD would have to rely on purchasing water from the City of Dallas under the Dallas contract and supplies to the Tom Harpool WTP from the Emergency Storage Pond.

1.6.1.1 City of Dallas Contract (Dallas Water Utilities)

UTRWD's contract with DWU is for withdrawal of water from Lewisville Lake or Ray Roberts Lake. UTRWD currently does not have infrastructure to divert water directly from Ray Roberts Lake; however, they do have the right, under their agreement with the city of Dallas, to construct diversion facilities in Ray Roberts Lake. UTRWD accesses water from Ray Roberts Lake by releases from the lake into Lewisville Lake, diverting the water at its Lewisville Lake Raw Water Intake to the Tom Taylor WTP which can provide water to the Tom Harpool WTP. There is no direct connection between Tom Harpool WTP and Lewisville Lake.

Both lakes are operated by the USACE and are managed in tandem.[4] UTRWD's contract is for 11,200 AF of raw water per year plus a sufficient quantity to meet the present and future needs of the following named entities: Argyle Water Supply Corporation (WSC), Carrollton, Coppell, Denton, Corinth, Lake Cities MUA, Flower Mound, Highland Village, and Lewisville.[5,6] These entities were historically supplied by DWU, but UTRWD took over responsibility of delivering water to them by execution of its 1992 contract with DWU. UTRWD began supplying treated water on a limited basis in 1996.

The DWU contract specifies an annual volume limit only; there is no limit to the daily amount that UTRWD can withdraw. However, the 11,200 AF which UTRWD may withdraw is not a firm yield from Lewisville Lake and Ray Roberts Lake because during periods of water shortage, the available water may be allocated among those entities with water rights in the lakes based on their

[4] The USACE releases water from Lewisville Lake first in order to meet any withdrawal needs and then releases water from Ray Roberts Lake to keep Lewisville Lake at the desired level.

[5] Carrollton, Coppell, Denton and Lewisville are not UTRWD Customers. DWU provides raw water to UTRWD to meet the demands of these entities and UTRWD treats and delivers that DWU water to these entities.

[6] The named entities (excluding Carrollton, Coppell, Denton and Lewisville) are included in the needs analysis because they are UTRWD Members and Customers. Their population and water demand is forecast as UTRWD will require the facilities to handle the total amount of water demanded in the future. When the project need is calculated, the demands of the named entities (excluding Carrollton, Coppell, Denton and Lewisville) are considered to be fully supplied and contribute nothing towards the project need.

proportionate amount of storage in the lakes. UTRWD accesses water from Ray Roberts Lake by releases from the lake into Lewisville Lake and diverting the water at its Lewisville Lake Raw Water Intake which immediately supplies the Tom Taylor WTP. Water must be moved to Tom Harpool WTP via an interconnection with Tom Taylor. To date UTRWD has not been restricted in the quantity of water it procures under the Dallas Contract.

UTRWD's contract with DWU expires in February of 2022 and according to a recent communication, DWU will make no commitment to renew that contract as of January 2015[7]. Even so, DWU makes the assumption that it will continue to supply the base amount of the existing contract plus future demands for the named entities. As embodied in its long range water supply plan, DWU has assumed this relationship will continue at least through 2070.

In sum, the DWU water supply is subject to reduction and even curtailment in time of water shortages and contract renewal is subject to some uncertainty, although this uncertainty is perceived to be low. For the purposes of this DEIS, although there is some vulnerability associated with UTRWD's water supply from DWU, it is considered a reliable source based on UTRWD's continued provision of water to its current member and customer base as well as their willingness to rely on such a source for future customers.

1.6.1.2 City of Commerce Contract

UTRWD has a contract with the City of Commerce for raw water from Jim Chapman Lake. In turn, the City of Commerce has a contract with the Sulphur River Municipal Water District (SRMWD), who owns 20 percent of the water rights in Chapman Lake.[8] The City of Commerce contracts for half of SRMWD's share of Chapman Lake (10 percent of the lake's total water). UTRWD's contract with the City of Commerce is for a maximum of 16,106 AF/year.[9] In fact, due to water availability in Chapman Lake, UTRWD has only been able to divert a maximum of 13,730 AF in the 11 years it has had this contract, with an average of 11,090 AF. The contract was signed in 1991 and automatically renews every 25 years unless UTRWD provides five years notice prior to termination. After 2066, the City of Commerce can reduce the quantity of water supplied with each subsequent renewal and in 2141 they have the right to cancel the contract if they wish. Included in this contract is an inter-basin transfer permit allowing UTRWD to transfer the water from the Sulphur River Basin to the Trinity River Basin. UTRWD gets raw water via the Irving pipeline which delivers it directly to the Tom Harpool WTP and from an intake in Lewisville Lake that connects to the Thomas E. Taylor WTP.

[7] Letter from Jody Puckett, Director, DWU to Stephen Brooks, USACE, January 28, 2015.
[8] The SRMWD consists of the cities of Sulphur Springs, Commerce and Cooper.

[9] This is the entire amount of the contract between the City of Commerce and SRMWD.

In sum, this supply source depends on the fulfillment of two contracts, but those appear to be secure for at least 60 years. An additional contract with the City of Irving was executed in 1999 that provided space in a pipeline to convey the Chapman Lake raw water to Lewisville Lake. This supply is also subject to shortages of available water in Chapman Lake during drought conditions.

1.6.1.3 City of Denton Contract

Currently the City of Denton owns water rights in Lewisville and Ray Roberts Lakes in excess of their needs. UTRWD has a contract with the City of Denton to purchase this excess raw water. The City of Denton provides this excess raw water to UTRWD via UTRWD's intake in Lewisville Lake. The quantity of water available for purchase by UTRWD is determined by the City of Denton on an annual basis and varies each year. In 2013, UTRWD purchased approximately 6,900 AF from the City of Denton. This contract expired in 2012, but UTRWD has exercised its option to renew for another 10-year period and the negotiations are ongoing. The City of Denton anticipates that its water needs will grow and this UTRWD water supply will diminish to zero by 2022.[10] This supply is excluded from available UTRWD supplies in this EIS after 2022.

1.6.1.4 State of Texas Reuse Permit

UTRWD holds a reuse permit from the State of Texas allowing for the withdrawal of up to 9,664 additional AF/YR of water from Lewisville Lake annually.[11] The specific amount is based on effluent treated by UTRWD but cannot exceed 9,664 AF/YR. The daily allowed withdrawal is equal to 60 percent of the amount of Chapman Lake water deposited into Lewisville Lake for use by UTRWD on the previous day assuming UTRWD brings over the full authorization of 16,106 AF/year from Lake Chapman. The reuse permit takes into account the fact that only a portion of the water that UTRWD takes from Lewisville Lake is fully consumed; the remainder is used in a manner such that it ends up back in Lewisville Lake. Almost all the water reclamation plants serving UTRWD's Customers release treated water back into Lewisville Lake. While the reuse permit makes additional water available for UTRWD Customers, it is dependent on the daily availability of water from Chapman Lake which is considered a reliable source.

1.6.1.5 Permits and Agreements

UTRWD has the following permits and agreements in place in order to operate its water system:

- UTRWD has a pass-through agreement with DWU, the City of Denton and the City of Lewisville allowing them to transfer its water across Lewisville Lake. This agreement

[10] CP & Y, Raw Water Reliability Study, Upper Trinity Regional Water District, 2010b

[11] The permit includes a pass-through clause, which states that the current pass-through agreements UTRWD has negotiated with the Cities of Dallas, Denton and Lewisville apply equally to the reuse water. Additionally, reuse water is not subject to a priority call by senior water rights owners in the Trinity Basin. The permit only applies to water that UTRWD brings over from Chapman Lake and becomes null and void if any of the contracts involved in bringing the water over expire or are terminated.

stipulates daily accounting, so any water UTRWD puts in to Lewisville Lake has to be taken out that day or it becomes unavailable. UTRWD water imported into the Trinity Basin is either diverted directly to the Tom Harpool WTP Emergency Storage Pond or discharged into Lewisville Lake via Doe Branch Creek. Water diverted to Doe Branch Creek is withdrawn at the UTRWD Lewisville Lake raw water intake and treated at the Thomas E. Taylor WTP. As part of this agreement, UTRWD is allowed to purchase additional raw water from DWU. The amount purchased is limited to 40 percent of the Jim Chapman Lake return flows discharged into the Lewisville Lake drainage basin. While the long term water supply plan from Dallas does not assume any additional sales to UTRWD beyond the water for the named entities, to ensure a conservative supply estimate, this possibility is included in the analysis.

- To transfer the raw water associated with the Commerce Contract from Chapman Lake to Lewisville Lake, UTRWD executed a conveyance contract with the City of Irving in 1999 for 23 percent of their pipeline capacity. In 2002 the contract was amended. As amended, the contract provided for the conveyance of 16,106 AF/year from Jim Chapman Lake and any other water UTRWD may obtain the right to divert and use such as Lake Ralph Hall. The contract also provides that UTRWD may use any pipeline capacity not being used by the City of Irving. The contract expires in 2029, but will be automatically renewed for an additional 25 years unless UTRWD provides five years notice. UTRWD has no control over the operation or maintenance of this pipeline.

- UTRWD holds a "bed & banks" permit (Texas Natural Resource Conservation Commission [TNRCC], 2002) which allows them to transfer Chapman Lake water through Doe Branch (see **Figure 1-6**) and Lewisville Lake. UTRWD holds Permit No. 5701 issued by TCEQ which grants UTRWD the right to discharge its Lake Chapman Water at a rate up to 76,389 gallons per minute (gpm) into Doe Branch and transport the water along the bed and banks of Doe Branch and Lewisville Lake to UTRWD's water treatment plant on the banks of Lewisville Lake (Thomas E. Taylor WTP) for subsequent diversion. This is a perpetual right, as defined under Texas water law, and is considered to meet the reliable requirement of this analysis. This permit allows UTRWD to deposit water into the north end of Lewisville Lake and then withdraw it at their WTP on the south shore. The permit places limits on both the rate of discharge (~ 76,000 gpm) and the annual quantity conveyed through Doe Branch (~16,000 AF/year).

With the exception of the pass-through agreement, which provides up to 6,400 AF/year, these agreements are operational in nature and do not provide UTRWD with any additional water supplies.

1.6.1.6 Water Treatment Facilities

UTRWD currently operates two WTPs (see **Figure 1-9**). The Thomas E. Taylor Regional WTP was expanded to a treatment capacity of 70 mgd in 2001. Its intake is located just north of the Lewisville Lake Dam. The Tom Harpool WTP began operation in 2008 and has a treatment capacity of 20 mgd. Raw water is provided to it from the City of Irving pipeline. A pipeline also connects the Thomas E. Taylor WTP to the Tom Harpool WTP which supplies treated water when the Irving Pipeline is out of service. The two plants operate as a system to meet the needs of the UTRWD's Customers. The two plants are connected by a water transmission pipeline, which has a limited capacity of approximately 8 mgd. This limits UTRWD's ability to serve its Customers from either plant alone. During the peak water demand months, each plant must meet the needs of the Customers in proximity to that plant.

UTRWD's water reclamation program includes three water reclamation plants (see **Figure 1-9**): 1) the 5.5 mgd Lakeview Treatment Plant located in the City of Lake Dallas; 2) the 2.0 mgd Riverbend Treatment Plant and; 3) the 0.94 mgd Peninsula Treatment Plant serve Customers in the northeast portion of UTRWD's service area.[12] A fourth treatment plant (the 2.0 mgd Doe Branch Treatment Plant) is currently under construction to meet future growth.

1.6.1.7 Emergency Water Supplies to UTRWD Members and Customers

UTRWD also maintains the following interconnections with other water providing entities for emergency purposes: 1) a connection with the DWU that could serve the Denton County Fresh Water Supply District (FWSD) also known as Castle Hills; 2) a connection with the City of Lewisville that could serve the City of Highland Village upon completion of required improvements; 3) a connection with the City of Denton on I-35 E that could serve the Lake Cities MUA, City of Corinth, Argyle WSC, and Cross Timbers WSC and; 4) a connection with the City of Denton on FM 2181 that could serve the City of Lantana, Lake Cities MUA, City of Corinth, Argyle WSC, and Cross Timbers WSC once some minor construction is completed.

1.6.1.8 Additional Water Supplies Available to UTRWD Members and Customers

Certain UTRWD Members and Customers obtain water from other sources:

- The City of Denton treats their own water.
- Flower Mound receives up to 11 mgd of its treated water from DWU, all remaining needs are met by UTRWD.

[12] Wastewater treatment plants also function as water reclamation plants.

- The City of Lewisville receives treated and raw water from DWU.
- Northlake currently receives two thirds of its water from Fort Worth by contract.
- Celina may receive up to 30 percent of its future supplies from the North Texas Municipal Water District.
- Certain existing Members and Customers currently supplement their supplies with groundwater.

These water supplies are accounted for in assessing the future demands upon UTRWD from present and prospective Members and Customers[13].

1.6.1.9 Summary of Available Water Supplies

The above sources provided UTRWD with an estimated total supply of 45,600 AF in 2010 and are expected to provide about 43,400 AF from 2020 through 2060. The total amount of water that UTRWD Members, Customers and Prospective Customers obtain from other sources was about 40,500 AF in 2010 and these are projected to grow to around 56,200 AF by 2060. The total amount of water available to UTRWD's Members, Customers and Prospective Customers from all sources was approximately 86,100 AF in 2010, increasing to just over 99,600 AF in 2060.

1.7 Water Demand

Water demands are a critical element in determining the need for the Lake Ralph Hall project. UTRWD's Members and Customers face future water demands which they expect UTRWD to supply. Future water demands must be projected for comparison with available supplies from UTRWD plus those other supplies available to the Members and Customers to indicate whether or not there are future unmet needs which UTRWD must fill with alternative water supplies. The projection of water demands into the long term is the starting point for this comparison to determine the quantity of new water supplies that will be required in the future and when those needs will occur.

Water demands can be projected through a number of techniques, but the technique most widely utilized by the UTRWD, many other water utilities, and TWDB, is a population/gpcd-based approach. This technique requires the development of population projections and the application of those projections to water use patterns expressed as gallons per capita per day (gpcd). Whereas econometric demand forecasting approaches or sectoral demand projections are respected water demand forecasting techniques as well, the gpcd-based technique is appropriate in this instance.

[13] The list of Prospective Customers is restricted to those entities that have a contractual relationship with UTRWD for future water service and have an explicit expression to participate. There will likely be other entities that receive water from UTRWD in the future, but they are not included in this EIS.

The relatively large number of small entities have limited data, which means that the gpcd approach is the best practicable approach for accomplishing the demand projections.

TWDB has also prepared demand projections as part of the state-wide water planning process; UTRWD is located within Region C, and is thus subject to the Region C Plan. The UTRWD projections are found in the 2010 RWRS. The TWDB has also prepared demand projections as part of the state-wide water planning process; the Region C Plan is the component which includes UTRWD. The population and water use data for these projections were evaluated and utilized to the extent appropriate in the water demand projections for this EIS. Population projections from other entities were also considered. Water use pattern information from a separate survey, conducted specifically for this EIS was utilized in the analyses. The population estimation, projections, and the water use pattern data are described below, leading to the water demand projections adopted for this EIS.

1.7.1 Population

Historically, population estimates are not compiled specifically for the UTRWD since it is not a county, municipality or a Census designated place. The UTRWD service area is comprised of cities and towns designated by the census, but also water user groups, including WSCs, FWSDs and MUAs, which are not estimated by the Bureau of Census or agencies normally responsible for population estimates and projections. This group of small communities and rural areas are situated on the northern outskirts of the Dallas metropolitan area and are continuing to become urbanized. As suburbanization occurs in North Dallas, these areas have evolved into suburban, mostly bedroom communities.

Current UTRWD Members and Customers and those Customers who are expected to join UTRWD in future years are included in the historical population data, the population projections and the water demand projections. Contractual commitments from each existing Member and Customer have been examined to verify the UTRWD supply responsibility. For future customers, this EIS only considers those with a written, clear and explicit request expressing an interest in joining UTRWD, coupled with UTRWD's geographic service responsibility expressed in its authorization documents.[14] In fact, it is possible that UTRWD will have additional customers not accounted for in this EIS. Historical population estimates for UTRWD's Members and Customers establish growth trends and are utilized in calculating gpcd. As set forth in **Table 1-5**, historical population estimates from 1990 through the year 2013 were compiled and estimated from a number of sources, including Bureau of the Census and Customer counts from individual water suppliers. The UTRWD Service area grew by almost four-fold from 1990 through 2013, from about 66,000

[14] UTRWD is governed by a Board of Directors appointed by its members. Members set the policies of UTRWD and establish the programs through their direct representation on the Board of Directors. Consequently, the services provided by UTRWD fit local needs and are in response to the requests of its Members (http://www.utrwd.com/History.html).

persons to 249,000 persons. Average annual growth was 5.9 percent during the 1990-2013 period and 4.5 percent from 2000 through 2013.

Table 1-5: Population Trends for UTRWD Members and Customers, 1990-2013

Members and Customers	1990	2000	2010	2011	2012	2013
Current						
Argyle WSC (total)	4,197	6,232	9,372	9,513	9,760	10,090
Argyle	1,575	2,322	3,282	3,336	3,442	3,561
Argyle WSC	2,622	3,910	6,090	6,177	6,318	6,529
Aubrey	1,138	1,561	2,595	2,677	2,703	2,718
Cross Timbers WSC (total)	4,407	5,684	7,070	7,371	7,521	7,641
Bartonville	849	1,131	1,469	1,604	1,621	1,633
Cross Timbers WSC	916	861	1,400	1,470	1,543	1,620
Copper Canyon	978	1,258	1,334	1,368	1,388	1,393
Double Oak	1,664	2,434	2,867	2,929	2,969	2,995
Celina	1,737	3,060	6,028	6,315	6,537	6,744
Corinth	3,944	11,383	19,935	20,250	20,517	20,618
Denton County FWSD #1A	748	2,400	7,749	8,921	9,720	10,922
Denton County FWSD #7	29	604	6,874	6,960	7,549	8,018
Denton County FWSD #8A	8	15	2,501	3,363	3,567	4,430
Denton County FWSD #9	66	672	4,786	5,230	5,674	6,106
Denton County FWSD #10	0	27	4,307	4,352	4,396	4,834
Denton County FWSD #11A	8	198	2,753	3,237	3,534	4,004
Flower Mound	15,527	50,853	64,669	66,112	67,969	68,609
Highland Village	7,027	12,172	15,056	15,389	15,617	15,747
Justin	1,234	1,894	3,246	3,290	3,322	3,333
Krum	1,542	2,077	4,157	4,339	4,503	4,632
Lake Cities MUA (total)	6,594	9,719	12,964	13,280	13,497	14,065
Hickory Creek	1,893	2,064	3,247	3,362	3,439	3,970
Lake Dallas	3,656	6,101	7,105	7,238	7,315	7,337
Shady Shores	1,045	1,554	2,612	2,680	2,743	2,758
Lincoln Park	287	517	308	311	312	311
Northlake	250	676	1,724	1,860	1,871	1,880
Mustang SUD (Denton Co) (total)	3,645	6,466	12,591	12,482	13,153	13,805
Cross Roads	361	581	1,563	853	862	865
Krugerville	735	1,032	1,662	1,608	1,625	1,637
Mustang SUD	1,904	3,099	6,580	7,095	7,649	8,248
Oak Point	645	1,754	2,786	2,926	3,017	3,055
Sanger	3,508	4,864	6,916	7,072	7,155	7,415
Denton County Unincorporated	10,404	20,062	27,850	29,081	31,385	32,714

Members and Customers	1990	2000	2010	2011	2012	2013
Subtotal:	**66,291**	**141,135**	**223,451**	**231,404**	**240,262**	**248,635**
Prospective Customers						
Ladonia	658	682	612	611	608	605
Pilot Point	2,538	3,550	3,856	3,912	3,989	4,006
Ponder	771	993	2,491	2,545	2,589	2,604
Prosper (Denton County portion only)	-	-	-	-	-	-
Subtotal:	**4,136**	**5,584**	**7,504**	**7,623**	**7,746**	**7,778**
Total:	**70,427**	**146,719**	**230,955**	**239,027**	**248,008**	**256,412**

Note: The list of Prospective Customers is restricted to those entities that have a contractual relationship with UTRWD for future water service and have an explicit expression to participate. There will likely be other entities that receive water from UTRWD in the future, but they are not included in this EIS.

Source: US Census Bureau, 2014; Raw Water Reliability Study, UTRWD, 2010b; 2011 Region C Plan, TWDB, 2011; UTRWD Member/Customer Survey, 2009; Harvey Economics (HE), 2014

Since the UTRWD serves a portion of Denton County and its mission is to continue to serve Denton County jurisdictions which request service, the growth of Denton County and its relationship to the UTRWD is instructive for UTRWD's own population projections. Denton County experienced an average annual growth rate of 4.4 percent from 1990 through 2013 and 4.1 percent from 2000 through 2013. UTRWD Members and Customers represented about 24 percent of total Denton County population in 1990; this percentage rose to 33 percent by 2000 and to 34 percent by 2013. It is clear that both have grown substantially since 1990 and that the relationship of UTRWD service area to Denton County has been relatively consistent from the standpoint of population, with UTRWD growing somewhat faster than Denton County. **Table 1-6** provides alternative population projections for Denton County from the year 2010 through 2060.

Table 1-6: Alternative Population Projections for Denton County, 2010 through 2060

Year	Texas State Data Center*		Texas Water Development Board		NCTCOG	
	Population	Average Annual Growth Rate	Population	Average Annual Growth Rate	Population	Average Annual Growth Rate
2010	662,614	4.35%	674,322	4.53%	643,572	4.16%
2020	827,987	2.25%	889,705	2.81%	862,332	2.97%
2030	1,028,537	2.19%	1,118,010	2.31%	1,085,343	2.33%
2040	1,268,195	2.12%	1,347,185	1.88%	N/A	N/A
2050	1,535,959	1.93%	1,573,994	1.57%	N/A	N/A
2060	N/A	N/A	1,839,507	1.57%	N/A	N/A

* Note: This is the 0.5 scenario. For a description of the scenarios, see text.

Source: The Texas State Data Center, 2012; TWDB, 2011; North Central Texas Council of Governments (NCTCOG), 2009.

The Texas State Data Center (currently the Texas Demographic Center) prepares and publishes population projections for jurisdictions throughout the State of Texas. They employ a cohort survival model and a population migration component with their projections under several scenarios. The different scenarios prepared by the Texas State Data Center refer to the amount of migration which occurred from 1990 to 2000, and the projection of that amount of migration going forward. The 0.5 scenario assumes that half the migration that occurred from 2000 to 2010 will continue through the year 2050. The TWDB also projects population for various water suppliers. The forecasting methodology employed by the TWDB is similar to that of the Texas State Data Center except that migration rates for each county are modified based upon urbanization with a recognition for counties which are near build-out versus more sparsely populated areas likely to be urbanized. This county specific consideration is considered more accurate in the instance of Denton County. The North Central Texas Council of Governments (NCTCOG) projects population for Denton County as well. They employ a land-use based approach.

The RWRS prepared by UTRWD in 2010 updates the population projections from the 2006 TWDB projections and focuses on UTRWD Members and Customers. This report relies upon build-out information for specific jurisdictions as well as population projections, developer plans and other Customer specific aspects of future development. The RWRS relies upon the underlying methodology of the Texas State Data Center and the TWDB, but is more specific to the UTRWD service area.

During the evaluation of data and preparation of the DEIS, a top down population forecasting approach was chosen because projecting UTRWD's service area population as a whole is more reliable than projecting each small entity. The Denton County average annual growth rates from TWDB are considered the most appropriate starting point for these service area projections. However, it is believed that the UTRWD service area population will grow more rapidly than Denton County, based on past trends and the RWRS projections. The average annual growth rates adopted for this EIS are shown in **Table 1-7**.

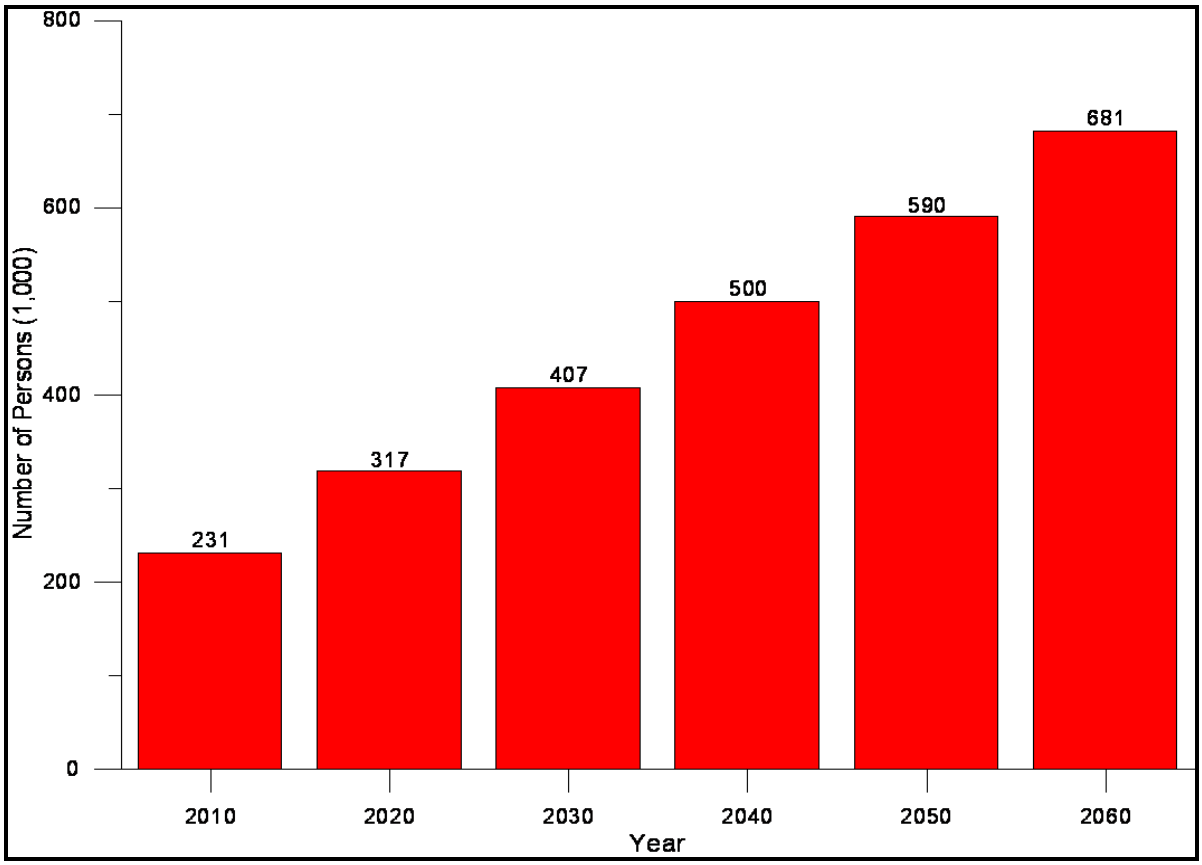
Table 1-7: Projected UTRWD Service Area Population Growth Rates, 2010 through 2060

Years	Denton County Growth Rate	Incremental Growth Rate for UTRWD Service Area	Adopted Annual Growth Rates for UTRWD Service Area
2010 to 2020	2.81%	0.30%	3.11%
2020 to 2030	2.31%	0.20%	2.51%
2030 to 2040	1.88%	0.20%	2.08%
2040 to 2050	1.57%	0.10%	1.67%
2050 to 2060	1.57%	-	1.57%

Source: The Texas Water Development Board, 2011; and HE 2014.

The incremental growth rate assumes a small, declining difference between UTRWD and Denton County growth rates. UTRWD service area population projections from the year 2010 through 2060 are set forth in **Figure 1-10**.

Figure 1-10: Projected UTRWD Service Area Population, 2010 through 2060



Source: HE, 2014. The 2010 population is from the decennial census. The 2020 population was projected from the 2013 population using the 2010 to 2020 adopted annual growth rate for the UTRWD area for seven years. The remaining decades were projected using the appropriate growth rate for ten years. Population is expected to increase from approximately 230,000 persons in 2010 to 681,000 persons by the year 2060 for an average annual growth rate of about 2.2 percent. Although these projections assume a fairly rapid growth rate, they are less than the recent historical experience for Denton County and the UTRWD service area. They are also consistent with the transformation of Denton County from rural agricultural communities to an urbanized area over the next 50 years.

Population projections for individual UTRWD Members and Customers were developed from a share of growth method. That is, the share of growth for each individual Member and Customer from the year 2010 to the year 2020 was applied to the total population change each decade to estimate population by entity. Based on the 2009 UTRWD Member and Customer surveys and the 2010 RWRS, a number of entities will reach build-out before 2060; their populations were held constant, and the growth which would have been allocated to them was re-allocated to the remaining entities who had not reached build-out. **Table 1-8** provides population projections for current and prospective Members and Customers through the year 2060.

Table 1-8: Projected Population for UTRWD Members and Customers, 2010 through 2060

Members and Customers	2010	2020	2030	2040	2050	2060
Current						
Argyle WSC (total)	9,400	12,100	15,100	18,500	22,100	25,800
Argyle	3,300	4,200	6,300	9,700	13,300	17,000
Argyle WSC	6,100	7,900	8,800	8,800	8,800	8,800
Aubrey	2,600	3,300	5,000	7,700	10,500	13,400
Cross Timbers WSC (total)	7,100	8,400	10,700	12,300	12,900	12,900
Bartonville	1,500	1,900	2,800	4,400	5,000	5,000
Cross Timbers WSC	1,400	2,000	2,800	2,800	2,800	2,800
Copper Canyon	1,300	1,500	2,100	2,100	2,100	2,100
Double Oak	2,900	3,000	3,000	3,000	3,000	3,000
Celina	6,000	8,600	12,900	20,000	27,400	35,000
Corinth	19,900	25,400	28,000	28,000	28,000	28,000
Denton County FWSD #1A	7,700	12,200	12,200	12,200	12,200	12,200
Denton County FWSD #7	6,900	11,800	12,500	12,500	12,500	12,500
Denton County FWSD #8A and 11A	5,300	12,700	16,700	16,700	16,700	16,700
Denton County FWSD #9	4,800	8,900	10,300	10,300	10,300	10,300
Denton County FWSD #10	4,300	7,300	10,900	16,900	17,000	17,000
Flower Mound	64,700	77,700	93,000	93,000	93,000	93,000
Highland Village	15,100	17,600	18,000	18,000	18,000	18,000
Justin	3,200	4,100	6,100	9,400	12,900	15,500
Krum	4,200	5,900	7,000	7,000	7,000	7,000
Lake Cities MUA (total)	13,000	16,300	21,300	21,800	21,800	21,800
Hickory Creek	3,200	5,000	7,400	7,900	7,900	7,900
Lake Dallas	7,100	8,000	9,900	9,900	9,900	9,900
Shady Shores	2,600	3,400	3,900	3,900	3,900	3,900
Lincoln Park	300	800	1,000	1,100	1,300	1,500
Northlake	1,700	2,500	3,700	5,800	7,900	10,100
Mustang SUD (Denton Co) (total)	12,600	17,600	26,300	40,700	55,700	71,000
Cross Roads	1,600	1,000	1,500	2,300	3,200	3,800
Krugerville	1,700	1,900	2,900	4,500	6,200	7,900
Mustang SUD	6,600	10,900	16,300	25,200	34,500	44,200
Oak Point	2,800	3,700	5,600	8,600	11,800	15,100
Sanger	6,900	8,700	13,100	20,200	27,700	35,400
Denton County Unincorporated	27,900	39,200	58,700	90,700	124,300	159,000
Subtotal:	**223,500**	**301,200**	**382,700**	**462,900**	**539,300**	**617,200**
Prospective Customers						
Ladonia	600	600	600	600	600	600

Members and Customers	2010	2020	2030	2040	2050	2060
Pilot Point	3,900	4,200	6,300	9,800	13,400	17,200
Ponder	2,500	3,400	5,100	7,900	10,900	13,900
Prosper (Denton County portion only)	-	8,000	12,000	18,500	25,400	32,400
Subtotal:	**7,500**	**16,300**	**24,100**	**36,900**	**50,300**	**64,100**
Total:	**231,000**	**317,500**	**406,700**	**499,800**	**589,600**	**681,300**

Note: The list of Prospective Customers is restricted to those entities that have a contractual relationship with UTRWD for future water service and have an explicit expression to participate. There will likely be other entities that receive water from UTRWD in the future, but they are not included in this EIS.
Source: HE, 2014.

Denton County unincorporated population is included since persons not currently within a Member or Customer boundary are expected to eventually join one of those entities as their boundaries expand and they will then be served by UTRWD. Although population is expected to grow considerably overall, there will continue to be certain Members or Customers who are much larger than others; the Cities of Celina and Sanger, the Towns of Flower Mound and Prosper[15], and the Mustang SUD will likely be the largest Members and Customers by the year 2060. These individual entity population projections are applied to the gpcd estimates to arrive at water demand projections.

1.7.2 Water Use Patterns

An important consideration in water demand forecasting is the historical water use patterns. As part of its efforts to independently evaluate the need for the proposed project and provide full information concerning project need, USACE requested that UTRWD conduct a survey of its Members and Customers to ascertain their historical water use patterns. Total water sales including residential, commercial and public water uses were gathered for the Members and Customers of UTRWD from the years 2000 through 2012. These data were supplemented with information from the RWRS and the 2011 Region C plan from the TWDB. For each Member and Customer, the total water use was divided by the population for that entity in that year to derive a gpcd estimate by year from 2000 through 2012. **Table 1-9** displays the gpcd estimates for UTRWD Members and Customers from 2000 through 2012.

[15] This refers only to the portion of Prosper that is in Denton County and will be served by UTRWD.

Table 1-9: Water Demand Patterns for UTRWD Members and Customers, 2000 through 2012

Members and Customers	Gallons Per Capita Per Day (GPCD)				
	2000	2010	2011	2012	Average 2000 - 2012
Current					
Argyle WSC (total)	224	226	215	223	220
Argyle	274	292	292	292	284
Argyle WSC	194	191	174	185	183
Aubrey	96	104	106	102	106
Cross Timbers WSC (total)	205	164	176	169	170
Bartonville	172	134	136	132	136
Cross Timbers WSC	243	151	161	150	181
Copper Canyon	234	188	204	198	202
Double Oak	191	175	191	185	166
Celina	103	159	155	155	130
Corinth	207	140	163	156	192
Denton County FWSD #1A	146	217	214	187	183
Denton County FWSD #7	227	184	224	199	181
Denton County FWSD #8A and 11A	48	129	120	119	99
Denton County FWSD #9	99	118	120	113	122
Denton County FWSD #10	62	113	155	149	206
Flower Mound	194	207	135	206	199
Highland Village	137	196	212	201	174
Justin	148	120	132	119	132
Krum	111	99	113	126	111
Lake Cities MUA (total)	117	116	127	116	118
Hickory Creek	164	141	152	139	149
Lake Dallas	100	117	128	118	110
Shady Shores	124	84	91	83	103
Lincoln Park	116	129	123	124	114
Northlake	163	141	142	152	139
Mustang SUD (Denton Co) (total)	139	111	138	121	133
Cross Roads	389	224	506	463	324
Krugerville	77	74	95	87	81
Mustang SUD	117	86	98	84	108
Oak Point	131	128	150	135	138
Sanger	264	146	135	130	135

Members and Customers	Gallons Per Capita Per Day (GPCD)				
	2000	2010	2011	2012	Average 2000 - 2012
Denton County Unincorporated	198	221	217	219	206
Weighted Average Subtotal:	**180**	**177**	**191**	**178**	**177**
Prospective Customers					
Ladonia	321	74	74	74	171
Pilot Point	121	177	182	187	145
Ponder	163	90	91	92	109
Prosper (Denton County portion only)	N/A	N/A	N/A	N/A	N/A
Weighted Average Subtotal:	**122**	**121**	**123**	**125**	**118**
Weighted Average Total:	**175**	**172**	**186**	**174**	**172**

Note: The list of Prospective Customers is restricted to those entities that have a contractual relationship with UTRWD for future water service and have an explicit expression to participate. There will likely be other entities that receive water from UTRWD in the future, but they are not included in this EIS.
Source: UTRWD Survey of Members and Customers; Raw Water Reliability Study, 2010b; 2011 Region C Plan, 2011; HE, 2014.

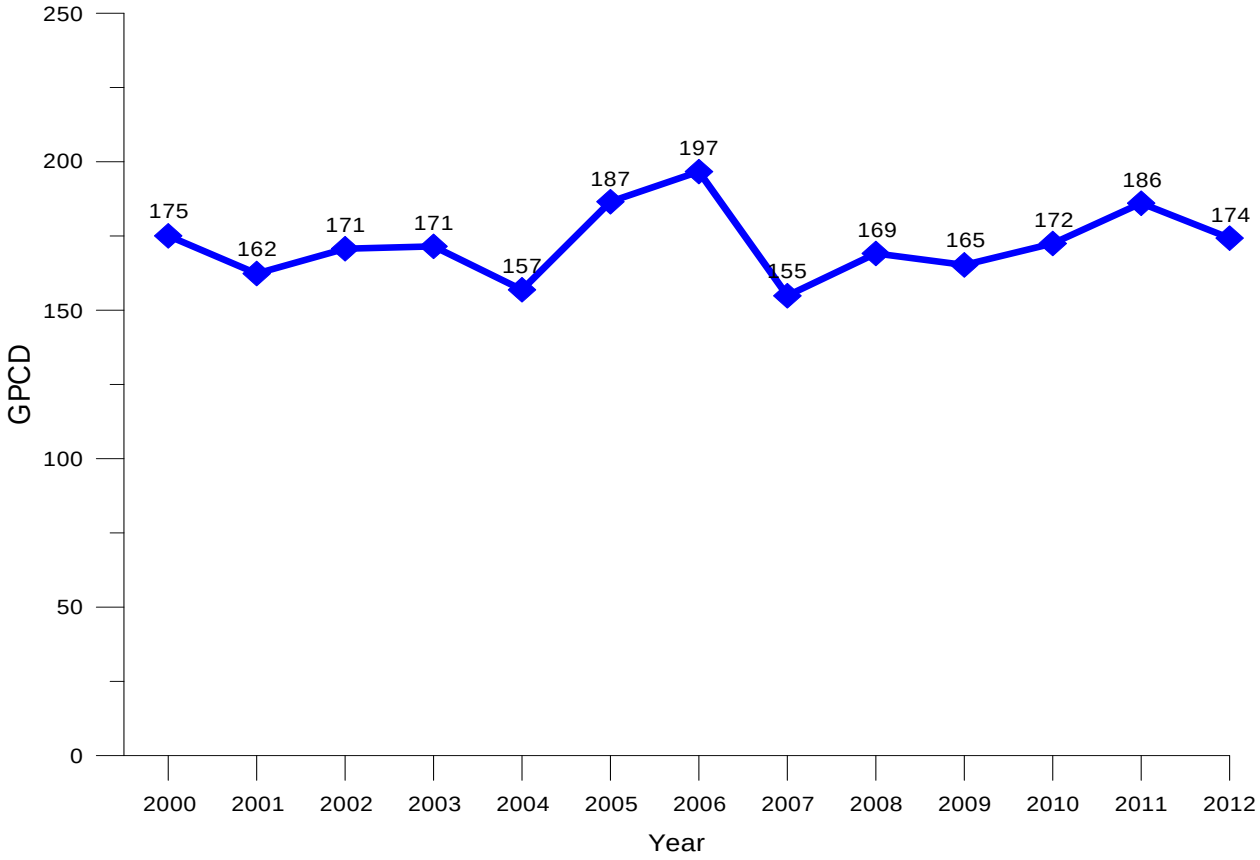
The gpcd varies from year to year for each Member and Customer for a number of reasons, including weather variation, the implementation of conservation programs, and evolving socioeconomic conditions in that particular Member or Customer's jurisdiction. For example, growth in commercial development with urbanization would result in increasing gpcd. Measurement anomalies might exist for certain districts. However, some districts with high gpcd's might exhibit water use practices inconsistent with UTRWD's conservation mandate.

The average gpcd figures for 2000 through 2012 for each Member and Customer provided in **Table 1-9** also shows a very wide variation. Water use pattern differences among Members and Customers, as indicated can be explained by a number of factors including, but not limited to the variation of socioeconomic characteristics from entity to entity, (i.e., income levels, family size, size and mix of dwelling units, etc.); the extent of commercial and public water use, (i.e., shopping, offices, schools, hospitals, etc.); losses; the extent of outdoor watering or landscaping; water use practices; and weather patterns.

A specific analysis of these factors was not conducted[16]. Even recognizing these differences among Members and Customers, the average water use among all the current and prospective Customers of UTRWD present a relatively stable trend from 2000 through 2012, as exhibited in **Figure 1-11**.

[16] Both Argyle and Cross Roads have unusually high gpcds. As they together account for only 3.2 percent of the 2010 overall demand, an in-depth analysis to determine the causes of these high gpcds was deemed not worthwhile.

Figure 1-11: Average GPCD among UTRWD Current and Prospective Customers, 2000 through 2012



Source: HE, 2012. The average gpcd for all the current and prospective UTRWD Members and Customers from 2000 through 2012 is 172. There is no apparent trend in gpcd over time among UTRWD Members and Customers when viewed as a group.

To project water demand at the tap or point of use, a gpcd assumption was developed for each UTRWD Member and Customer:

- For almost half of the Members and Customers, the gpcd assumption was the average gpcd for that entity from 2000 through 2012. This assumption is considered reasonable, since that time period included wet years and dry years and overall gpcd averages indicate no long-term upward or downward trends.[17] By basing gpcd assumptions on the recent historical average, conservation measures that were put in place prior to 2000 are imbedded in the water use patterns. In this manner, existing conservation is accounted for and assumed to continue through the long-term projection period.

- In instances where the historical water use data was lacking or inconsistent, or when gpcd figures appeared to be abnormally high or low, gpcd data and assumptions from other sources, including the UTRWD's Draft RWRS, the 2006 Region C Plan, and the TWDB

[17] Examination of gpcd data from the Statewide water planning effort for Region C, also indicated that these entities generally do not exhibit consistent long-term gpcd trends prior to the year 2000.

historical gpcd data were considered. Further, if an entity was currently undeveloped and expected to grow substantially by 2060, gpcd was increased to reflect the evolving presence of a commercial and public water use base in that particular jurisdiction. Reliable recent historical water use data were not available for the prospective customer group; it was assumed that their future water use patterns would be similar to current UTRWD Members and Customers. The assumed gpcd for each jurisdiction was applied to population projections for that jurisdiction to project water demand at the tap or point of use for Members and Customers through the year 2060, as shown in **Table 1-10**.

Total water demands at the point of use are expected to increase from approximately 14.7 billion gallons in 2010 to 43.5 billion gallons by the year 2060.

Distribution or system loss, treatment plant loss, plus water losses from the master meter of each Member or Customer back to the point of diversion (i.e. the losses occurring between the water's source, conveyance, interim storage, treatment and the customer's delivery point) must be estimated and projected to compare future water demands with the potential yield of the proposed Lake Ralph Hall project or other water resource alternatives. Water loss from the tap, or point of use, back to the master meter for each Member or Customer was gathered through the survey of Members and Customers conducted by UTRWD in 2009 and updated in 2014. Losses varied from year to year, depending upon pipe flushing, public losses, leak detection and remediation. Weighted average losses for those jurisdictions which responded to the survey amounted to 6.6 percent.[18] Conveyance losses from the point of diversion to the master meter have been estimated by UTWRD (and accepted by the TCEQ) to average 2.9 percent per year, from 2009 through 2013.[19]

[18] Loss data was provided by seventeen of the twenty UTRWD Members and Customers, covering over 85 percent of the total water use. No loss data was available for Denton County Unincorporated or any of the prospective customers.

[19] Texas Commission on Environmental Quality, Water Conservation Implementation Report for UTRWD, May, 2014.

Table 1-10: Water Demand Projections for UTRWD Members, Customers and Prospective Customers at Point of Use, 2010 through 2060

Members and Customers	GPCD Assumptions for Projections	Millions of Gallons					
		2010	2020	2030	2040	2050	2060
Current							
Argyle WSC (total)		774	972	1,256	1,617	1,995	2,384
Argyle	291	350	447	667	1,029	1,407	1,795
Argyle WSC	183	424	525	588	588	588	588
Aubrey	121	98	129	200	319	450	593
Cross Timbers WSC (total)		424	499	638	714	745	745
Bartonville	136	72	94	141	218	249	249
Cross Timbers WSC	157	77	115	160	160	160	160
Copper Canyon	202	92	108	154	154	154	154
Double Oak	166	183	182	182	182	182	182
Celina	154	351	487	729	1,127	1,544	1,974
Corinth	151	1,017	1,397	1,542	1,542	1,542	1,542
Denton County FWSD #1A	204	613	911	911	911	911	911
Denton County FWSD #7	181	461	780	824	824	824	824
Denton County FWSD #8A and 11A	122	248	563	744	744	744	744
Denton County FWSD #9	122	207	395	456	456	456	456
Denton County FWSD #10	148	178	395	591	913	917	917
Flower Mound	208	4,889	5,896	7,053	7,053	7,053	7,053
Highland Village	194	1,076	1,245	1,275	1,275	1,275	1,275
Justin	132	142	197	295	456	624	798
Krum	136	150	231	291	310	329	347
Lake Cities MUA (total)		550	701	929	956	956	956
Hickory Creek	141	168	255	382	409	409	409
Lake Dallas	116	303	338	422	422	422	422
Shady Shores	88	80	108	126	126	126	126
Lincoln Park	139	14	40	48	56	65	76
Northlake	140	89	128	191	296	405	518
Mustang SUD (Denton Co) (total)		509	729	1,153	1,875	2,699	3,584
Cross Roads	294	128	109	163	251	344	408
Krugerville	101	45	57	91	149	216	291
Mustang SUD	132	206	377	620	1,044	1,547	2,128
Oak Point	137	130	187	279	432	592	756
Sanger	135	369	429	642	991	1,359	1,737

Members and Customers	GPCD Assumptions for Projections	Millions of Gallons					
		2010	2020	2030	2040	2050	2060
Denton County Unincorporated	206	2,244	2,943	4,407	6,808	9,329	11,929
Subtotal:		**14,403**	**19,067**	**24,175**	**29,245**	**34,223**	**39,364**
Prospective Customers							
Ladonia	74	16	16	16	16	16	16
Pilot Point	177	249	274	410	634	869	1,111
Ponder	177	81	222	332	513	703	899
Prosper (Denton County portion only)	177	-	517	774	1,196	1,639	2,096
Subtotal:		**347**	**1,029**	**1,533**	**2,360**	**3,228**	**4,123**
Weighted Average Total:		**14,479**	**20,096**	**25,708**	**31,605**	**37,451**	**43,487**

Note: The list of Prospective Customers is restricted to those entities that have a contractual relationship with UTRWD for future water service and have an explicit expression to participate. There will likely be other entities that receive water from UTRWD in the future, but they are not included in this EIS.

Source: HE, 2014

1.7.2.1 Safety Factor

Water providers and water supply planners typically include a safety factor in their modeling to provide a buffer in the event of an unanticipated stress on their water delivery systems such as a storage or delivery system failure, forest fire, adverse unexpected court or regulatory rulings, more severe drought than used for planning (including climate change), ineffectiveness of conservation measures or drought restrictions, increased raw water losses in drought years, or higher than expected demand growth. The safety factor goes beyond drought or dry water year planning criteria; it accounts for the myriad of considerations which are simply unaccounted for by water system planners in traditional contingency planning. Some providers use an "increased annual demand" safety factor which increases the anticipated annual demand on their system by a chosen percentage. Others incorporate a "reserve pool" safety factor in their modeling which keeps a quantity of water equal to some percentage of the total annual demand in storage at all times. A third safety factor method employed is a time cushion, e.g. this year's supply will meet demand 10 years in the future. This method allows for a flexible safety factor that will change based on future demand projections. The recently permitted Lower Bois D'Arc Creek Reservoir incorporated a 10 percent safety factor (USACE 2017).

The State of Texas and its water providers recognize and encourage the use of safety factors in water system planning. A safety factor must be reported in all regional water planning group plans. The TCEQ mandates a safety factor of 15 percent for water system capacity.[20] The Region C

[20] TAC, Title 30, Part 1, Chapter 290 Subchapter D Rule 290.45, (g2)

Planning Group generally adopts strategies that will develop a total supply of between 20 and 30 percent greater than the projected demands.[21]

In fact, there is no established standard regarding the size of the safety factor, although in recent USACE Regulatory EIS's, the average safety factor was about 10 percent. Examples include the Northern Integrated Supply Project in Colorado which uses a 10 percent safety factor.[22] This water project is sponsored by a wholesale provider which plays a role similar to UTRWD with its many small retail water suppliers. The San Antonio Water System uses a 10-year time cushion (e.g. the 2010 water demand will be available by the year 2000), which calculates to an 8 percent safety factor.[23] In their 2003 Integrated Water Resource Plan, the Metropolitan Water District of Southern California calls for a 10 percent buffer supply.[24] The Halligan Project in northern Colorado, benefitting the City of Fort Collins, uses an increased annual demand safety factor of approximately 15 percent which is derived from a 15 percent reserve pool factor[25]. The safety factor method chosen for this EIS is the percentage of demand. UTRWD does not control its own supply at present, so the additional supply pool was rejected. The number of years ahead of supply requires assumptions about utility planning and additional steps in recalculation.

This EIS adopts a higher than normal safety factor of 15 percent for the Lake Ralph Hall EIS to reflect the unique aspects of UTRWD and its existing supplies. In addition to the standard risks stated above, the UTRWD faces a less common risk of contract risk. Their entire current supply is all contracted and they do not control any sources of their supply. There is also risk that the other parties to the various contracts would be unwilling or unable to deliver the water or provide the transportation facilities that were contracted for. In 2010, DWU only provided 8,290 AF of the contracted 38,815 AF/year due to limited supplies.[26] The DWU contract must be re-negotiated by 2022 and there are no guarantees about terms, water supply reliability (due to failure to provide committed water in the past), etc. Additionally, Harvey Economics (HE) is assuming that UTRWD has access to the total amount of water specified in all of the UTRWD contracts. In practice, this is not always the case. For example, in the 11 years that they have been diverting water from Jim Chapman Lake, the maximum amount of water that UTRWD has ever diverted was about 85 percent of the total contracted amount.

There is also an unusual demand side risk. In addition to serving existing and the few committed Members and Customers, UTRWD is obligated to serve other water providers in Denton County

[21] 2011 Region C Plan, TWDB, 2014

[22] US Army Corps of Engineers Omaha District, Northern Integrated Supply Project Draft Environmental Impact Statement, April 2008.

[23] San Antonio Water System. Long-Range Plan, San Antonio Water System, San Antonio, TX, 1999.

[24] Metropolitan Water District of Southern California. *Draft Integrated Water Resources Plan, 2003 Update*, Metropolitan Water District of Southern California, Los Angeles, CA, 2003.

[25] [Halligan footnote] Not citable until the reports are published.

[26] Table 4E.15, 2011 Region C Plan, TWDB

if they come forward later and request inclusion. Bolivar WSC inclusion would represent a significant increase, for instance.

More specifically, UTRWD's risks include:

1. The water supply contract with DWU must be renegotiated. The terms of that future contract are not guaranteed.

2. The City of Commerce contract involves the performance of a number of parties. This performance over the long term carries the uncertainties common to such multiple party agreements. The reuse water is subject to the same uncertainty as the City of Commerce supplies coming out of Chapman Lake.

3. The amount of water available under UTRWD's contracts may be less than the total amount of water specified. This is applicable to both the DWU and City of Commerce contracts (plus the reuse agreements, as they rely on the amount of water diverted under the City of Commerce Contract).

4. Regardless, the existing contracts carry a concept of "shared shortage." Unlike firm yield which is available in times of drought, UTRWD will share the shortage in its supply with the other participants in each contract. This creates another layer of uncertainty.

5. Members' and Customers' non-UTRWD supplies face a host of uncertainties. Groundwater might decline in productivity or quality, for instance. If these supplies are inadequate, UTRWD would be obligated to increase its support upon request by Members or Customers.

6. Physical risks with the system are always evident (i.e. pipeline failure, source contamination, etc.).

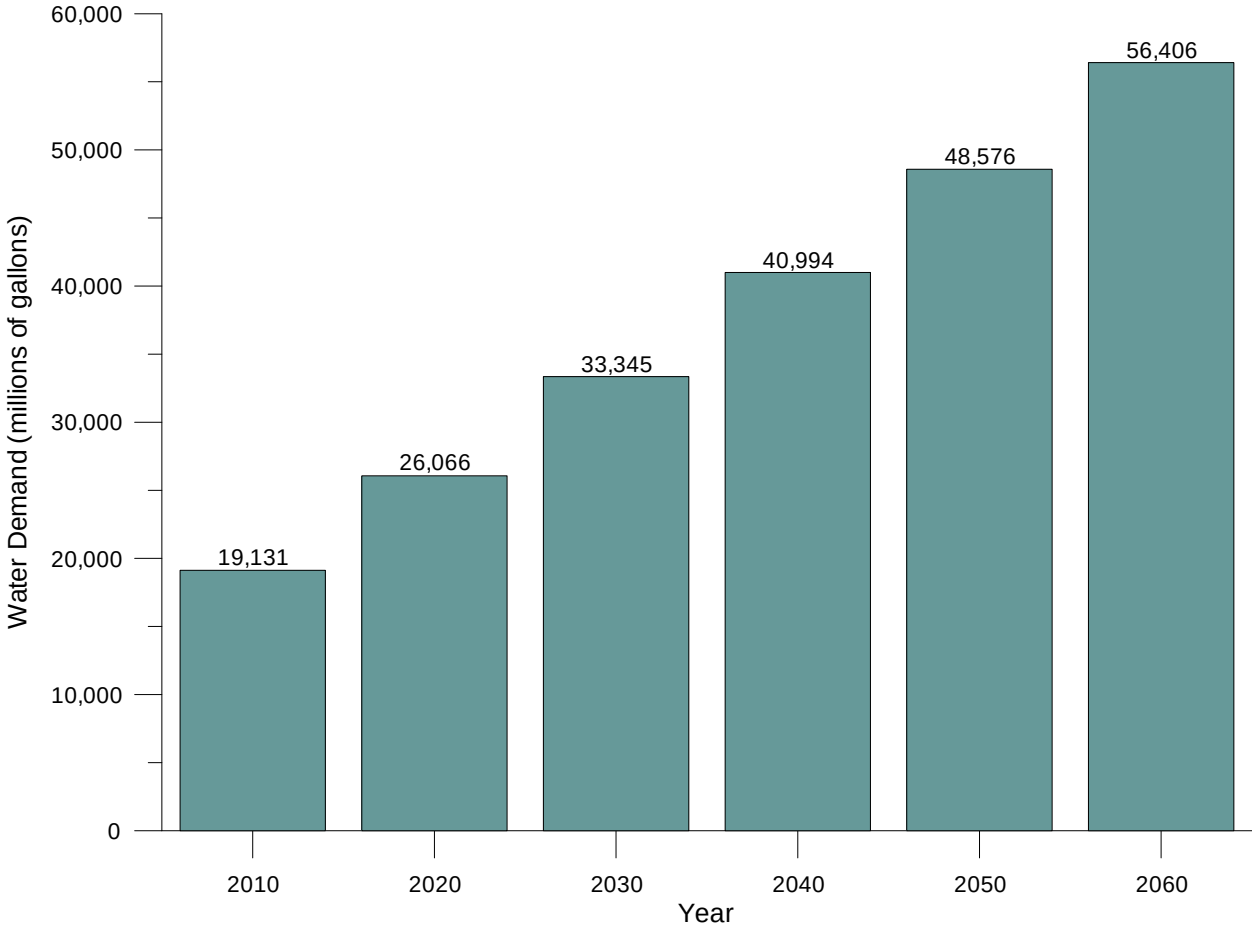
7. Demands might exceed projections.

8. Drought might be worse than planned (i.e. climate change).

Due to the additional risks, beyond those normally faced by a wholesale water supplier, USACE concludes that a 15 percent safety factor is appropriate for the Lake Ralph Hall EIS. Because the project does not meet all needs to 2060, this safety factor does not apply to future potential permit actions UTRWD may pursue (e.g., Marvin Nichols) even though it has been considered here. The values for a 15 percent safety factor are 10,200 AF in 2020 increasing to slightly less than 22,100 AF in 2060.

Figure 1-12 presents UTRWD water demand projections at the point of diversion from the year 2010 through 2060.

Figure 1-12: UTRWD Water Demand Projections at the Point of Diversion (MG/YR)

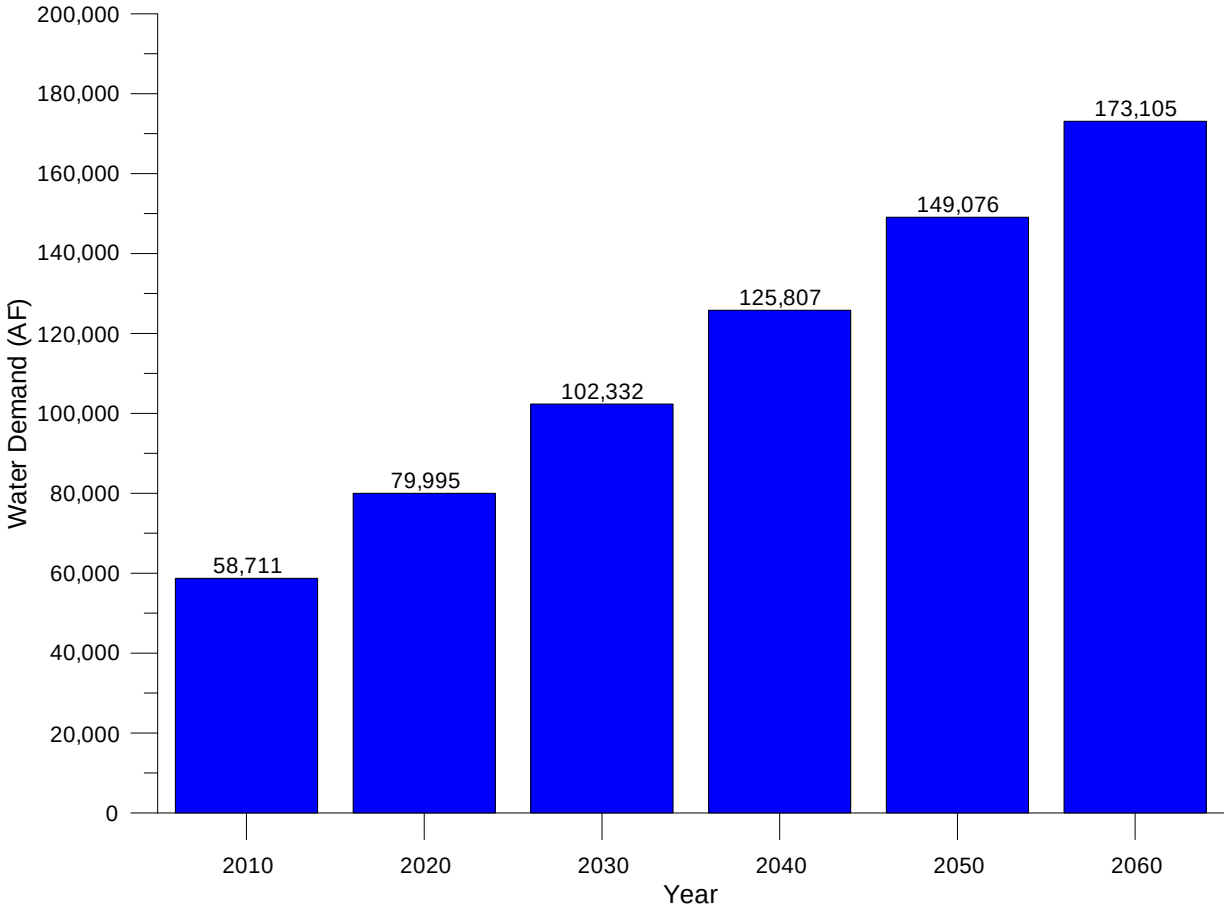


Note: These projections include water demands at the tap plus system losses plus transmission losses from the point of diversion plus a safety factor of 15 percent.

Source: HE, 2014

This graphic is displayed in millions of gallons, and **Figure 1-13** represents the same projections expressed in terms of AF. Whereas UTRWD Members and Customers commonly use millions of gallons in measuring their demand, water resource planning at the point of diversion, such as the yield of Lake Ralph Hall, is typically expressed in AF. UTRWD demand is expected to grow from 60,000 AF in 2010 to 102,000 AF by 2030. By 2060 UTRWD demand at the point of diversion is expected to approximate 173,000 AF.

Figure 1-13: UTRWD Water Demand Projections at the Point of Diversion (AF/YR)



Note: These projections include water demands at the tap plus system losses plus transmission losses from the point of diversion plus a safety factor of 15 percent.

Source: HE, 2014.

1.8 Water Conservation

Water conservation encompasses the policies, strategies and activities to manage fresh water as a sustainable resource, to protect the water environment, and to meet current and future human demand. The goal of water conservation is to allow a given amount of water to serve more people and to ensure water availability for future generations. It requires the efficient use of water resources which involve significant use of water or that significantly affect the availability of water for alternative uses including opportunities to reduce demand and improve efficiency in order to minimize new supply requirements. In the context of this Purpose and Need chapter, conservation is considered to determine if the need for the project can be reduced. The TCEQ requires that all public and wholesale water suppliers have a drought contingency plan and that certain providers have a water conservation plan[27].

[27] Texas Administrative Code Title 30, Chapter 288.

TCEQ requires a water conservation plan from the following entities:

- Entities with 3,300 connections or greater.
- A non-irrigation surface water right greater than 1,000 AF/year.
- An irrigation surface water right greater than 10,000 AF/year.
- Entities applying for a new water right or an amendment to an existing water right.

The TWDB also requires certain water suppliers to have a water conservation plan. There are three instances when a water conservation plan should be submitted to TWDB:

- TWDB rules require that entities that are applying for or receiving financial assistance of more than $500,000, to develop, submit, and implement a water conservation program for the life of the loan and report annually on the progress of the program. More information can be found at http://www.twdb.texas.gov/about/rules/index.asp.
- In 2007, the 80th Texas Legislature amended Section 13.146 of the Texas Water Code to require each retail public utility that provides potable water service to 3,300 or more connections to submit a water conservation plan to the TWDB. The plans were due on May 1, 2009. The code also requires the plan to be reviewed and updated once every five years thereafter and for the entity to report annually on the progress of program implementation. The Water Conservation Rules for entities with 3,300 or more connections can be found at http://www.twdb.texas.gov/conservation/ municipal/plans/doc/TAC363_15.pdf.
- Each entity that is required to submit a water conservation plan with TCEQ should also submit a copy of the plan to the TWDB and report annually to the TWDB on the entity's progress in implementing their plan.

In general, the water conservation plan rules require public water suppliers, such as the UTRWD Members and Customers, to implement conservation strategies such as a water savings goal, a public education program, a conservation rate structure and evidence of enforcement, along with a supplier profile. The TCEQ rules also encourage the adoption of further conservation strategies. The water conservation plan must be updated at least every five years and sent to the TCEQ each time it is revised. The water conservation requirement became Texas law in 2004, compliance was required by January 2008.

Wholesale suppliers, such as UTRWD, have additional requirements such as a leak detection plan and UTRWD must require their Customers to implement a water conservation plan. As per TCEQ rules, the UTRWD water conservation plan includes a description of the service area, a water savings goal, a leak detection, repair and water loss monitoring program, and the requirement that all their Members and Customers have a water conservation plan, as well as all the other requirements. UTRWD has a conservation plan goal of losses less than 10 percent between point of diversion and master meter. Its losses average less than five percent. In addition, UTRWD has

developed an outline for its Members and Customers to aid them in the preparation of their own plans. UTRWD also works with its Members and Customers to help them develop their own plans.

In general, the Members and Customers conservation plans follow the outline suggested by the TCEQ and the TWDB. The goals set by the Members and Customers range from reducing system losses to aggressive targets for reducing per capita consumption. The median goals are a five percent reduction in gpcd over five years and a ten percent reduction over ten years. This equates to a reduction of six gpcd over five years and a reduction of thirteen gpcd over ten years. The different sets of water conservation programs that each Member, Customer and Prospective Customer will use to achieve their goals is shown in **Table 1-11**.

Table 1-11: Water Conservation Measures Adopted by UTRWD Members and Customers, 2014

Members and Customers	Water Conservation Plan	Date Plan Implemented	Leak Detection & Repair	Monitoring of Effectiveness and Efficiency	Public Education	Requirement for Water Conservation Plans by Wholesale Customers	Water Conservation Pricing (Rate Structure)	Incentive Programs	Regulatory Measures	Drought Response Plan
Argyle WSC (total) [1]	✓	8/23/2007	✓	✓	✓	✓	✓		✓	✓
Aubrey	✓	6/18/2002	✓		✓		✓			✓
Cross Timbers WSC (total) [2]	✓	2009	✓	✓	✓		✓			✓
Celina	✓	4/1/2009	✓	✓	✓	✓	✓		✓	✓
Corinth	✓	5/21/2009	✓	✓	✓		✓			✓
Denton County FWSD #1A	✓	8/18/2009	✓	✓	✓	✓	✓		✓	✓
Denton County FWSD #7	✓	5/9/2013	✓	✓	✓		✓		✓	✓
Denton County FWSD #8A	✓	6/25/2009	✓	✓	✓	✓	✓		✓	✓
Denton County FWSD #9	✓	7/20/2009	✓	✓	✓		✓		✓	✓
Denton County FWSD #10	✓	7/16/2009	✓	✓	✓		✓		✓	✓
Denton County FWSD #11A	✓	6/25/2009	✓	✓	✓	✓	✓		✓	✓
Flower Mound	✓	4/5/2010	✓	✓	✓	✓	✓	✓	✓	✓
Highland Village	✓	4/14/2014	✓	✓	✓		✓	✓	✓	✓
Justin	✓	9/8/2008	✓	✓	✓	✓	✓		✓	✓
Krum	✓	2003	✓	✓	✓		✓		✓	✓
Lake Cities MUA (total) [3]	✓	4/14/2009	✓	✓	✓	✓	✓			✓
Lincoln Park	✓	3/20/2002			✓		✓		✓	✓
Mustang SUD (Denton Co) (total) [4]	✓	6/1/2013	✓	✓	✓	✓	✓	✓	✓	✓
Sanger	✓	3/18/2014	✓	✓	✓	✓	✓		✓	✓
Ladonia	[5]									✓
Pilot Point	[5]									✓
Ponder	[5]									✓
Prosper (Denton County portion only)	✓	11/1/2007	✓	✓	✓	✓	✓		✓	✓

Notes:

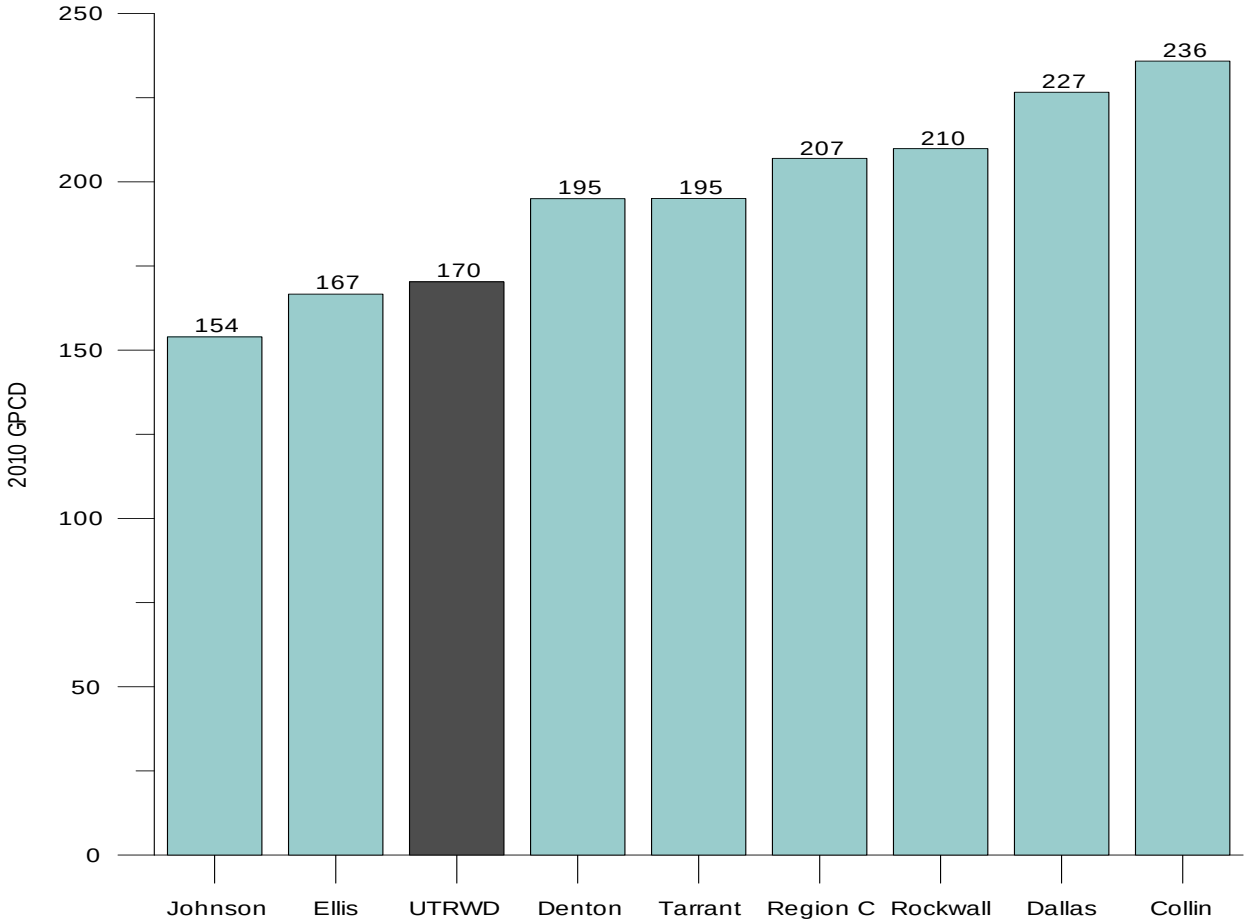
[1] Includes Argyle and Argyle WSC
[2] Includes Bartonville, Bartonville WSC, Copper Canyon and Double Oak.
[3] Includes Hickory Creek, Lake Dallas and Shady Shores.
[4] Includes Cross Roads, Krugerville, Mustang SUD, and Oak Point.
[5] These entities are not currently receiving water service from UTRWD, therefore they are not required by UTRWD to have a conservation plan on file.

Source: UTRWD, 2014.

Overall, the water conservation and drought plans for UTRWD's Members and Customers all meet or exceed the TCEQ Rules and are consistent with the UTRWD's own conservation and drought plans.

Figure 1-14 provides the year 2010 gpcd for UTRWD's Members and Customers that received water from UTRWD in 2010 along with the 2010 gpcd for comparable local counties. This figure demonstrates how UTRWD's gpcd relates to others in the area.

Figure 1-14: UTRWD's and Comparable Counties' 2010 GPCD



Source: 2011 Region C Water Plan. Region C Water Planning Group, 2011
HE, 2014

As can be seen in the chart, UTRWD has one of the lowest gpcds in the region. The overall gpcd for all the areas shown was 207, considerably higher than the UTRWD gpcd of 170.

Figure 1-14 demonstrates that the water use rates for UTRWD customers are already low relative to their peers. Additionally, all current UTRWD Members and Customers have conservation plans and the prospective customers will be required to have a plan as part of their agreement with UTRWD. A small number of UTRWD Customers have gpcd usage higher than these averages,

but their use is quite small. All of the UTRWD Members, Customers and Prospective Customers have 2010 gpcds that are below 150 percent of the 2010 Region C average. This indicates the reasonableness of the Member and Customer water use rates and shows that any additional conservation requirements for purposes of USACE review are unnecessary. However, it should be noted that UTRWD continues to strive to improve its water conservation program. In 2012, UTRWD updated its Plan[28] to provide for a more robust conservation program along with a dedicated operation budget to fund its conservation activities.

1.9 Basis for Need

The determination of need for the proposed Lake Ralph Hall project supplies is based upon a comparison of projected water demands with available supplies to determine when and how much new supply will be needed. Supply has two components: existing UTRWD supplies as described earlier in this Chapter, plus water supplies available to UTRWD Members and Customers from non-UTRWD sources such as groundwater, DWU, the City of Fort Worth and others. Non-UTRWD water supply information was gathered from the 2009 UTRWD survey of Members and Customers and supplemented by information by UTRWD as found in the RWRS and the 2011 Region C plan.

Table 1-12 compares projected water demands from UTRWD Customers with available supplies through the year 2060.

[28] UTRWD's Water Conservation Plan, 2012.

Table 1-12: A Comparison of Projected Water Demand (AF) from UTRWD Customers with Available Supplies, 2010 through 2060

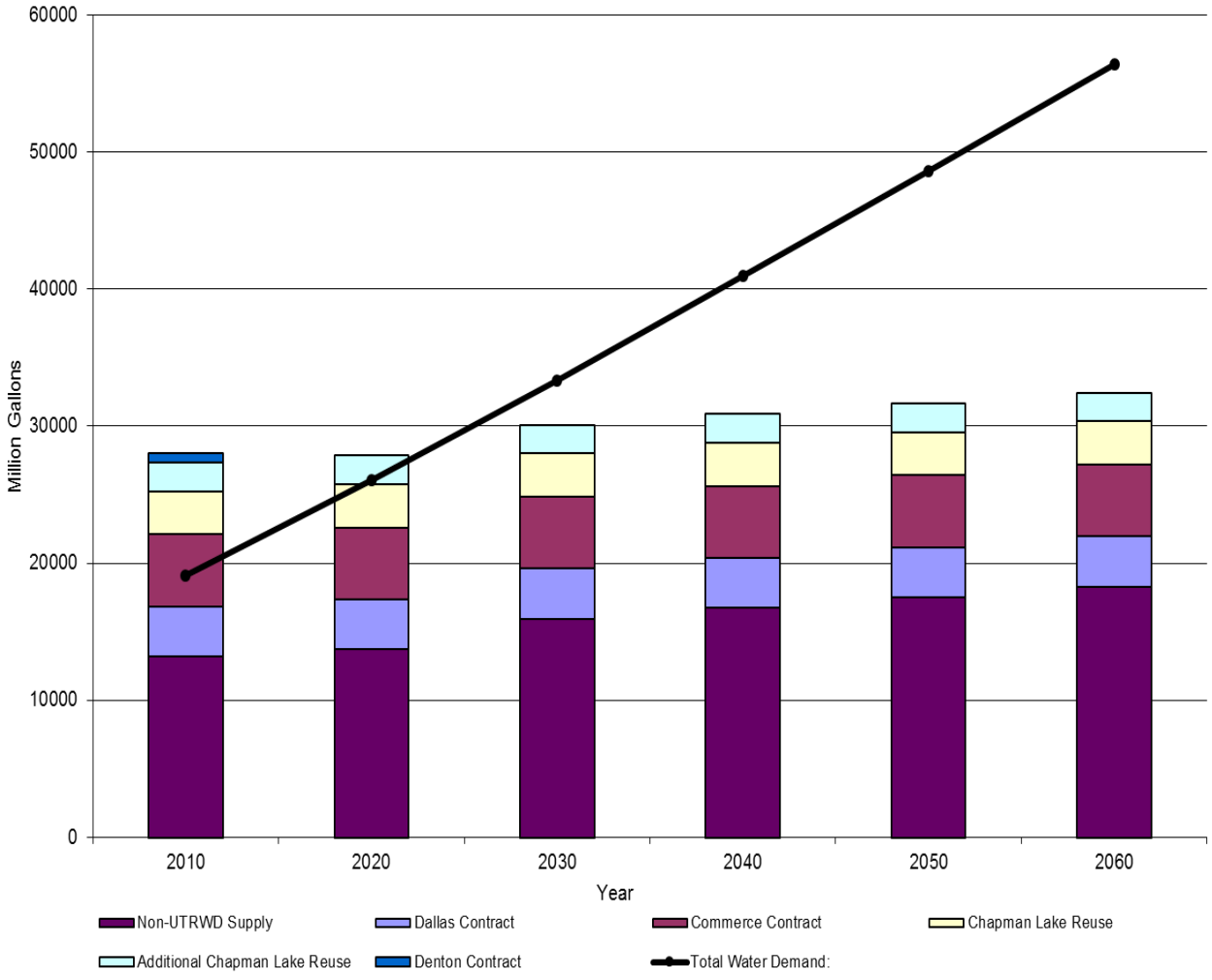
Year	A[1]	B[2]	C[3]	D
	Total UTRWD Member and Customer (Current and Prospective) Water Demands at Point of Diversion	UTRWD Existing Supplies	Water Supplies Available to UTRWD Members and Customers from Non-UTRWD Sources	Water Supply Surplus/Deficit for UTRWD Members and Customers (A-B-C)
2010	58,711	45,612	40,512	-27,414
2020	79,995	43,413	42,071	-5,490
2030	102,332	43,413	48,953	9,966
2040	125,807	43,413	51,326	31,068
2050	149,076	43,413	53,725	51,938
2060	173,105	43,413	56,190	73,502

Notes: (1) Includes water demands at tap plus losses back to point of diversion and a 15% safety factor.
(2) Includes DWU Contract, City of Commerce Contract, City of Denton Contract, and Reuse Permit.
(3) Includes groundwater, DWU supplies to named entities and others, City of Fort Worth supplies and North Texas Water District supplies.

Source: Raw Water Reliability Study, 2010b; 2011 Region C Plan, 2011; UTRWD, 2014, HE 2014.

In the year 2010, existing UTRWD water supplies plus those available to UTRWD Members and Customers was over 27,000 AF more than demands anticipated in that year. By the year 2020, supplies will also exceed projected demands, but by about 5,000 AF. By the year 2024, water demands will exceed supplies and new water supplies must already be on-line to meet those demands and the growing difference between demand and available supplies out into the future (see **Figure 1-15**). By 2060, water demands will exceed available supplies by approximately 73,502 AF.

Figure 1-15: Demand and Supply for Lake Ralph Hall



Under Column B of **Table 1-12**, UTRWD existing supplies will diminish between 2010 and 2020, because the City of Denton supplies are unlikely to be available as the City of Denton water demands grow to meet its available supplies and the City of Denton no longer markets its excess water to UTRWD.[29] Under Column C, water supplies will increase over time, primarily because certain existing UTRWD members are designated in UTRWD's contract with DWU, wherein their future water demands will be met by water supplied from DWU. Those water supplies are simply passed through to UTRWD for conveyance and treatment. In 2010, the named entities accounted for about 56 percent of total UTRWD demand, by 2060, this percentage is forecast to go down to about 30 percent.

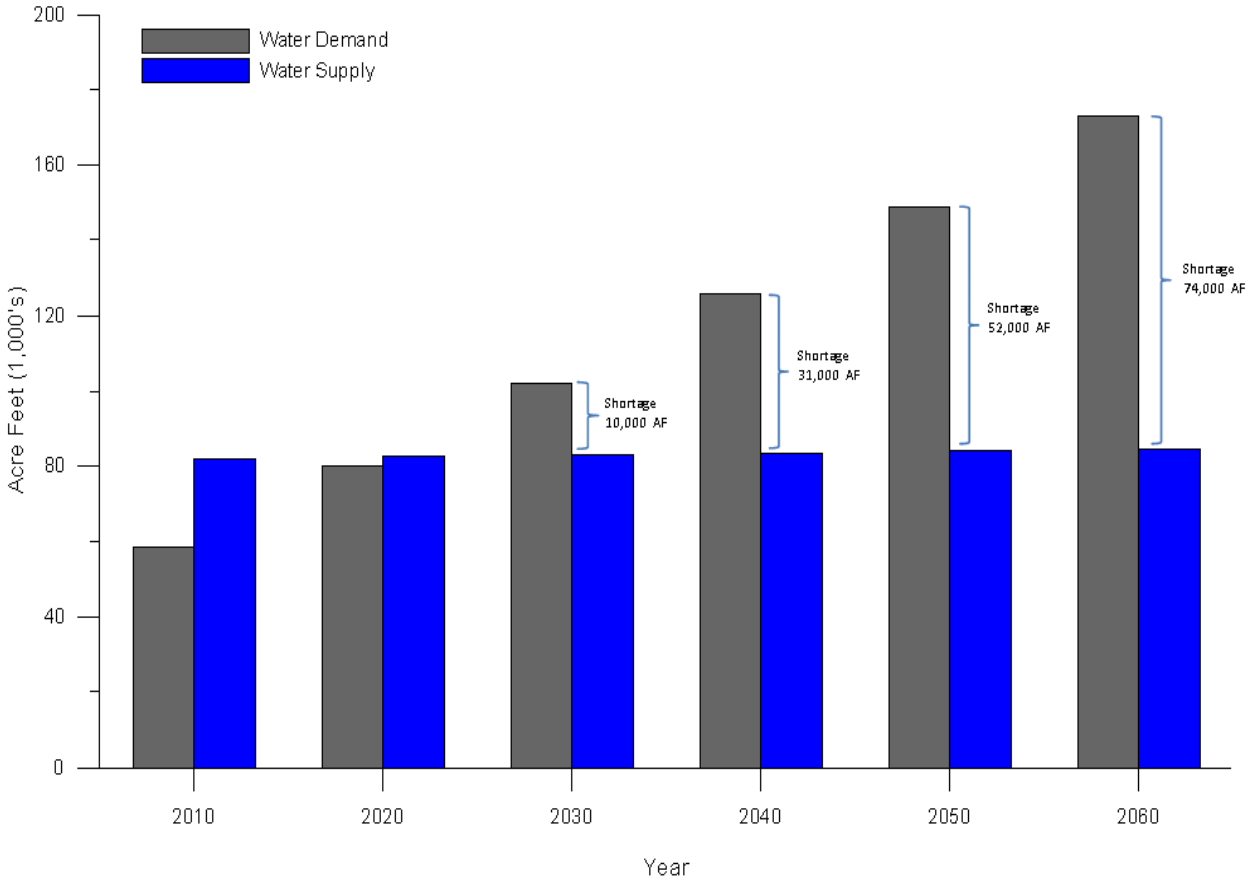
By the year 2030, it is predicted that the UTRWD must have 10,000 AF of additional supply on-line to meet the projected shortage (**Figure 1-16**). This shortage will grow to an estimated 73,502

[29] UTRWD Draft, Raw Water Reliability Study, 2009.

AF by the year 2060. UTRWD has chosen to develop approximately 34,050 AF of new firm yield to address a portion of its needs.

Clearly, UTRWD has an imminent need for water beyond its present supply. The District has identified a project for meeting that need and has additional long terms plans to further supplement its supplies. By 2040, one or more of these additional strategies must be implemented.

Figure 1-16: Projected UTRWD Water Shortages



1.10 Purpose Statement

A definition of the UTRWD overall purpose statement is required to address USACE's and other Federal agency's regulatory responsibilities for NEPA analysis. Additionally, the overall purpose statement is needed for USACE's public interest review as well as compliance with the 404(b)(1) guidelines. USACE also defines a basic project purpose for the 404(b)(1) guidelines to determine whether a proposed action is water (or special aquatic site) dependent.

1.10.1 Basic Project Purpose

In an effort to afford special protection to wetlands and other special aquatic sites (as defined in Subpart E of the 404(b)(1) guidelines), the guidelines establish two rebuttable presumptions for activities which do not require access or proximity to or siting within the special aquatic site to fulfill their basic purpose. Such activities are considered to be non-water dependent and the USACE presumes that practicable alternatives that do not involve special aquatic sites are available and such alternatives are less damaging to the aquatic ecosystem. Whether an activity is water dependent or not is based on the definition of the basic project purpose. Defining the basic project purpose involves the determination of the basic essence of the proposal. For the Lake Ralph Hall project, the basic project purpose is to provide water. The basic purpose of supplying water, whether for municipal, industrial or agricultural uses, does not need to be within a wetland or riffle pool complex (the special aquatic site types to be affected by the proposed actions) for it to be fulfilled. Therefore, the proposed action is not "water dependent" for the purposes of the 404(b)(1) guidelines and the rebuttable presumptions apply. The rigorousness of the alternatives analysis will be adjusted to demonstrate whether these presumptions are overcome.

1.10.2 Overall Project Purpose

The Purpose Statement is intended to provide the basis for defining and evaluating alternatives within the USACE's decision-making process. It is to be developed from the need analysis and reflect those factors determined by USACE to be legitimate. USACE will, in all cases, exercise independent judgment in defining the purpose and need for a project to be permitted under its regulatory program from both the applicant's and public's perspective (33 CFR Part 325 Appendix B(9)b(4)). The Corps' responsibility for this determination, particularly in relation to the 404(b)(1) guidelines, is furthered in formal counsel and national guidance contained in the findings for "Permit Elevation, Plantation Landing Resort Inc.," dated April 21, 1989 (Plantation Landing 1989). While USACE should consider the views of the applicant regarding the project purpose and the existence (or lack) of practicable alternatives, USACE must determine and evaluate these matters itself, with no control or direction from the applicant, and without undue deference to the applicant's wishes. USACE must be careful not to so narrowly define a project purpose that it unduly restricts a reasonable search of alternatives and at the same time not prescribe a definition that requires such an exhaustive review of alternatives that an analysis cannot reasonably be completed. USACE's definition is to be formulated in light of the purpose(s) and need(s) identified by the applicant(s).

UTRWD summarized its project's purpose in the 404 permit application. They stated that the purpose of Lake Ralph Hall is to provide additional raw water supplies to meet the growing demands from its wholesale customers and the proposed lake is one strategy to provide that additional water while providing additional security in the event supply from any of its other sources is interrupted. UTRWD identified economic benefits from recreational use, residential and

commercial development and protected natural areas as well as environmental benefits due to reductions in soil losses due to erosion.

Based on the information provided by UTRWD and the additional needs analysis presented within this chapter and its supporting information, USACE defines the overall project purpose as:

> **To provide approximately 34,050 AF of additional, reliable, firm annual yield through a regional project to meet a portion of existing and projected future municipal and industrial water demands by 2024 within UTRWD's defined regional planning area.**

This statement incorporates a number of terms requiring definition. The term "reliable" refers to water supplies having a high degree of certainty as to their amount and long term availability. "Firm annual yield" refers to the hydrologic availability of this water supply including times of drought, as defined by UTRWD and is reflected in hydrologic modeling of the various river basins and UTRWD's water system. "Regional" recognizes the status of UTRWD as a current regional provider which must serve its Members and Customers in accordance with existing agreements and contracts which have been reviewed and accepted by USACE to support the project need. This Overall Project purpose statement will be used to identify, evaluate, and screen alternatives in this EIS.

In summary, the Lake Ralph Hall project is intended to provide UTRWD with additional firm yield to address only a portion of the increasing demands for water from those Members and Customers previously identified.

1.11 Key Scoping Issues

Comments relevant to UTRWD's proposed Lake Ralph Hall received during the Public Scoping Meeting held on April 15, 2008 and the following 45 day commenting period indicate that the following issues are major concerns to interested public and agencies: 1) Property Rights (displacement of residents and need for more accurate mapping of affected properties); 2) Project Design and Management (need for additional project alternatives, lake size and level, and long-term capacity of Lake Ralph Hall); 3) Social and Economic Resources (reallocation of rural water resources to urban areas, potential property tax increases, and the need for water conservation); 4) Water Resources (mitigation design, overall water quality, and geomorphology); 5) Erosion and Sedimentation (sedimentation within conservation pool, effects on downstream sediment transport, and loss of valuable farmland) and; 6) Biological Resources (adverse effects to wildlife and loss of bottomland hardwood forests).[30] This DEIS will address these, and other, key scoping issues in the following chapters.

[30] Proposed Lake Ralph Hall Scoping Summary, USACE Fort Worth District, June 2008

2.0 Alternatives

This chapter discusses the identification, screening and description of alternatives that are evaluated in detail in the Draft Environmental Impact Statement (DEIS) which are available to the U.S. Army Corps of Engineers (USACE) and to the Upper Trinity Regional Water District (UTRWD), including the No Action Alternative, development of the proposed Lake Ralph Hall project (the Applicant's Proposed Action), and those alternatives that were considered but eliminated from detailed evaluation. As detailed in **Section 2.3**, a wide range of alternatives have been considered by USACE and UTRWD. The analysis of alternatives was accomplished ensuring compliance with the requirements of National Environmental Policy Act (NEPA), the Section 404(b)(1) Guidelines for Specification of Disposal Sites for Dredged or Fill Material (40 CFR 230), and the USACE Public Interest Review (PIR) at 33 CFR 320.4. USACE undertook an independent evaluation and screening process of alternatives initially considered by the applicant as well as developed other options.

The objective of the alternative evaluation process is to identify a reasonable range of alternatives with potential to meet the purpose and need of the proposed Lake Ralph Hall project. NEPA requires that the Lake Ralph Hall EIS evaluate a range of reasonable alternatives including the No Action Alternative. However, NEPA regulations do not specify the number of alternatives that need to be considered in the EIS.

The Council on Environmental Quality (CEQ) defines reasonable alternatives as "those that are practical or feasible from the technical and economic standpoint and using common sense, rather than simply desirable from the standpoint of the applicant*"* (CEQ 1986). CEQ regulations also require that all reasonable alternatives, including no action, are rigorously explored and objectively evaluated and that the reasons for eliminating alternatives are discussed (40 CFR 1502.14).

In addition to satisfying NEPA requirements, projects subject to permitting by USACE under the Clean Water Act also must comply with the Section 404(b)(1) Guidelines (40 CFR, Part 230) for the discharge of dredge and fill material into waters of the U.S. The Section 404(b)(1) Guidelines require that the Corps permit only the least environmentally damaging practicable alternative (LEDPA), unless the LEDPA has other significant adverse environmental consequences. These Guidelines specify "no discharge of dredged or fill material shall be permitted if there is a practicable alternative to the proposed discharge which would have less adverse impact on the aquatic ecosystem, so long as the alternative does not have other significant adverse environmental consequences." An alternative is considered practicable if "it is capable of being done after taking into consideration cost, existing technology, and logistics in the light of overall project purposes." Practicable alternatives under the Guidelines assume that "alternatives that do not involve special aquatic sites are available, unless clearly demonstrated otherwise." Guidelines also assume that "all practicable alternatives to the proposed discharge which do not involve a discharge into a special aquatic site are presumed to have less adverse impact on the aquatic ecosystem, unless

clearly demonstrated otherwise." The alternatives analysis required for Section 404(b)(1) Guidelines can be conducted either as a separate analysis for 404 permitting or incorporated into the NEPA process. The Corps has integrated NEPA and 404(b)(1) Guidelines into the alternatives analysis. Integration of both NEPA and 404(b)(1) Guidelines ensures that the alternatives selected for evaluation in the EIS provide a reasonable range of alternatives and that the alternatives are practicable.

In addition to NEPA and the 404(b)(1) guidelines, USACE further evaluates alternatives associated with its PIR (33 CFR 320.4(a)(2)(ii)). Where there are unresolved conflicts as to resource use, the practicability of using reasonable alternative locations and methods to accomplish the objective of the proposed structure or work are considered by USACE. Such a consideration can be broader in scope than both NEPA and the Guidelines. While these are separate yet simultaneous evaluations, additional factors to the PIR determination are separate and cannot be used to offset an unfavorable finding under the 404(b)(1) guidelines, including the LEDPA determination.

2.1 Alternatives Available to USACE

There are three decision options available to USACE relative to the Applicant's Preferred Alternative (APA) as identified in their permit application: 1) issue the permit; 2) issue the permit with special conditions; and 3) deny the permit. A permit cannot be issued by the USACE if such issuance is found contrary to the public interest (33 CFR 320.4) and/or if the project does not comply with the Section 404(b)(1) Guidelines at 40 CFR 230.12(a)(1)(i-iii) due to:

- There is a less damaging practicable alternative to the proposed action
- The project results in significant degradation to the aquatic ecosystem
- The mitigation for impacts to the aquatic ecosystem is inadequate

2.2 Alternatives Available to UTRWD

UTRWD considered various alternative water supply strategies during feasibility and planning studies for the proposed Lake Ralph Hall project. These studies included the following:

- Raw Water Reliability Study (UTRWD, 2010b); and
- Summary of Additional Water Supply Strategies (UTRWD, 2009a).

Additionally, the Texas State Water Plan includes identification of various alternatives to address water needs from a statewide perspective. The overall plan is comprised of 16 regional plans of which UTRWD is included within Region C. Alternatives from the State Water Plan were included

in the applicant's materials and were considered in the overall range of alternatives evaluated. However, these more broadly developed alternatives were modified by USACE to reflect the specific need of the applicant rather than a larger planning group since UTRWD is the only applicant involved in the proposed permit action. UTRWD undertook an initial development and analysis of alternatives to its proposed action. They evaluated the use of two different water supply strategy alternatives: 1) increasing raw water supply from existing sources; and 2) pursuing and developing other new raw water supply sources. Portions of UTRWD's evaluation of these water supply strategy alternatives and their rationale for eliminating various options is included in **Appendix A-1**. USACE reviewed and independently evaluated the alternatives identified in the applicant's studies, modified some of the alternatives, and developed others based on the issues identified during the scoping and project evaluation processes. USACE's evaluation and modification of the alternatives are provided below or in **Appendix A** which contains summaries of each alternative identified and pertinent correspondence and documentation compiled as part of USACE's evaluation. Modifications to alternatives typically involved changing the size of proposals to be consistent with the specified need and purpose of the proposed project which allowed for uniform evaluations and comparisons. While UTRWD has demonstrated a larger need, they are not pursuing alternatives that provide more yield than approximately 34,050 AF/YR.

2.3 Alternatives Analysis

To be able to identify which alternatives need to be evaluated in detail in the EIS, USACE compiled a listing of potential water sources and infrastructure components that may be viable alone or if paired together to formulate various types of alternatives to address the project purpose. These sources and infrastructure components were evaluated to determine if they were reasonable and practicable, in keeping with the requirements of NEPA and the 404(b)(1) guidelines as well as the PIR. Water sources are defined as those features that can provide new firm yield to the applicant without the need for additional infrastructure components to obtain and utilize such water. Such a consideration is warranted since some water sources may be able to provide new supplies without the need to construct and operate new development features (e.g., obtaining water supplies via contract, modification of existing water rights, new water rights to be accessed with existing infrastructure components, etc.). Water sources can also be provided, with greater and possibly multiplied yields, when combined with new infrastructure components that can capture, hold, treat and move water sources (e.g., dams, pipelines, wells, intakes, etc.). Reasonability and practicability evaluations and determinations can occur individually for sources and infrastructure components as well as in combination to ensure a full and robust alternatives analysis is accomplished. If sources are found to not be viable without the need to evaluate them in conjunction with infrastructure components, then they can be eliminated from further consideration. It must be recognized that not all sources or infrastructure components may be reasonable and/or practicable and they must be considered individually. Sources that may not be reasonable or practicable on their own can quickly become viable options when combined with infrastructure components. It must also be recognized that not all infrastructure components may

be reasonable and/or practicable and must also be considered individually. Therefore, reasonability and practicability evaluations and determinations can occur for both sources and infrastructure components individually as well as in combination to ensure a full and robust alternatives analysis is accomplished. A total of 17 sources, infrastructure components and alternatives were identified, including the APA and No Action Alternative, and are listed in **Table 2-1**.

Table 2-1: Alternatives Identified

Alternative	Source	Infrastructure Components
1. No Action		
2. Lake Ralph Hall (APA)	New water right	New reservoir, pipelines, pumps
3. Marvin Nichols Reservoir	New inter-basin transfer water right	New reservoir, pipelines, pumps
4. Wright Patman Reservoir	New contract and inter-basin transfer water right	New pipelines, pumps
5. Additional Dallas Water Utilities Supply	New contract	New pipelines, pumps
6. Oklahoma Water	New contract and OK water right	New reservoir, pipelines, pumps
7. Toledo Bend Reservoir	New contract and inter-basin transfer water right	New pipelines, pumps
8. Lake Texoma	New contract and inter-basin transfer water right	New pipelines, pumps
9. George Parkhouse Reservoir (N)	New water right	New reservoir, pipelines, pumps
10. George Parkhouse Reservoir (S)	New water right	New reservoir, pipelines, pumps
11. Gulf of Mexico	New water right	New reservoir, pipelines, pumps, treatment plant
12. Cypress Creek Basin	New contract & inter-basin transfer water right	New pipelines, pumps
13. Precipitation Enhancement		
14. Groundwater Imports	New contract	New wells, pumps, pipelines
15. Lower Bois d'Arc Reservoir	New water right	Expanded reservoir, new pipelines, pumps
16. Lake Fastrill	New water right	New reservoir, pipelines, pumps
17. Lake Livingston/Joe Pool Lake/Trinity River Basin	New contract	New pipelines, pumps

2.3.1 Alternatives Screening

Screens to determine the viability of alternatives to be carried forward for detailed analysis in the EIS were developed primarily in light of the requirements of the 404(b)(1) guidelines due to their generally more specified and/or substantive nature compared to NEPA. NEPA and PIR considerations also occurred to ensure that a reasonable range of options were evaluated to determine which alternatives need to be in the EIS that meets purpose and need. Screens were

divided into two general categories to address the LEDPA requirement at 40 CFR 230.10(a) and reflect NEPA requirements and include:

- Whether the alternative is practicable (practicable is defined as "available and capable of being done after taking into consideration cost, existing technology, and logistics in light of overall project purpose" (40 CFR 230.3(q)), OR

- Whether the alternative is less damaging to the aquatic ecosystem than the APA.

An alternative was eliminated if it failed any one of the defined practicability screens or if it was found to have greater impacts to the aquatic ecosystem than the APA. These are pass/fail determinations because if an alternative cannot pass any of the screens, it cannot be permitted.

2.3.1.1 Screening Criteria

As established in **Section 1.0**, the purpose of the project is to provide the UTRWD planning area with approximately 34,050 acre-feet per year (AF/YR) of additional, reliable, firm annual yield to meet a portion of existing and projected future municipal water demands by 2024. Four practicability screening criteria and one environmental screen were developed to ensure that alternatives advanced for detailed study satisfy the purpose and need and are less damaging to the aquatic ecosystem than the APA. The screens are summarized in **Table 2-2**. While many alternatives include certain risks and uncertainty concerning their viability, the screening criteria and evaluations were conducted to allow firm determinations of practicability. Vague explanations of practicability with terms such as "may" or "could" were avoided or rejected for determining practicability or impacts to aquatic resources. Additionally, similar consideration was also applied to the initial coarse environmental screens developed to determine adverse effects to aquatic resources relative to satisfying LEDPA requirements.

Criterion 1: Provide reliable new firm annual yield.

Criterion 1 is a practicability screen and considers the purpose of providing reliable additional firm annual yield for meeting anticipated future water demands. The term "reliable" refers to water supplies having a high degree of certainty as to their amount and long term availability. In this instance, to be reliable, an alternative must result in a water supply source that the applicant has substantial direct control over (for more information see **Chapter 1, Section 1.10.2**). Firm annual yield refers to the hydrologic availability of a water supply including times of drought.

Criterion 2: Add approximately 34,050 AF of new supply.

Criterion 2 is a practicability screen and reflects the approximate amount of water the applicant is pursuing to address their projected demands. While the needs analysis in **Chapter 1** documents a need of approximately 73,500 by 2060, which is well in excess of the proposed amount from the proposed action, UTRWD has determined that 34,050 AF of new supply addresses their overall water supply strategy and system management and development goals at this time.

Criterion 3: Add new firm annual yield to UTRWD's supplies by 2024.

Criterion 3 is also a practicability screen and focuses on the temporal aspect of the purpose and need statement that includes a timeline for meeting projected demand by 2024. As detailed in **Section 1.9**, UTRWD's planning area is projected to begin facing a water supply deficit by 2024. UTRWD's 404 permit application included an analysis of water supplies and future demands. UTRWD stated that population and resulting water demand growth was very rapid in its service area, and a five-fold increase in demands by the year 2060 was expected. Based on an assessment of current and anticipated supplies, UTRWD believes that water demands will exceed supplies before the year 2030 and that the shortfall will grow considerably by 2060. USACE evaluation of these projections and concerns were verified through its own additional analysis as described in **Chapter 1**, including supply and demand evaluations, and review of population projections, historical water use patterns and data from a survey of Members and Customers. By the year 2024, water demands will exceed supplies and new water supplies must already be on-line to meet those demands and the growing difference between demand and available supplies out into the future.

Criterion 4: Exorbitant Costs.

Criterion 4 is a practicability screen that was developed to determine if sources, infrastructure components and/or alternatives involve costs that are exorbitantly expensive in relation to the project. Cost as a practicability determination screen in relation to the 404(b)(1) guidelines is normally analyzed in the context of the overall scope/cost of the project and consideration of comparable costs for similar actions in the region or analogous markets. Cost considerations are to be based on an objective, industry-neutral inquiry that does not consider an individual applicant's financial standing. The data used for any cost must be current with respect to the time of the alternatives analysis. However, just because one alternative costs more than another does not mean that the more expensive alternative is impracticable. It is important to note that in the context of this definition, cost does not include economics. Economic considerations, such as job loss or creation, effects to the local tax base, or other effects a project is anticipated to have on the local economy are not part of the cost analysis. Development of a cost threshold can be made to determine whether various alternatives are practicable or not. However, if costs of an alternative are clearly exorbitant compared to similar actions that address the project purpose, they can be eliminated without the need to establish a cost threshold for practicability determinations. A cost

screen threshold was not established for this EIS although consideration of whether some water supply options were exorbitant did occur.

Criterion 5: Aquatic Resource Direct Impacts (Does not result in greater direct impacts to wetlands/waters of the U.S. than the proposed project.)

This criterion is an environmental impact screen related to consideration of impacts to the aquatic ecosystem and was developed to determine if alternatives resulted in greater direct impacts to aquatic resources and is used rather than undertaking practicability determinations, as applicable (EPA/USACE 1993). Coarse aquatic resource assessments consisting of general off-site and non-data specific or intensive methods and best professional judgment were developed and applied to some alternatives. If the direct effects (fill, inundation, etc.) of the proposed alternative (infrastructure components) to aquatic resources were of greater acreage, linear feet and general quality than the APA, such alternatives were eliminated from further consideration because they could not be permitted under the 404(b)(1) guidelines.[1]

Table 2-2: Alternatives Screening Criteria

Criteria	Parameters
1	Provide reliable new firm annual yield.
2	Provide approximately 34,050 AF of new supply.
3	Add new firm annual yield to UTRWD's supplies by 2024.
4	Exorbitant costs.
5	Aquatic Resources Direct Impacts (Does not result in greater direct impacts to wetlands/waters of the U.S. than the proposed project).

2.4 Screening Results

Screening criteria were applied to the applicant's Proposed Action and other water supply sources, infrastructure components and/or alternatives (**Figure 2-1**). In order for a source, infrastructure component and/or an alternative to be considered practicable and carried forward in the EIS, it must not fail any of the practicability screening criteria. Additionally, if an option can be demonstrated as having greater impacts to aquatic resources than the APA, then it was eliminated from further consideration. The following sections describe the evaluation and discussion of the screening of each option and summary results.

[1] Jurisdiction was not established during the development and application of the screen. All alternatives were treated equally relative to the screen. It is assumed all identified National Wetland Inventory wetlands/waters are jurisdictional. The common standard for the alternative screen ensures that errors are equally applied as well as assumptions.

Figure 2-1: New Supply Sources, Infrastructure Components, or Alternatives

Source: 2016 Region C Water Plan (TWDB, 2015a)

2.4.1 No Action Alternative

The No Action Alternative is a required consideration of NEPA. It also has consideration in the 404(b)(1) guidelines as defined at 40 CFR 230.10(a)(1)(i). A variety of options exist within the No Action alternative and can include permit denial, construction of an alternative that does not involve a regulated discharge under Section 404 of the Clean Water Act, and alternatives that are unavailable to the applicant (even if they require Federal action (permits)). Each of these scenarios result in no permit being issued by USACE. Alternatives that are beyond the capability of the applicant are to be evaluated to the extent necessary to allow a complete and objective evaluation of the public interest and a fully informed decision regarding the permit application. Additionally, predictable actions by others (e.g., UTRWD and its members and customers) as well as other likely uses of a project site are to be discussed as necessary, if the permit is denied. Further, it is recognized that the No Action alternative does not necessarily have to be as fully developed as the action alternatives [2].

An action that addresses the need and purpose and does not involve a regulated discharge was not identified, even though some concepts and alternatives can be accomplished without the need for a regulated discharge. Therefore, the No Action alternative is based on denial of the permit. Recognizing the applicant's responsibility in providing an essential social need of water supply, and to allow a complete evaluation of the public interest as well as disclose the likely consequences of a permit denial, USACE requested the applicant provide information relative to the most likely action(s) that may be taken by them and their members and customers under such a scenario. While the applicant would not receive a permit, they and their participants would continue to operate their systems. They would also seek other sources and/or other water management strategies to meet projected demands and to address existing operation challenges, including minimizing risks inherent in their current water supply portfolios and/or systems. Consistent with the Proposed Action, the No Action Alternative is based on the following assumptions and conditions:

- The water demand projections for the No Action Alternative are the same as those developed for the Proposed Action and assume that UTRWD would continue to have access to water supplies under existing contracts, including the City of Dallas water supply contract that is currently set to expire in 2023.

- Demand projections assume continued implementation of the conservation efforts identified in **Chapter 1** of this EIS as well as UTRWD's maximization of reuse of its imported water from Lake Chapman.

[2] 40 CFR 1502.14(d), 33 CFR 325 Appendix B, Section 9.b(5), 40 CFR 230.10(a)(1)(i), Regulatory Guidance Letter 88-13

- All water system improvements designed to provide additional sources of water supply through approximately 2024 currently planned and underway are developed.

- The No Action Alternative has the same interpretation of water rights, agreements, and permit requirements as the Proposed Action.

The water supply action alternatives that might be available to UTRWD and its members and customers are presented and discussed in subsequent subsections of this chapter. As presented in those discussions, these alternatives either cannot be completed until well after 2024, will fail to provide the needed water as identified in the project purpose, or both. The likely predictable actions by others in the No Action Alternative would involve the use of a combination of strategies to strive to meet the need for additional water supply, including pursuing temporary/emergency water supply contracts, local development of groundwater by individual UTRWD members and customers, and imposing more severe mandatory water use restrictions than the Proposed Action. Even when used in combination, these strategies would result in unmet water demands for UTRWD and its members and customers.

No Action Alternative Strategy 1 – Temporary/Emergency Water Supply Contracts

As part of the No Action Alternative, UTRWD would seek temporary and/or emergency water supplies from the Cities of Denton, Dallas, or a combination of the two. UTRWD temporary/emergency supplies from either Denton or Dallas would be subject to availability of surplus water from these cities. The water plans approved by the Region C Planning Group show that both of these cities project the need to implement their own new water supply strategies during the planning period; therefore, UTRWD has no assurances that these cities will have water available when UTRWD has a need in 2024.

UTRWD members and customers may also individually seek temporary and/or emergency water supply contracts with other entities. While the City of Dallas might provide a small quantity of additional water to its existing customers, documentation presented in other sections of this chapter demonstrates that the City of Dallas does not have the capability to provide significant additional supplies to UTRWD's members and customers beyond what the City of Dallas has already committed via its water supply contracts with UTRWD and some of UTRWD's members and customers.

No Action Alternative Strategy 2 – UTRWD Member/Customer Development of Local Groundwater Supplies

If UTRWD is unable to meet its members' and customers' growing water demands because of limited supplies, those members and customers would be faced with an unmet deficit in their water supplies. The magnitude of the deficit for each member and customer is presented in **Chapter 1**. Under the No Action Alternative, those members and customers would have to seek alternative

supplies on their own. As discussed, the supplies that can be developed timely are limited to purchasing water from other local water suppliers or developing local groundwater.

Some of UTRWD's members and customers may seek to install additional groundwater capacity by modifying their existing groundwater wells or installing new wells. As presented in other sections of this chapter, groundwater resources in UTRWD's service area have been in decline for a number of years. The information presented also demonstrates that the projected groundwater use is only slightly less than the modeled available groundwater (MAG), hence the reliability and availability of groundwater to meet all of UTRWD's members and customers is not assured.

No Action Alternative Strategy 3 – Mandatory Water Use Restrictions

If the permit is denied and UTRWD pursues another alternative that cannot be completed by 2024, and UTRWD cannot obtain adequate temporary/emergency supplies from the City of Denton, or City of Dallas, UTRWD will have to implement strategies from its drought contingency plan to limit the quantity of water it provides to its members and customers to its available supply capacity. The plans contain multiple stages with the most restrictive measures including:

- Prohibit outdoor irrigation
- Intensify leak detection and repair activities
- Prohibit use of water to wash any motor vehicle, motorbike, boat, trailer or other vehicle not occurring at a commercial vehicle washing facility or commercial service stations
- Increased enforcement activities
- Suspend issuance of permits for new swimming pools, hot tubs, spas and ornamental ponds
- Prohibit the filling, draining and refilling of existing swimming pools, wading pools, Jacuzzis and hot tubs except to maintain structural integrity, proper operation and maintenance or to alleviate a public safety risk

If an individual member or customer of UTRWD is unable to secure sufficient supplies, including purchases from UTRWD, purchases from other entities or developed supplies, to meet its demands, the remaining strategy available is to implement measures from its drought contingency plan to manage its retail customers' demands to the supplies available to that member or customer. UTRWD's members and customers have their own unique drought contingency plans, but those plans are required, by the water sales agreement with UTRWD, to achieve results consistent with UTRWD's drought contingency plan. In addition to implementing water use reduction measures similar to those listed above, UTRWD members and customers may choose to implement a retail rate surcharge to further control usage.

Summary of No Action Alternative Strategies

The No Action Alternative is the most likely alternative to be implemented in the absence of the Proposed Action due to denial of the permit. Unmet water supply needs of UTRWD and its members and customers are projected to begin in 2024. UTRWD and its members and customers would respond to these unmet demands by seeking other water supply and management strategies incrementally, particularly, seeking temporary/emergency water supply contracts, developing local groundwater supplies (by individual UTRWD members and customers only), and implementing mandatory water use restrictions. To achieve mandatory water use restrictions, UTRWD would limit the quantity of water it delivers to its members and customers based on its available supplies. Its members and customers would then be forced to limit the amount of water they deliver to their retail customers by (1) placing demand limits on their customers, (2) imposing a moratorium or otherwise limiting new customer connections to their system, or (3) a combination of both.

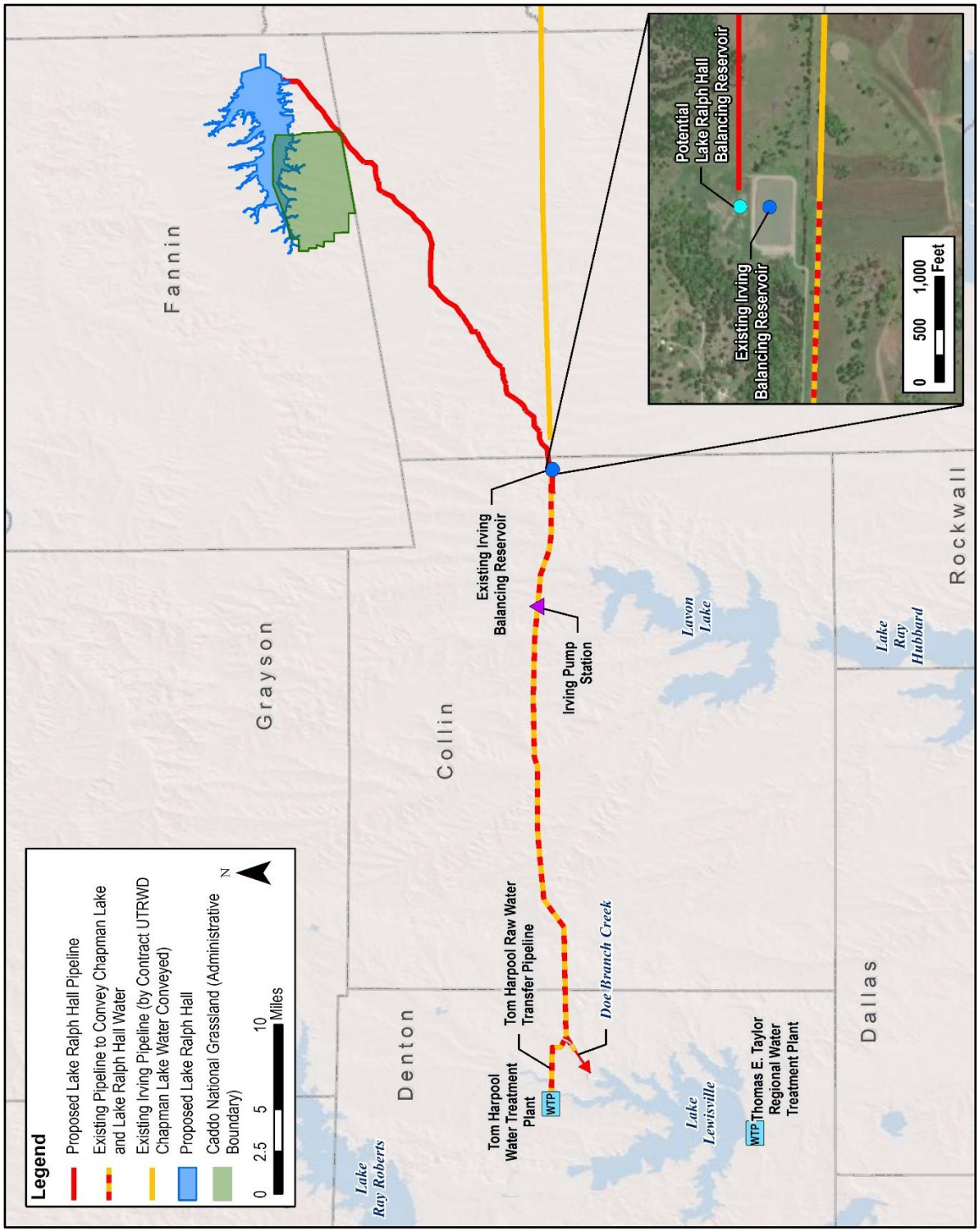
2.4.2 Lake Ralph Hall – Applicant Preferred Alternative (APA)

The proposed Lake Ralph Hall project would include the construction of an earth-filled dam embankment across the valley of the North Sulphur River (**Figure 2-2**) with a concrete uncontrolled principal spillway located adjacent to the existing channel of the river and an excavated unlined earthen channel emergency spillway located within the embankment on the northern floodplain of the river. The embankment placed would vary between 566 feet and 568 feet North American Vertical Datum of 1988 (NAVD88) to account for anticipated settlement of the embankment thus providing an effective elevation of 566 feet NAVD88 after settlement and would adjoin the existing ground surface on both ends of the structure. Current studies indicate the proposed Lake Ralph Hall reservoir would have a conservation pool storage capacity of approximately 160,235 AF (at an elevation of 551.0 feet above MSL), and at that capacity, the surface area of the reservoir would be approximately 7,605 acres. However, it is anticipated that the storage volume is somewhat larger due to continued erosion that has occurred during the permitting and planning period. The maximum depth of the reservoir at the dam would be approximately 90 feet. The firm annual yield of the proposed project would be approximately 34,050 AF/year.

UTRWD intends to divert raw water from the proposed project reservoir and operate it as part of UTRWD's overall water supply system. Raw water would be conveyed from the proposed Lake Ralph Hall project directly to the Tom Harpool WTP adjacent to Lewisville Lake and the Tom Taylor WTP through discharge to Lewisville Lake via a proposed raw water transfer pipeline. Through this inter-basin transfer, UTRWD would provide water to towns and cities in Collin, Cooke, Dallas, Denton, Grayson, and Wise Counties within the Trinity River Basin. UTRWD would also make water available to Ladonia and those portions of Fannin County that lie in the Sulphur River Basin. The proposed Lake Ralph Hall project would divert raw water for municipal,

industrial, and agricultural purposes, with ancillary benefits of in-place recreational uses and impeding continued erosion and environmental degradation of the North Sulphur River channel. The proposed Lake Ralph Hall project would also require the relocation and/or abandonment of state and county roads and the reconstruction of the State Highway (SH) 34 Bridge that crosses the North Sulphur River within the proposed project footprint.

Figure 2-2: Lake Ralph Hall Raw Water System Location Map



Source: Upper Trinity Regional Water District, 2015

2.4.2.1 APA Dam Alignment Options

Variations of the APA have been considered to determine if impacts can be avoided and minimized. Alternative on-site dam alignments and potential conservation pool sizes were considered in the alternatives development and analysis process. UTRWD's consideration of alternative dam sites and conservation pool sizes are provided in UTRWD (2009c) and **Appendix A-2**.

With the proposed Lake Ralph Hall project design, the dam would provide a storage volume at conservation pool of approximately 160,235 AF and would be located between two major tributaries to the North Sulphur River. The project, as proposed, would include waters from the Merrill Creek tributary and would exclude waters from the Baker Creek tributary farther downstream. The following sections include discussion of both upstream and downstream alternatives to this location, as well as alternative pool sizes. **Figures 2-3** through **2-6** illustrate the alternative dam site locations and **Figure 2-7** shows the Proposed Dam Site C.

Upstream Dam Alignments (Dam Sites A and B)

Dam Site A is located upstream of the North Sulphur River's confluence with Merrill Creek and just downstream of the confluence with Bralley Pool Creek, both major tributaries to the North Sulphur River. With the same elevation as the Proposed Action, 551 feet msl, this alternative would have an annual yield of 21,860 AF/YR. This alternative dam location would only provide approximately 61 percent of UTRWD's projected target need of 34,050 AF/YR. Therefore, it does not provide enough raw water to satisfy Criterion 2; further consideration of this alternative was not conducted.

Dam Site B is also located upstream of the confluence with Baker Creek and Merrill Creek, but further downstream from the confluence with Bralley Pool Creek. With the same elevation as the Proposed Action, 551 feet msl, this alternative would have an annual yield of 27,460 AF/YR.

This alternative dam location would only provide approximately 83 percent of UTRWD's projected target need of 34,050 AF/YR. Therefore, it does not provide enough raw water to satisfy Criterion 2; further consideration of this alternative was not conducted.

Downstream Dam Alignment (Dam Site D)

Locating the dam below the proposed location would entail incorporating the Baker Creek drainage, a major drainage of the North Sulphur River. This tributary's headwaters extend almost to Grayson County. Dam Site D would satisfy Criterion 1 and Criterion 2. However, Criterion 5 would not be satisfied.

Benefits of the downstream alternative would include a greater water supply for future populations. Water supply yield with the Dam Site D are estimated to be 47,370 AF/YR, as opposed to the

34,050 AF/YR predicted for the proposed Lake Ralph Hall project. This water supply could support greater economic growth in the region. Additionally, the larger size of the reservoir located above Dam Site D would offer greater recreation opportunities.

Impacts to wetlands/waters of the U.S. for the proposed Lake Ralph Hall project is estimated to include 387 acres of degraded ephemeral and intermittent streams and approximately 10 acres of wetlands (**Appendix E-4**). Potential impacts from Dam Site D (429 acres) would result in greater impacts to wetlands/waters of the U.S. than the proposed Lake Ralph Hall project's impacts to the same resources (387 acres) and therefore this alternative does not meet Criterion 5.

Applicant's Preferred Alternative (Dam Site C)

The proposed Lake Ralph Hall project (Dam Site C) would include the construction of an earth-filled dam embankment across the valley of the North Sulphur River (See **Figure 2-7**). The dam is anticipated to have a concrete uncontrolled principal spillway located adjacent to the existing channel of the river and an excavated unlined earthen channel emergency spillway located within the embankment on the northern floodplain of the river. The top of the dam embankment is anticipated to be at an elevation of 562.0 feet msl and would adjoin the existing ground surface on both ends of the structure. The proposed Lake Ralph Hall project would have a conservation pool storage capacity of approximately 160,235 AF (at an elevation of 551.0 feet msl, and at that capacity, the surface area of the reservoir would be approximately 7,605 acres). The maximum depth of the reservoir at the dam would be approximately 90 feet. The firm annual yield of the proposed project would be approximately 34,050 AF/YR. This alternative will impact approximately 387 acres of degraded ephemeral and intermittent streams and 10 acres of wetlands which are waters of the U.S. Details concerning these resources and impacts are contained in **Chapter 3** and **Chapter 4** of this EIS.

Table 2-3 shows the practicability screening results for the alternative dam sites A, B, and D.

Table 2-3: Alternative Dam Sites Practicability & Impact Screening Results

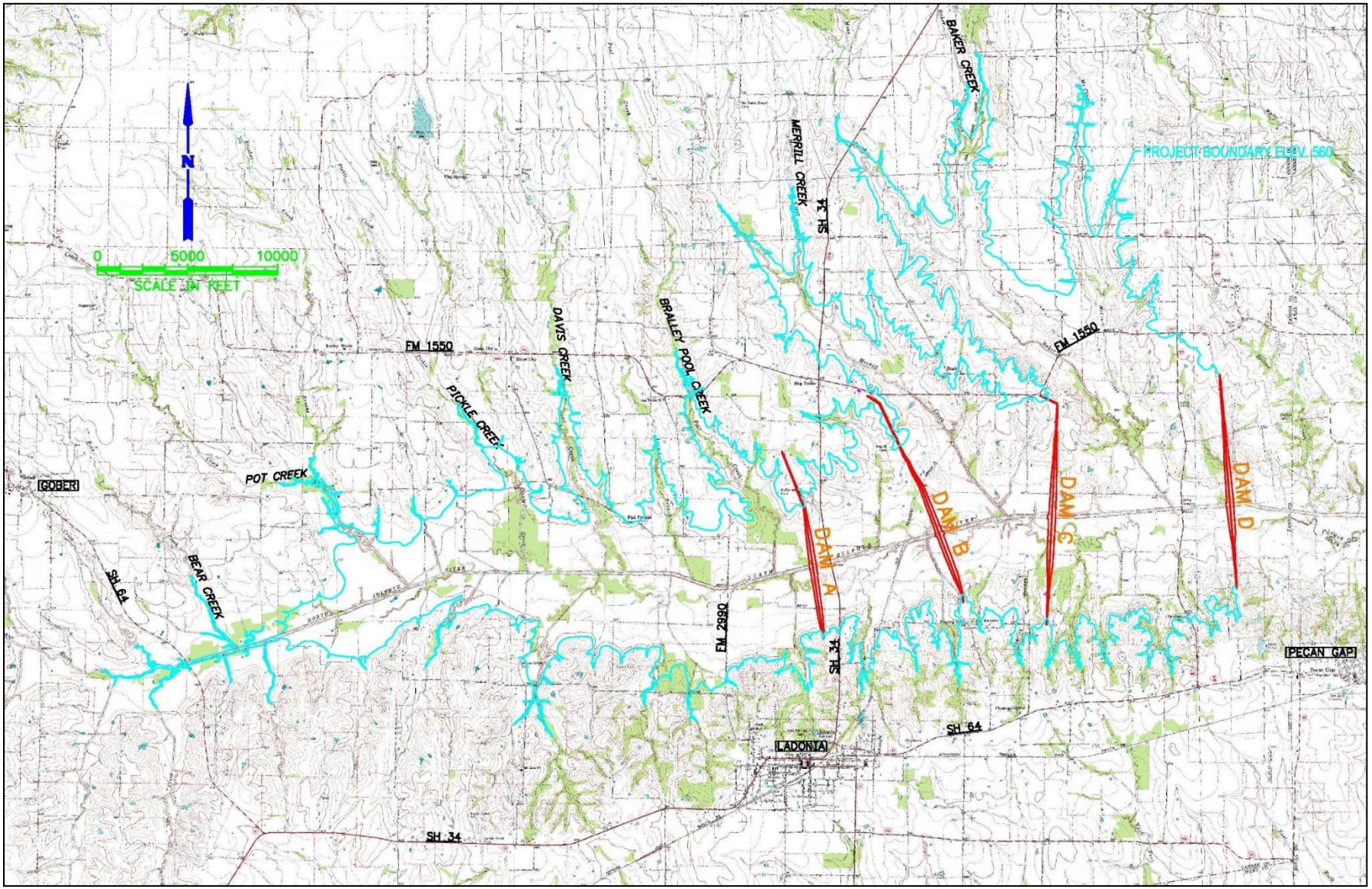
Alternative	No. 1	No. 2	No. 3	No. 4	No. 5	Advance
Dam Site A - Upstream	-	X	-	-	-	No
Dam Site B - Upstream	-	X	-	-	-	No
Dam Site C - Proposed	-	-	-	-	-	Yes
Dam Site D - Downstream	-	-	-	-	X	No

2.4.2.2 Alternative Conservation Pool Size

Design of the conservation pool size placed at the Proposed Action location along the river could be larger or smaller than currently proposed. If smaller, it would not meet Criterion 2. A larger

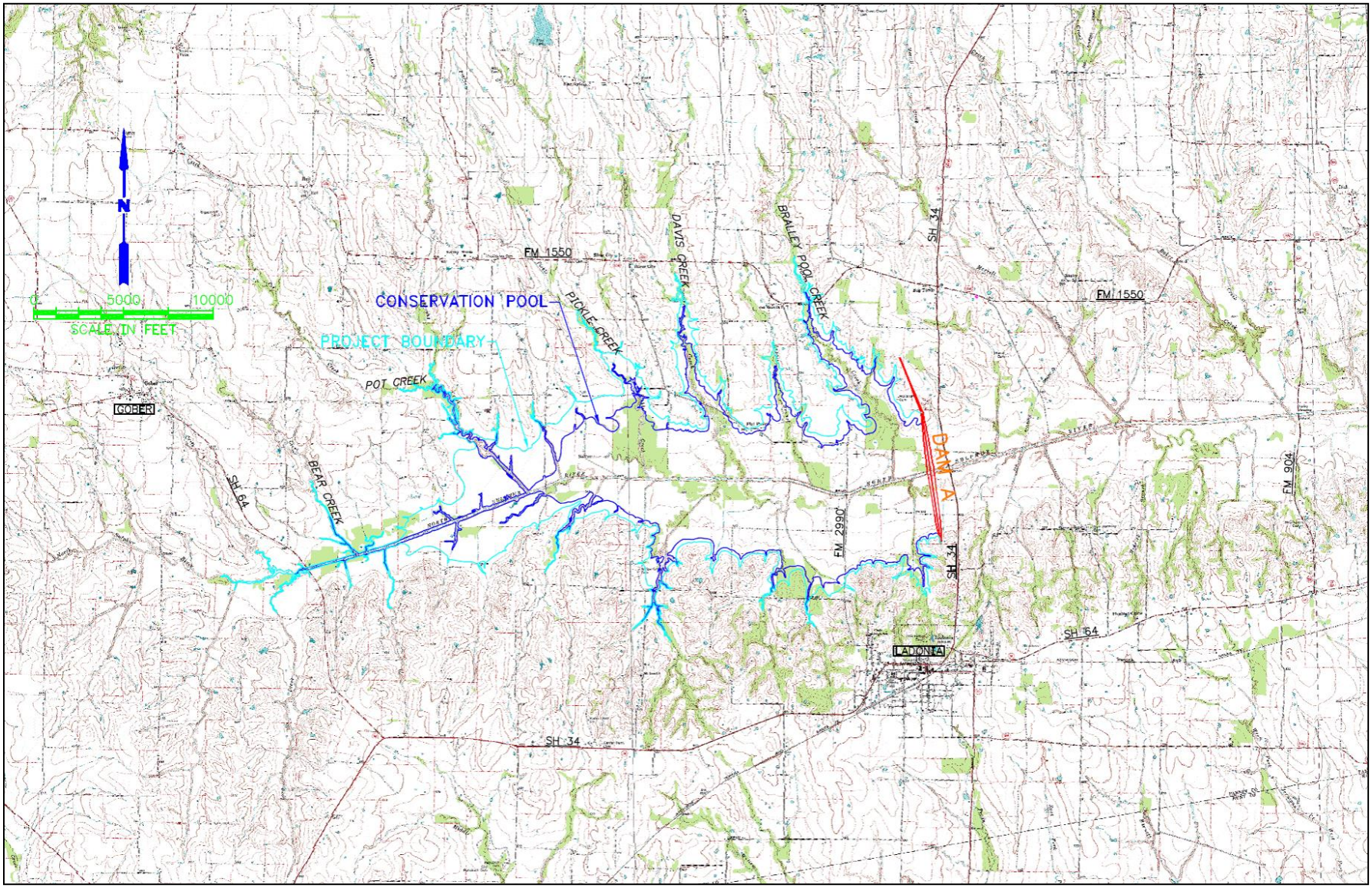
pool could be practicable in terms of yield, but the increased size would have more impacts to waters of the U.S and was not considered further. Additional details related to varying elevations of the conservation pool are provided in UTRWD (2009c) and **Appendix A-2**.

Figure 2-3: Dam Sites A, B, C, and D



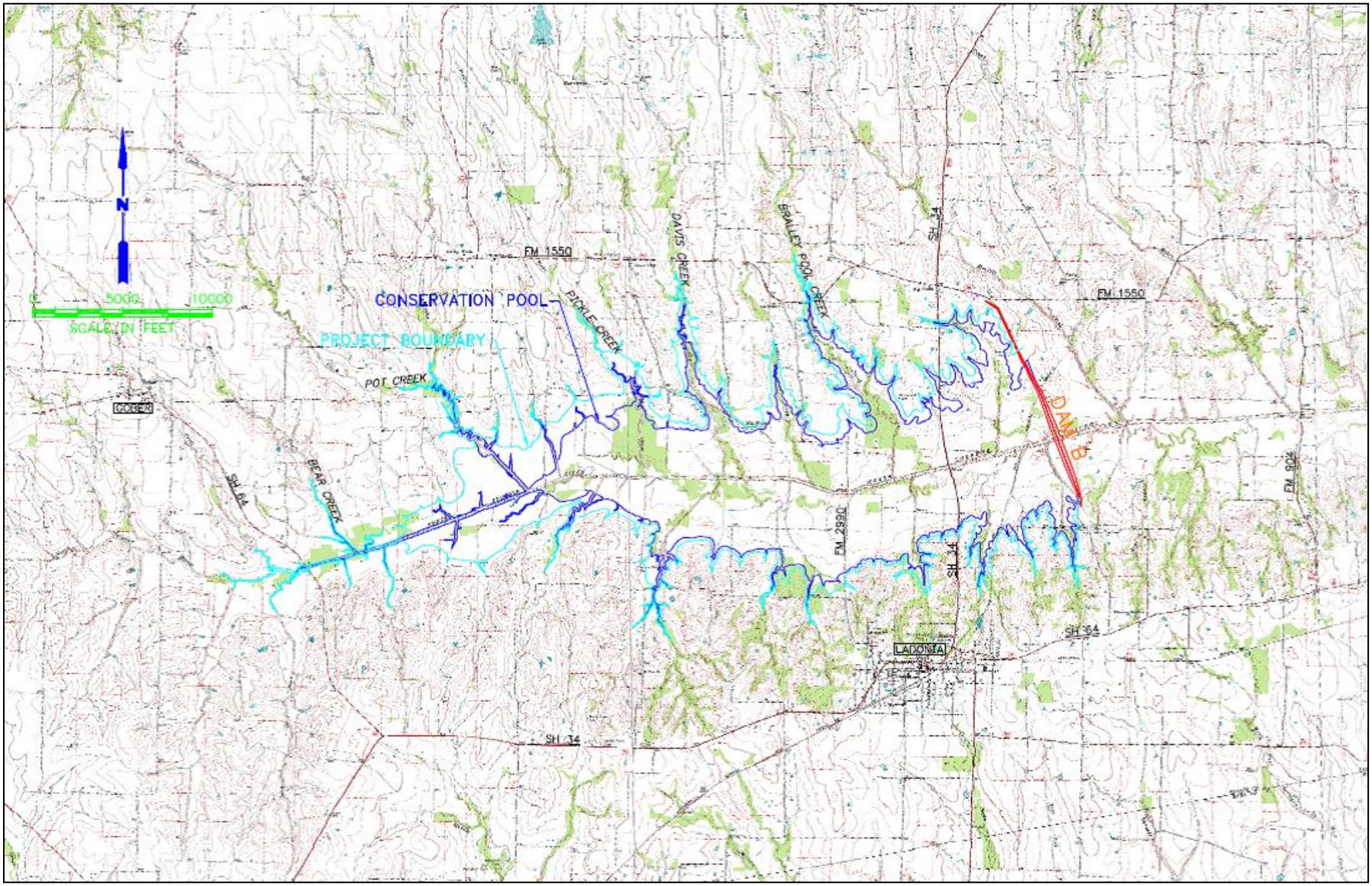
Source: UTRWD, 2009c

Figure 2-4: Dam Site A - Upstream



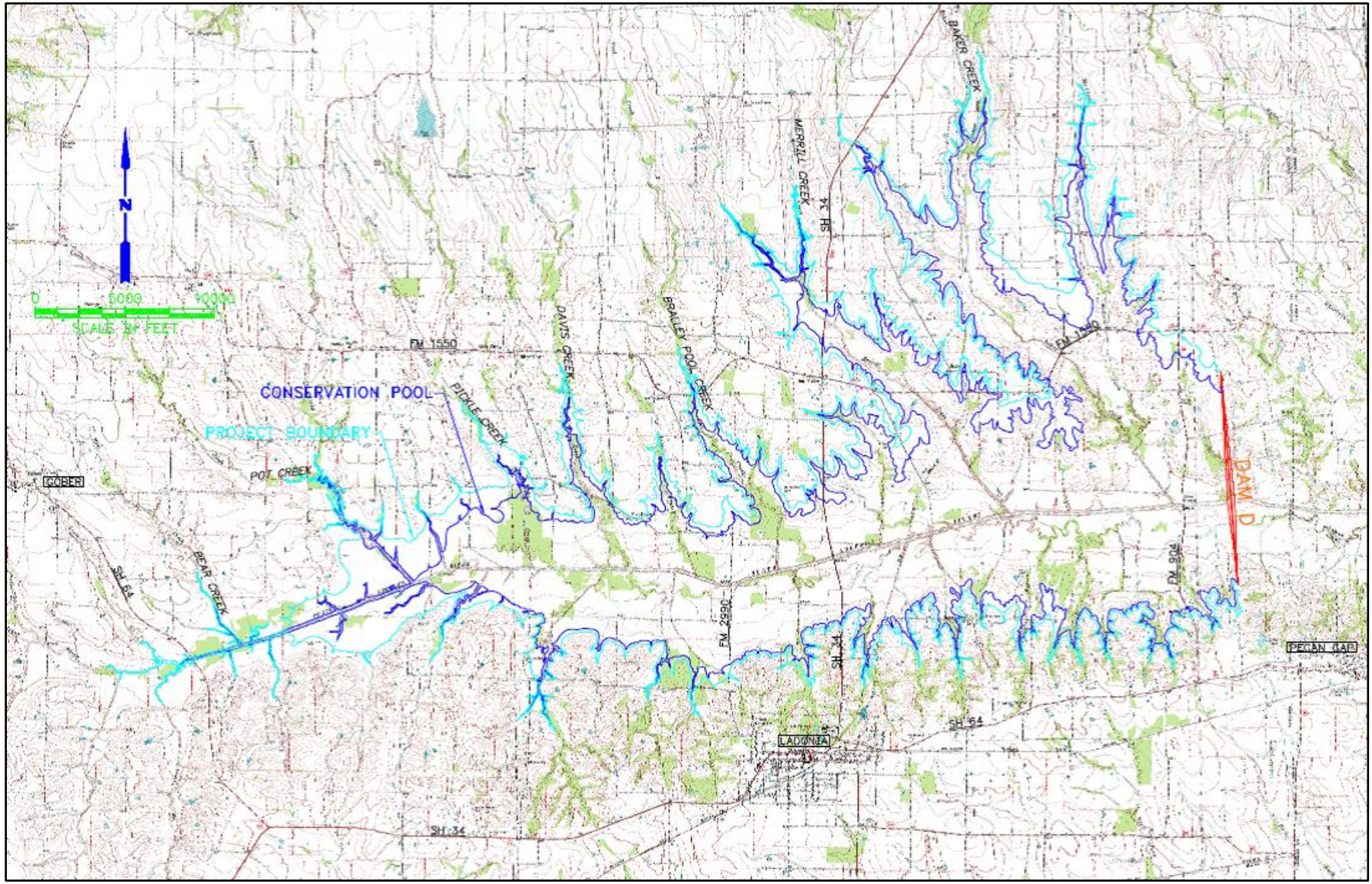
Source: UTRWD, 2009c

Figure 2-5: Dam Site B - Upstream



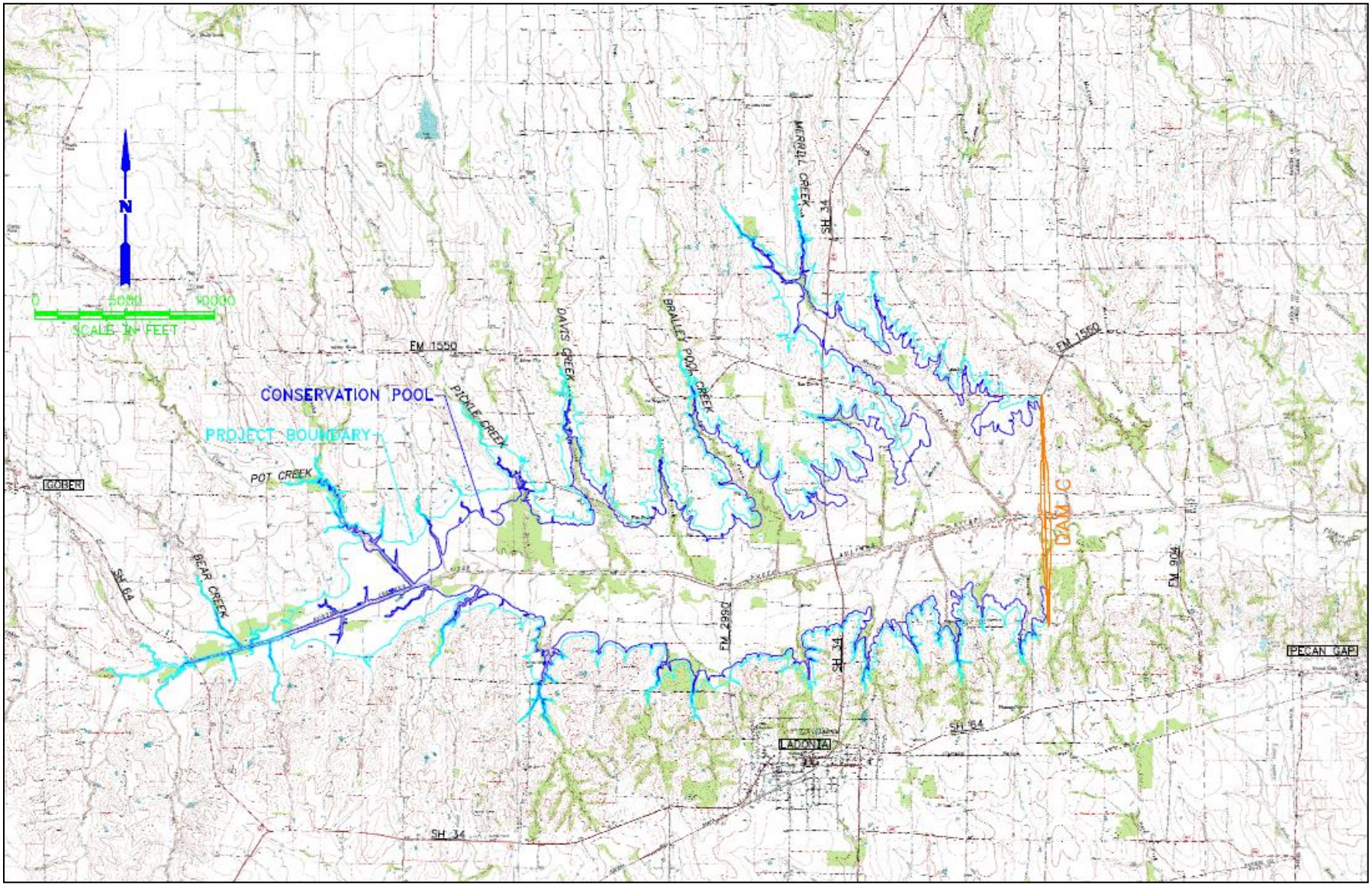
Source: UTRWD, 2009c

Figure 2-6: Dam Site D - Downstream



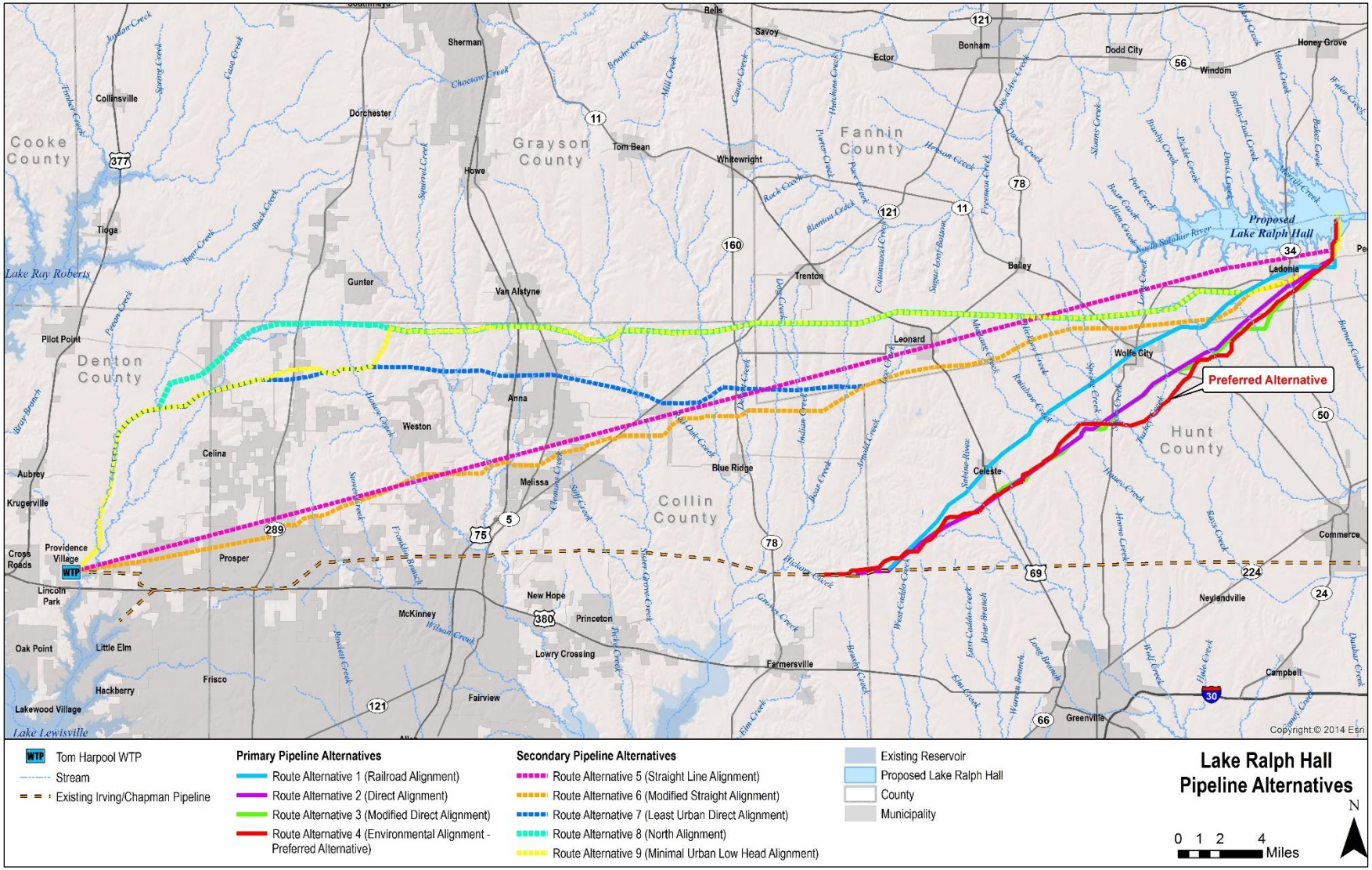
Source: UTRWD, 2009c

Figure 2-7: Dam Site C (Proposed Action)



Source: UTRWD, 2009c

Figure 2-8: Pipeline Alternatives



Source: UTRWD, 2010a

Note: Route Alternative 4 is the preferred pipeline route.

2.4.2.3 Conveyance Alternatives Evaluation

As part of the Dam Sites alternatives evaluation process, nine raw water conveyance alternatives were evaluated since UTRWD would need to be able to move raw water from any of the proposed Lake Ralph Hall dam sites to the Tom Harpool WTP. All nine of the conveyance alternatives evaluated in this DEIS consist of a pipeline, each of which varies in terms of the specific alignment. Four primary and five secondary alignments were evaluated for a total of nine conveyance alternatives (see **Figure 2-8**). Primary alignments include those alignments that connect to the existing Irving Pipeline that extends from Chapman Lake to the Tom Harpool WTP. These alignments were considered primary because they are substantially shorter, and therefore less costly and involve less waters of the U.S. crossings, than the secondary alignments. Secondary alignments include those that extend from the Lake Ralph Hall project dam sites directly to the Tom Harpool WTP. The pipeline alignments were analyzed using cost factors including pipeline length and right-of-way impacts and environmental factors including impacts to waters of the U.S., Caddo National Grasslands, and cultural resources. Additional information about the conveyance alternatives can be found in the *Lake Ralph Hall Water Pipeline Alignment Study* (UTRWD, 2010a) portions of which are included in **Appendix A-3**. Route Alternative 4 was selected as the recommended pipeline alternative to carry forward into NEPA analysis because it was one of the shortest (therefore less costly) alternatives with the fewest stream crossings. Other benefits included that it does not cross the Caddo National Grasslands and had the fewest impacts to wooded areas.

2.4.3 Lake Ralph Hall – Other Alternatives Considered

Marvin Nichols Reservoir (at 280 msl)

As described in UTRWD's initial information and the State Water Plan, Marvin Nichols Reservoir would be a much larger alternative than what is needed to address UTRWD's needs as defined in this EIS. The project is a proposed reservoir located on the Sulphur River in the Sulphur River Basin within Region D (North East Texas) in Red River and Titus counties. It has been a recommended strategy in the 2011, 2006, and 2001 Region C Water Plans for the North Texas Municipal Water District (NTMWD), the Tarrant Regional Water District (TRWD), and the UTRWD. In 2015 the Region D Water Planning Group raised an objection to the inclusion of the Marvin Nichols Reservoir (as part of the Sulphur Basin Supplies strategy) in the 2016 Region C Initially Prepared Plan (IPP) (TWDB, 2015a). Based on the resulting mediation agreement, Marvin Nichols Reservoir was modified to begin in 2070 rather than in 2050 (as it was presented in the IPP). The larger configuration of Marvin Nichols Reservoir (at elevation 328 feet, msl) that was included in the previous three Region C Water Plans was retained as an alternative strategy for the 2016 Region C Water Plan.

According to the 2011 Region C Water Plan, Marvin Nichols would provide a large source of additional supply for the Metroplex. The total yield of Marvin Nichols Reservoir is estimated to

be approximately 612,300 AF/YR, assuming that Lake Ralph Hall is in place as a senior water right to Marvin Nichols Reservoir and that Marvin Nichols Reservoir is operated as a system with Wright Patman Lake[3]. The division of the 489,840 AF/YR assumed to be available to Region C from the reservoir is:

- 280,000 AF/YR for TRWD
- 174,840 AF/YR for NTMWD
- 35,000 AF/YR for UTRWD.

To ensure a comparable comparison of potential impacts of the Marvin Nichols alternative to the Applicant's proposed Lake Ralph Hall project, the dam location for Marvin Nichols Site 1A was used and the conservation pool elevation was lowered to the point where the annual firm yield of the Marvin Nichols alternative was approximately equal to that of Lake Ralph Hall, 35,000 AF/YR, approximately 280 feet msl. Using ArcGIS software, the surface elevation of 280 feet msl was mapped and overlain on National Wetland Inventory (NWI) mapping for the same area. Based on this analysis, a Marvin Nichols alternative at a 280 feet msl conservation pool elevation with approximately the same yield as the Applicant's proposed Lake Ralph Hall project (~35,000 AF/YR) would result in an inundated surface area of approximately 6,056 acres.

The results of the evaluation of potential impacts to wetlands/waters of the U.S. based NWI maps resulting from a Marvin Nichols alternative at 280 feet msl conservation pool are included in **Table 2-4** below.

Table 2-4: Impacts from Marvin Nichols Alternative - 280 feet msl

NWI Wetland Type	Acreage Inundated
Freshwater Emergent Wetland	674.62
Freshwater Forested/Shrub Wetland	4,560.71
Freshwater Pond	23.53
Riverine	227.73
Total NWI Resources Inundated	5,537.61

Source: NWI GIS (Geographic Information System) Data, 2015

The total impacts to wetlands/water of the U.S. for the proposed Lake Ralph Hall project is estimated to be 387 acres and consists of impacts to degraded ephemeral and intermittent streams and approximately 10 acres of wetlands. Potential impacts from a Marvin Nichols alternative (5,537.61 acres) with approximately the same firm annual yield as Lake Ralph Hall (35,000

[3] 2011 Region C Water Plan, page 4E.2

AF/YR) would result in substantially greater impacts to high quality wetlands/waters of the U.S. The project site contains a portion of the state's Priority 1 bottomland hardwoods. These wetlands are considered high value to key waterfowl species and would require comparable mitigation (TWDB, Report 370, 2008). Since this alternative would result in greater impacts to the aquatic ecosystem, it fails Criterion 5.

Additionally, development of this supply would require a new water rights permit, an interbasin transfer in order to transfer the water from the Sulphur River Basin to the Trinity River Basin, and a 404 permit from USACE involving the development of an EIS. This reservoir site has been studied at the reconnaissance level only; no detailed field studies have been completed, and no permit applications have been filed. Because of the regional conflicts associated with the proposal and additional water rights and Federal permitting requirements, land acquisition for the reservoir and pipeline alignment and pumping stations, development is expected to take a substantial amount of time, well in excess of 2024. A more refined analysis and estimate was not developed to firmly determine if the alternative could be implemented within the time frame of Criterion 3. However, similar options (i.e. the Toledo Bend alternative discussed below) involving such efforts resulted in a timeline that extended well beyond 2024 for many of the issues facing Marvin Nichols without the need to develop an EIS for the construction of a dam and reservoir. Therefore, this option also fails to meet Criterion 3.

Due to failure of Criteria 3 and 5, the Marvin Nichols Reservoir Alternative was not carried forward for detailed evaluation in this DEIS.

Wright Patman Lake

Wright Patman Lake is an existing reservoir on the Sulphur River in the Sulphur River Basin, about 150 miles from the Metroplex. It is located in Region D, the North East Texas Region, and owned and operated by USACE. There are three different ways in which water could be made available from Wright Patman Lake for UTRWD.

- Water could be purchased from the City of Texarkana under its existing water right.
- Flood storage in Wright Patman Lake could be converted to conservation storage, and the increased yield could be used by the applicant.
- Wright Patman Lake could be operated as a system with Jim Chapman Lake (formerly Cooper Lake) upstream to further increase yield (2006 Region C Water Plan).

The City of Texarkana has contracted with the USACE for storage in the lake and holds a Texas water right to use up to 180,000 AF/YR from the lake. However, to obtain a reliable supply of this amount, Texarkana would have to activate a contract with the USACE to increase the conservation storage in the lake. Implementation of this contract would require an environmental evaluation of

the change in operation of the reservoir as required by NEPA. Additionally, accessing the full 180,000 AF/YR in the Texas water right would require additional modifications to the USACE contract.

For the purchase option, UTRWD would secure 34,050 AF/YR from the City of Texarkana from its currently held water rights. Of their current right, 135,000 AF/YR is allocated to industrial use (more than their projected water demand). For the conversion option, a recent study associated with an ongoing USACE Fort Worth District storage reallocation analysis, reported that increasing the top of conservation storage in Wright Patman Lake to elevation 228.64 feet msl and allowing diversions as low as elevation 215.25 feet msl would increase the yield of the project to about 364,000 AF/YR. In that study, it was assumed that 180,000 AF/YR of the additional supply developed could be made available to water suppliers in the Metroplex, including UTRWD. The yield of Wright Patman Lake could be increased to much more than 364,000 AF/YR by converting additional flood storage to conservation storage and increasing the top of conservation storage. For the system operation option, Wright Patman Lake and Jim Chapman Lake could increase the yield from the two projects by about 108,000 AF/YR. The study assumed that the combination of purchasing water from Texarkana, converting flood storage to conservation storage, and system operation with Jim Chapman Lake could make 390,000 AF/YR available for Region C from Wright Patman Lake (2006 Region C Water Plan), of which UTRWD is party to.

These options involve the same implementation hurdles as the Marvin Nichols alternative relative to being implemented in a timely fashion due to the time required to evaluate and obtain a state water right permit, new land acquisition for pipeline alignment and pump stations as well as utilities, and contract negotiations with Texarkana and/or USACE. While the purchase of water from Texarkana sub-option does not result in additional direct environmental consequence to wetlands and other waters at the reservoir site, the reallocation sub-option sized to meet the UTRWD's need of 34,050 AF/YR apart from other Metroplex players being involved would result in additional inundation to a large area of bottomland hardwoods and streams within the White Oak Creek Mitigation Area. Additionally, reallocation within the reservoir itself could not be accomplished earlier than 2025 (USACE, 2016a – Personal communication to Chandler Peter, USACE, March 2017a). The integrated operations with Chapman sub-option would require contractual changes between the USACE and Texarkana, willing sellers, impacts to the White Oak Creek Mitigation Area, changes to USACE operations of the lake, and conflicts with other potential users (Freese and Nichols, 2008).

All three sub-options would fail to provide the needed water to UTRWD by 2024, similar to the reasons identified in the analysis completed with the Toledo Bend alternative. This is due to water rights permitting, obtaining right of way for pipeline alignment and pumping facility locations, utilities locations, as well as design and construction requirements. While permits would be required from USACE Regulatory program for the pipeline and operations, impacts would be substantially lower allowing use of Nationwide Permits or individual permit evaluation with the

development an environmental assessment rather than an EIS due to significantly reduced impacts to aquatic resources without the need for a new or modified dam. The other factors identified result in an estimated time of providing water by 2032, well past the needed time of 2024.

Due to failure of Criteria 3 and 5, the Wright Patman Lake Alternative was not carried forward for detailed evaluation in this DEIS.

Additional DWU Supplies

This alternative would entail securing additional contract water supplies above and beyond those already committed. Currently, UTRWD has a contract with DWU with an annual volume limit of 11,200 AF/YR. UTRWD's contract with DWU expires in February of 2022 and DWU will make no commitment to renew that contract as of January 2015[4]. DWU makes the assumption that it will continue to supply the base amount of the existing contract plus future demands for the named entities. As embodied in its long range water supply plan, DWU has assumed this relationship will continue at least through 2070. No additional water is projected to be provided by 2024.

Due to failure of Criterion 3, the Additional DWU Supplies Alternative was not carried forward for detailed evaluation in this DEIS.

Oklahoma Water

Importing water from southeastern Oklahoma is a water supply source that is potentially available to the applicant. It is listed as a recommended strategy in the 2016 Region C Water Plan, including an alternative strategy for UTRWD. UTRWD has filed applications with the Oklahoma Water Resource Board (OWRB) to secure such water. Other water suppliers have also filed applications or even entered into agreement in the same basins as UTRWD's applications. However, Oklahoma had imposed a moratorium on any permits or contracts authorizing the sale of water to users outside of the state. A Texas water provider pursued litigation in Federal Court to determine whether this moratorium could be overturned, and the U.S. Supreme Court subsequently ruled in favor of Oklahoma. Before the moratorium expired in 2009 the legislature passed a bill declaring that no out-of-state water permit will impair the ability of the state of Oklahoma to meet its obligations under any interstate stream compact or impair or affect the obligations of the United States and that out-of-state water permits must be approved by the Oklahoma Legislature.

Additionally, the Chickasaw and Choctaw Indian Nations have asserted legal claims to water in southeastern Oklahoma. In August of 2016 a settlement was reached under which Oklahoma would continue to manage the state's natural water supply but acknowledge tribal sovereignty and meet the tribes' conservation guidelines. The agreement also sets up a framework for out-of-state sales or transfers of water from a 22-county region in south-central and southeastern Oklahoma.

[4] See Appendix A-6 Letter from Jody Puckett, Director, DWU to Stephen Brooks, USACE, January 28, 2015.

It creates a five-person commission appointed by the state and tribal governments that will evaluate such proposals and make recommendations to the Legislature. The quantity of water in Oklahoma available to meet the needs of the various applicants and how that water will be allocated is yet to be resolved.

UTRWD has filed three separate applications with the OWRB for the right to withdraw up to a combined total of 115,000 AF/YR from the Kiamichi, Boggy Creek and Texoma basins. UTRWD has requested an extension to two applications which expired in 2016 (Kiamichi extension requested until 3/14/19 and Boggy Creek extension requested until 11/5/19). A response from the OWRB regarding these requests is pending. If ultimately permitted, it is estimated that 115,000 AF/YR would be available from Oklahoma to UTRWD and its partners at some point in the future. UTRWD's share is approximately 45 percent of the 115,000 AF/YR.

If the OWRB were to grant an Oklahoma water rights permit, the UTRWD would still need to obtain a Section 401 water quality certification if Oklahoma water were to be discharged to a Texas stream or lake, and a Section 404 permit for the diversion structure and any dam if needed. Depending upon the source of water and its diversion location, a transmission system would be needed to the UTRWD's service area. Due to the uncertain status of the Oklahoma water rights permit, this strategy would not be able to deliver water in a timely manner to meet the UTRWD's near-term (10-20 year) water needs.

Due to failure of Criterion 3, the Oklahoma Water Alternative was not carried forward for detailed evaluation in this DEIS.

Toledo Bend Reservoir

Toledo Bend Reservoir is an existing impoundment located in the Sabine River Basin on the border between Texas and Louisiana. It was built in the 1960s by the Sabine River Authority of Texas (SRA) and the Sabine River Authority of Louisiana. The yield of the project is split equally between the two states, and Texas's share of the yield is slightly over 1,000,000 AF/YR. The SRA holds a Texas water right to divert 750,000 AF/YR from Toledo Bend and is seeking the right to divert an additional 293,300 AF/YR (2006 Region C Water Plan).

The use of water from Toledo Bend Reservoir in East Texas for water supply in North Texas is a recommended strategy for several Metroplex entities, including UTRWD, in the 2016 Region C Water Plan. The Metroplex water suppliers have been investigating the possibility of developing substantial water supplies from Toledo Bend Reservoir, with up to 348,000 AF/YR delivered to Region C. (Toledo Bend Reservoir is located in Region I, the East Texas Region.) The development of this supply would require an agreement among the SRA and Metroplex suppliers, an interbasin transfer permit from the Sabine River Basin to the Trinity River Basin, and development of water transmission facilities including an intake pump station, pipelines, booster pump stations, maintenance access roads and associated utilities.

This alternative was modified to provide the need identified in this EIS of 34,050 AF/YR. Coordination with the SRA confirmed that adequate water supply was available to the applicant to meet the target need. Consideration of costs was also applied to this option. As described in **Section 2.3.1.1**, alternatives may be determined to be not practicable due to costs. An initial cost estimate was developed (**Appendix A-4**) to determine if the option was not practicable from an exorbitant perspective rather than develop a threshold that could be applied to all alternatives. Considerations focused on construction, operation and maintenance costs in present day value since they comprise the bulk of overall costs and allow for a reasonable comparison. The Lake Ralph Hall proposal estimated costs are approximately $330 million while this alternative's costs would be slightly more than $1 billion for the same amount of yield. While a threefold increase in overall costs to address the need is substantial, it was not considered to be exorbitant. Rather than attempt to develop a specific threshold which requires evaluation of regional costs for similar projects and possibly estimate costs for multiple alternatives, other screens were applied to evaluate the alternative.

Development of the infrastructure components and permitting requirements revealed that providing the needed water from this option in a timely manner was problematic. A schedule was developed and refined (**Appendix A-5**) that included water rights permitting, USACE permitting, land acquisition, design and construction. Additionally, consideration of other recent water pipeline projects in the state of Texas was included in the development of the schedule including the Integrated Pipeline project being pursued by the TRWD and City of Dallas Water Utilities, the Mary Rhodes Phase II Pipeline Project by the City of Corpus Christi, and the Lake Texoma Pipeline Project by the NTMWD.

Based on the analysis, it was determined that water from the proposed project would be available starting around 2032, well past the requirement of Criterion 3.

Due to failure of Criterion 3, the Toledo Bend Reservoir Alternative was not carried forward for detailed evaluation in this DEIS.

Lake Texoma

Lake Texoma is an existing USACE reservoir on the Red River between Texas and Oklahoma. It provides water supply for the NTMWD and the Greater Texoma Utility Authority (GTUA), the City of Denison, TXU, and the Red River Authority. According to the USACE, the firm yield of Lake Texoma with all hydropower storage reallocated to water supply would be 1,088,500 AF/YR. Under the Red River Compact, water from Lake Texoma is divided between Texas and Oklahoma.

The firm yield of Texas' share of Lake Texoma is 642,608 AF/YR in 2020, decreasing to 640,067 AF/YR by 2070. Based on the 2016 Region C Water Plan, the total Texoma supply available to Region C as of 2070 is 316,550 AF/YR (2,250 AF/YR for Red River Authority; 83,200 AF/YR for GTUA; 24,400 AF/YR for Denison; 197,000 AF/YR for NTMWD; and 16,400 AF/YR for

Luminant). In the case of Texoma, the available supply is limited to the water right amount. This strategy was listed as an alternative water supply strategy for UTRWD in the 2016 Region C Plan.

In 2010, an additional 150,000 AF out of the Texas share was reallocated for Texas water supplies. These supplies were fully subscribed by NTMWD and GTUA. That reallocation required 12 years to complete.

Water from Lake Texoma is brackish and unable to be used without blending it with higher quality water or using a desalination process. The city of Sherman, which receives raw water from GTUA, operates a desalination and treatment plant. GTUA along with NTMWD also blends water with higher quality and upstream source to make water from Lake Texoma potable. The Red River Authority is also sponsoring the Red River Chloride Control Project to improve water quality and desalinate prior to the brackish water reaching Lake Texoma. It is anticipated that UTRWD can implement similar treatment trains relative to Lake Texoma water. These conditions and requirements did not allow for a determination that this option is not practicable.

Further reallocation of hydropower storage to water supply in Lake Texoma would provide additional yield. Texas' share would be 544,250 AF/YR, leaving about 220,000 AF/YR of additional supply available to Texas by the reallocation of more hydropower storage to municipal use (beyond the supplies already contracted for and the currently authorized reallocation). The Lake Texoma waters available to Texas municipal water users have been spoken for or are lined up by the historical constituent utilities of the Lake, NTMWD and GTUA. NTMWD is projected to have water shortages, as evidenced by its starting negotiations with GTUA and the city of Sherman for receiving unused water. Reallocation of water from hydropower, would require an act of Congress.

UTRWD would need to establish a water right and an engineering plan for getting the water to its service area and rendering it potable first before applying to the USACE for the reallocation. The USACE would then need to initiate a process for reallocation, including a study to assess the reallocation. Hydropower interests and other Texas water interests would have an opportunity to comment and contest such a reallocation and water grant to UTRWD. Costs for this effort would be borne by UTRWD.

As previously identified, UTRWD has filed for a water rights permit from Lake Texoma from the OWRB to utilize a portion of Oklahoma's Lake Texoma water. The OWRB is not ruling on this and other out of state permits pending the outcome of related lawsuits. As discussed previously, the Supreme Court ruled in favor of Oklahoma, but additional lawsuits by Chickasaw and Choctaw Indian Nations have resulted in agreements that set up a framework for out-of-state sales, still only when authorized by the legislature.

It took UTRWD more than a decade to obtain a water right permit for its preferred alternative which was followed by litigation from 2012 up until the final ruling from the First District of Texas

Court of Appeals on June 9th, 2017. This ruling ended litigation making the water right permit for Lake Ralph Hall final and legally unappealable (**Appendix J**). Additionally, the USACE permit evaluation of the proposed Lake Ralph Hall project has taken over nine years to develop and release a Draft EIS. Due to the contentiousness of a reallocation effort, based on documented comments and concerns associated with the previous reallocation effort, the time associated with the state of Texas water right permit process and Congressional authorization, it is concluded that developing water from this potential alternative cannot occur within the timeframe screen established in Criterion 3 which is 2024.

Due to failure of Criterion 3, the Lake Texoma Alternative was not carried forward for detailed evaluation in this DEIS.

George Parkhouse Reservoir (North)

George Parkhouse Reservoir (North), also referred to as Parkhouse II Lake, is a potential reservoir on the North Sulphur River located downstream of the proposed Lake Ralph Hall project in Lamar and Delta Counties (Region D). The 2016 Region C Water Plan estimates that the reservoir yield would be 148,700 AF/YR, based on a conservation pool level of 410 feet, 118,960 AF/YR of which is assumed to be available for Region C, with 35,000 AF/YR of that amount allocated to UTRWD. Therefore this alternative would meet Criterion 2.

The previous TWDB Report 370 estimates the firm yield of the proposed reservoir at 144,300 AF/YR, and estimates that this would be reduced by 2,500 AF/YR for environmental flow requirements and by an additional 26,900 AF/YR if the proposed Lake Ralph Hall project is in place as a senior water right (if this is an alternative to Lake Ralph Hall then the Lake Ralph Hall right could possibly be transferred downstream if the existing Lake Ralph Hall water right was cancelled). According to the report, the firm yield of George Parkhouse Reservoir (North) would decrease if one or more of the proposed reservoirs in the Sulphur Basin (Ralph Hall, George Parkhouse Reservoir (South), and/or Marvin Nichols IA) are built and the George Parkhouse Reservoir (North) has a junior priority to any of these reservoirs. Yield analysis conducted in 2008 for the TWDB Report 370, determined that Lake Ralph Hall would reduce the firm yield of George Parkhouse Reservoir (North) by 26,900 AF/YR, which is 18 percent of the stand-alone yield. If all of the other planned reservoirs in the Sulphur Basin were in place the yield from George Parkhouse Reservoir (North) is estimated to be only 32,100 AF/YR, which is 112,200 AF/YR less than the stand-alone yield (or a reduction of 78 percent).

George Parkhouse Reservoir (North) site is located upstream of a Priority 1 bottomland hardwood preservation site identified as Sulphur River Bottoms West (TWDB, 2008). George Parkhouse Reservoir (North) would inundate approximately 14,400 acres of land at conservation storage capacity. **Table 2-5** summarizes existing landcover for the George Parkhouse Reservoir (North) site as determined by the Texas Parks and Wildlife Department (TWDB, 2008).

Table 2-5: Acreage and Percent Landcover for George Parkhouse Reservoir (North)

Landcover Classification	Acreage[a]	Percent
Bottomland hardwood forest	208	1.4%
Seasonally flooded shrubland	170	1.1%
Swamp	31	0.2%
Evergreen forest	9	0.0%
Upland deciduous forest	4,003	26.0%
Grassland	7,605	49.5%
Shrubland	672	4.4%
Agricultural land	2,424	15.8%
Urban/developed land	45	0.3%
Open water	200	1.3%
Total	**15,367**	**100.0%**

Source: Texas Water Development Board Report 370, 2008
Notes: [a]Acreage based on approximate GIS coverage rather than calculated elevation-area-capacity relationship.

Development of George Parkhouse Reservoir (North) would require a water right permit and an interbasin transfer permit. Detailed studies of water needs in the receiving and the source basins would be required as part of the permitting process for new interbasin transfers. The typical reservoir development schedule (**Appendix A-5**) indicates that due to the need for detailed engineering and environmental studies, new water rights and IBTs, it appeared unlikely that George Parkhouse Reservoir (North) could be developed in time to meet Criterion 3. Therefore, additional analysis was required.

Using Arc GIS software, the surface elevation of 375 feet msl was mapped and overlain on NWI mapping for the George Parkhouse II (North) reservoir site. A scaled down conservation pool elevation resulting in firm annual yield similar to that of Lake Ralph Hall (approximately 35,000 AF) was not available so the closest available yield (~30,000 acre-feet [AF]) elevation of 375 msl was selected for comparison.

Based on this analysis, a George Parkhouse II (North) alternative at a 375 feet msl conservation pool elevation with slightly less yield as the Applicant's proposed Lake Ralph Hall project would result in an inundated surface area of approximately 3,532 acres (TWDB, 2008). The results of the screening of potential impacts to wetlands/waters of the U.S. based on NWI maps and a George Parkhouse II (North) alternative at a 375 feet msl conservation pool are included in **Table 2-6**.

Table 2-6: Impacts from George Parkhouse Reservoir (North) Alternative - 375 feet msl

NWI Wetland Type	Acreage Inundated
Freshwater Emergent Wetland	2.81
Freshwater Forested/Shrub Wetland	776.96
Freshwater Pond	10.50
Riverine	101.27
Total NWI Resources Inundated	**891.54**

The total impacts to wetlands/water of the U.S. for the proposed Lake Ralph Hall project is estimated to be less than 387 acres and consists of impacts to degraded ephemeral and intermittent streams and approximately 10 acres of wetlands. Potential impacts from a scaled down George Parkhouse II (North) alternative (891.54 acres) with a slightly lower firm annual yield as Lake Ralph Hall would result in more than two times the amount of impacts to wetlands/waters of the U.S. than the proposed Lake Ralph Hall project's impacts to the same resources (387 acres). The George Parkhouse II (North) alternative would not meet Criterion 5 because it would result in greater impacts to wetlands/waters of the U.S. than the proposed Lake Ralph Hall project's impacts to the same resources.

Due to failure of Criteria 2, 3, and 5, the George Park House Reservoir (North) Alternative was not carried forward for detailed evaluation in this DEIS.

George Parkhouse Reservoir (South)

George Parkhouse Reservoir (South), also referred to as Parkhouse I Lake, is a potential reservoir located downstream from Jim Chapman Lake on the South Sulphur River in Hopkins and Delta Counties (Region D). According to the 2016 Region C Water Plan, George Parkhouse Reservoir (South) could supply 135,600 AF/YR based on a conservation pool level of 410 feet. Assumed to be available for Region C are 108,480 AF/YR, with 35,000 AF/YR of that amount assumed to be allocated to UTRWD.

The 2008 TWDB Report 370 estimated the firm yield to be 122,000 AF/YR based on a conservation pool elevation of 401 feet. The lower conservation pool elevation was used in this study based on concerns of operational and cost impacts if it were set at a higher level. TWDB Report 370 also estimates that environmental flow requirements would be 2,400 AF/YR, and notes that the yield would decrease if the proposed Lake Ralph Hall project is in place as a senior water right. George Parkhouse Reservoir (South) is not a recommended water management strategy for any Region C water supplier. It is an alternative strategy for the NTMWD and the UTRWD.

According to the report, the yield of George Parkhouse Reservoir (South) would decrease if one or more of the proposed reservoirs in the Sulphur Basin (Ralph Hall, Parkhouse II, and/or Marvin Nichols IA) are built, and George Parkhouse Reservoir (South) has a junior priority to any of these reservoirs. The scenario that produces the lowest yield assumes that George Parkhouse Reservoir (South) is built after all of the other proposed reservoirs in the Sulphur Basin. Under this scenario, the yield of George Parkhouse Reservoir (South) would be 48,400 AF/YR, or 73,600 AF/YR less than if the reservoir is senior to any other proposed reservoir. Lake Ralph Hall is senior to George Parkhouse Reservoir (South), as well as to George Parkhouse Reservoir (North) and Marvin Nichols Reservoir IA.

Development of George Parkhouse Reservoir (South) would require a water right permit and an interbasin transfer permit. Detailed studies of water needs in the receiving and the source basins would be required as part of the permitting process for new interbasin transfers. The typical reservoir development schedule (**Appendix A-5**) indicates that due to the need for detailed engineering and environmental studies, new water rights and IBTs, it is unlikely that George Parkhouse Reservoir (South) could be developed in time to meet Criterion 3. Therefore, as with George Parkhouse (North), additional analysis was required to determine practicability or greater environmental consequences to the aquatic ecosystem.

Texas Parks and Wildlife Department completed a study titled, An Analysis of Bottomland Hardwood Areas at Three Proposed Reservoir Sites in Northeast Texas. The results of the study are presented in the Final Report to Texas Water Development Board for the fulfillment of interagency agreement No. 97-483-211 (Changxiang Liu, Ph.D., Alison L. Baird, Craig Scofield, and A. Kim Ludeke, Ph.D.). As indicated in **Table 2-7**, the proposed George Parkhouse Reservoir (South) at a normal (mean) conservation pool (elevation 401 feet msl) would impact land use cover types including bottom land hardwoods (e.g. wetlands) as would a scaled down version sized for UTRWD's needed yield of 35,000 AF.

Table 2-7: Acreage of Land Use for George Parkhouse Reservoir (South)

Land Use Cover Type*	Normal Conservation Pool (Acres)	Reduced Conservation Pool (Acres)**
Water	830	216
Bottomland Hardwood	9,434	2,453
Secondary Bottomland Hardwood	1,959	509
Oak-Hickory	2,284	594
Cedar-Hardwood/Pine-Hardwood	161	42
Pure Cedar/Pine	7	2
Grassland	11,734	3,051
Crop/Managed Grassland	2,654	690
Bare Soil/Ground	118	31
Total	**29,181**	**7,588**

Notes: * https://tpwd.texas.gov/publications/pwdpubs/pwd_rp_t3200_1057a/index.phtml for land use cover type methods.
** Reduced conservation pool acreages were calculated by multiplying the normal conservation pool acreages by 0.26 since 35,000 AF is approximately 26% of 135,000 AF.

The total impacts to wetlands/water of the U.S. for the proposed Lake Ralph Hall project is estimated to be 387 acres and consists of impacts to degraded ephemeral and intermittent streams and approximately 10 acres of wetlands. Potential impacts from a George Parkhouse Reservoir (South) alternative (2,453 acres) with approximately the same firm annual yield as Lake Ralph Hall (35,000 AF/YR) would result in greater impacts to wetlands/waters of the U.S. than the proposed Lake Ralph Hall project's impacts to the same resources (387 acres) and therefore this alternative does not meet Criterion 5.

Due to failure of Criteria 3 and 5, the George Park House Reservoir (South) Alternative was not carried forward for detailed evaluation in this DEIS

Gulf of Mexico

The State of Texas has sponsored initial studies of potential seawater desalination projects, and this is seen as a potential future supply source for the state. This option has been mentioned through public input during the planning process, and it was evaluated in the 2016 Region C Water Plan in response to that input. While the cost of desalination has been decreasing in recent years, and some municipalities in Florida and California have been developing it as a supply source, the distance to the Gulf of Mexico and elevation change of more than 500 feet makes this option not a particularly promising source of supply for Region C, including the applicant. The energy required for desalination and the conveyance of raw water from this source to the applicant would be substantial. Similar to the Toledo Bend alternative, a cost estimate was developed for this option

to address UTRWD's need and purpose (**Appendix A-4**) and compared to the proposed action. Considerations focused on construction, operation and maintenance costs in present day value since they comprise the bulk of overall costs and allow for a reasonable comparison. The Lake Ralph Hall proposal estimated costs are $330 million while the Gulf of Mexico option costs would be slightly less than $2.4 billion for the same amount of yield. Such a stark contrast in costs, approximately eight times what is the least costly build option, allows for a determination that this alternative's costs are exorbitantly expensive.

Due to failure of Criterion 4, the Gulf of Mexico Alternative was not carried forward for detailed evaluation in this DEIS.

Cypress Creek Basin – Lake O' the Pines

Lake O' the Pines is an existing USACE reservoir, with Texas water rights held by the Northeast Texas Municipal Water District (NETMWD). The lake is on Cypress Creek in the Cypress Basin in Senate Bill One water planning Region D, the North East Texas Region. Lake O' the Pines is about 120 miles from the Metroplex. The distance and limited supply make this a potentially expensive water management strategy. Obtaining water from the Cypress River Basin is not a recommended strategy in the 2016 Region C Water Plan for any Region C supplier. Some Metroplex water suppliers have explored the possibility of purchasing supplies in excess of local needs from the Cypress Basin for use in the Metroplex. There could be as much as 89,600 AF/YR available for export from the basin. Development of this source would require contracts with the NETMWD and other Cypress River Basin suppliers with excess supplies and an interbasin transfer permit. Since this water management strategy obtains water from an existing source, the environmental impacts are expected to be low.

Coordination with NETMWD (**Appendix A-6**) revealed that approximately 26,000 AF/YR of reliable water could be provided to a customer. NETMWD also stated they are not interested in selling any of its water rights. Because development of this source would not generate the required amount of water under Criterion 2, this is not considered a practicable alternative and was eliminated from further consideration in the EIS. Additionally, in light of other alternatives that were evaluated which involved the need to develop contracts with a water provider in another basin with available supplies, required a new interbasin transfer permit from the TCEQ, and also required authorization under a Section 404 permit from the USACE, this option would also not meet Criterion 3.

Due to failure of Criterion 3, the Cypress Creek Basin Alternative was not carried forward for detailed evaluation in this DEIS.

Precipitation Enhancement

Precipitation enhancement involves seeding clouds with silver iodide to promote rainfall. Such programs are generally located within areas where the rainfall is lower than in Region C. Given that Region C has adequate rainfall, and that there are no studies showing what impact precipitation enhancement would have on streamflow and reservoirs in Region C, precipitation enhancement is not recommended as a potentially feasible water management strategy for Region C in the State Water Plan. However, there may be localized areas in Region C who might benefit from such a management strategy. The 2016 Region C Water Plan decision summary states "Do not include precipitation enhancement as a potentially feasible strategy for the development of additional water supplies. Allow for studies and localized pilot projects to further investigate precipitation enhancement" (2016 Region C Water Plan, 5A.9).

Since additional studies are required to ascertain the potential for use a water supply strategy and no development of precipitation enhancement is projected to occur by 2024, it would not meet Criteria 1, 2, or 3 and therefore is not considered a practicable alternative to the proposed Lake Ralph Hall project.

Due to failure of Criteria 1, 2, and 3, the Precipitation Enhancement Alternative was not carried forward for detailed evaluation in this DEIS.

Groundwater Imports

In Region C, only six percent of the water used comes from groundwater. Groundwater is sometimes used to meet peak demands in systems that have both groundwater and surface water supplies. This does not, however, increase total supply on an annual basis. Therefore, from a state perspective, conjunctive use is not considered as a potentially feasible water management strategy to provide additional supplies for Region C. The 2016 Region C Water Plan decision summary states "Do not include the conjunctive use of groundwater and surface water as a source of additional supplies for Region C. Conjunctive use to meet peak needs is appropriate and should continue" (2016 Region C Water Plan, 5A.5). USACE evaluated groundwater as a possible supply to address the project need. It is recognized that some UTRWD members and customers currently rely upon groundwater for portions of their supplies and there are numerous other entities that do as well.

Ogallala Groundwater (Roberts County)

In the 2006 Region C Water Plan, and covered in **Appendix A-1**, Mesa Water, Incorporated, was interested in selling groundwater from the Ogallala aquifer in Roberts County to water suppliers in Region C. (Roberts County is in Region A, the Panhandle Region.) Mesa Water controlled rights to 150,000 AF/YR of groundwater in Roberts County with options for additional supply and had permits from the local groundwater conservation district (GCD) to export groundwater. Mesa Water had indicated they could develop a reliable supply of 200,000 AF/YR for water suppliers in

Region C through 2060 and beyond. The groundwater in Roberts County is about 250 miles from the Metroplex. Since this is a groundwater supply, no interbasin transfer permit would have been required. However, these water rights were sold to the Canadian River Municipal Water Authority (CRMWA) in 2011 (CRMWA, 2017). Ogallala groundwater from Roberts County is not a recommended strategy for any Region C supplier. It was an alternative strategy for DWU and the NTMWD in the 2006 Plan. This strategy is not included in the 2016 Plan.

Carrizo-Wilcox Aquifer Groundwater (Brazos County and Vicinity)
The Carrizo-Wilcox aquifer covers a large area of east, central, and south Texas. Organizations and individuals have been studying the development of water supplies in Brazos County and surrounding counties for export. Metroplex water suppliers have been approached as possible customers for the water. (The supplies under discussion are located in Region G, called the Brazos G Region, and these supplies have also been studied for use by communities in that region.) Brazos County is about 150 miles from the Metroplex. Since this is a groundwater supply, no interbasin transfer permit would be required. Carrizo-Wilcox groundwater from Brazos County and vicinity is not a recommended strategy for any Region C supplier. It was an alternative strategy for the NTMWD in the 2006 Plan. This strategy is not included in the 2016 Plan.

Carrizo-Wilcox Aquifer Groundwater in Wood, Upshur, and Smith Counties (Regions D and I)
The Carrizo-Wilcox aquifer covers a large area of east, central, and south Texas. In Dallas' recent Long Range Plan, groundwater from the Carrizo-Wilcox aquifer in Wood, Upshur, and Smith Counties was identified as a potential water supply. Since this is a groundwater supply, no interbasin transfer permit would be required. Carrizo-Wilcox groundwater from Wood, Upshur, and Smith counties in Regions C and I is an alternative strategy for DWU in the 2016 Region C Water Plan.

Carrizo-Wilcox Aquifer Groundwater in Freestone and Anderson Counties (Region I)
Organizations (including Forestar) and individuals have been studying the development of water supplies in Freestone and Anderson Counties and surrounding counties for export. Metroplex water suppliers have been approached as possible customers for the water. Since this is a groundwater supply, no interbasin transfer permit would be required. Carrizo-Wilcox groundwater in Freestone/Anderson Counties is an alternative strategy for NTMWD in the 2016 Region C Water Plan.

In addition to reviewing groundwater sources evaluated in Region C Water Plans, potential groundwater sources from several GCDs and the Canadian River Municipal Water Authority (CRMWA) were evaluated. In addition to the CRMWA, the following GCDs were reviewed:

- Mid-East Texas
- Neches & Trinity Valleys
- Northern Trinity

- Upper Trinity
- Prairielands
- North Texas
- Red River
- Brazos Valley

According to the *Supplemental Evaluation of CH2M Hill's Groundwater Alternatives Analysis* (UTRWD, 2016), none of the GCDs or the CRMWA possess adequate groundwater supplies to provide the project yield of 34,050 AF/YR. In addition, two permits would be required to access groundwater supplies; a withdrawal permit and a permit to transfer the water beyond the boundaries of the GCD. Permits are generally issued for a period of one to five years and are subject to non-renewal or early termination. GCDs manage groundwater through the issuance of permits but actual ownership of the groundwater is the property owner(s). Individual land owners would need to sign leases to allow for the transfer of groundwater which has historically been met with considerable opposition and/or several years of litigation. Obtaining and maintaining the necessary groundwater permits do not qualify as "reliable" as defined in Criterion 1 and therefore do not meet the proposed project's purpose and need. Additionally, none of the above groundwater import strategies are projected to occur by 2024. Therefore, groundwater imports would not meet Criterion 3 and therefore is not considered a practicable alternative to the proposed Lake Ralph Hall project.

These potential groundwater alternatives were determined to not be practicable since they do not provide a reliable, long-term source of water available to meet the stated project purpose and need nor in a timely manner.

Due to failure of Criteria 1 and 3, the Groundwater Imports Alternative was not carried forward for detailed evaluation in this DEIS.

Lower Bois d'Arc Creek Reservoir

The proposed Lower Bois d'Arc Creek Reservoir (LBCR) is to be located on Bois d'Arc Creek (BDC) in Fannin County, upstream from the Caddo National Grasslands. The LBCR project consists of a regional water supply project intended to provide up to 175,000 AF/YR of new water, with an estimated firm yield of 120,665 AF/YR, for NTMWD 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 AF. The proposed action would eventually result in the transfer of approximately 120,665 AF of water annually from the Red River basin to the Trinity and Sulphur River basins. (The

appropriation request to TCEQ is for a maximum projected use of 175,000 AF/YR, but the firm yield would be 120,665 AF/YR.)

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 (USACE, 2017b).

The NTMWD submitted an application June 4, 2008, to the USACE Tulsa District to discharge dredged and fill material into BDC in Fannin County, Texas for the construction of a dam to impound the flow of the creek to provide a new water supply reservoir at the designed conservation pool of 534.0 msl. This reservoir would provide water to numerous towns, cities, and utility districts in portions of Collin, Dallas, Denton, Fannin, Hopkins, Hunt, Kaufman, Rains and Rockwall Counties in north central Texas. At conservation pool the proposed reservoir would store 367,609 AF and provide a firm yield of 120,665 AF/YR. A FEIS was released for the proposed action in November of 2017 and a Record of Decisions (ROD) was approved January 29, 2018. Note that the name has been changed to North Texas Municipal Lake but this EIS will reference Lower Bois D'Arc Creek Reservoir.

Potential accommodation of UTRWD's need of 34,050 AF at an expanded LBCR was considered as an alternative. An increase in the conservation pool of the currently proposed reservoir by NTMWD of 8.75 feet would be required to generate the additional yield for UTRWD. Such an expansion would result in the direct loss of 230 acres of emergent, scrub shrub and forested wetlands, some open water ponds, and an undetermined amount of intermittent and ephemeral streams (**Appendix A-7**). The Lake Ralph Hall site would result in the loss of approximately 387 acres of degraded ephemeral and intermittent streams, some open water pond, and approximately 10 acres of wetlands. Consideration of the quality of aquatic resources between the LBCR aquatic resources as described in the November FEIS and Ralph Hall resources as described in this EIS allows for the conclusion that, while the LBCR expansion may result in less acreage loss, greater functional loss would occur.

Therefore, this alternative would result in comparable and/or greater impacts to the aquatic ecosystem and is not less damaging than the proposed action.

Due to failure of Criterion 5, the LBCR Alternative not carried forward for detailed evaluation in this DEIS.

Lake Fastrill

The State of Texas first identified a site along the Upper Neches River in Anderson and Cherokee Counties as a potential reservoir to serve the growing Dallas/Ft. Worth Metroplex in 1961. The

Fastrill Reservoir site was included in a state water plan in 1984, and in the 1997 and 2001 Texas Water Development Board (TWDB) regional water plans. Dallas and TWDB's plan included constructing the reservoir in 2050 so that supply would be available in 2060.

According to the TWDB's Reservoir Site Protection Study (2008), Fastrill Reservoir would be constructed with a conservation pool elevation of 274 feet msl with a conservation pool surface area of 24,948 acres. The proposed reservoir would impound 503,563 AF of water. The firm yield of the proposed Fastrill Reservoir was estimated at 137,843 AF/YR at a conservation elevation of 274 feet.

After preparing an Environmental Assessment ("EA") of the proposed Neches Wildlife Refuge in East Texas, the U.S. Fish and Wildlife Service (USFWS) announced its Finding of No Significant Impact ("FONSI"), obviating the need to prepare an Environmental Impact Statement ("EIS"). USFWS then set an acquisition boundary for the refuge and accepted a conservation easement within that boundary. These actions precluded the Fastrill Reservoir proposed for the same site.

Dallas and TWDB sued in federal district court claiming that the EA that USFWS prepared was flawed, that under the National Environmental Policy Act ("NEPA") the agency was required to prepare an EIS, and that the establishment of the refuge violated the Tenth Amendment. The district court dismissed several of the Appellants' claims and granted USFWS' motion for summary judgment on others.

The 5th Circuit Court (City of Dallas Texas v. Hall, No. 08-10890, March 12, 2009) affirmed the District Court's decision. In 2010, Dallas and TWDB requested that the U.S. Supreme Court hear an appeal of a lower court's decision that favored Fish and Wildlife's plan. A decision of the United States Supreme Court on February 22, 2010 not to hear the appeals of the State of Texas and Dallas has effectively supported the creation of the Neches River National Wildlife Refuge (NRNWR) and rendered the development of Lake Fastrill not feasible. Since the existence of the refuge precludes the development of the reservoir this alternative cannot meet the yield, time, or reliability criteria.

Due to failure of Criteria 1, 2, and 3, the Lake Fastrill Alternative was not carried forward for detailed evaluation in this DEIS.

Lake Livingston/Joe Pool Lake/Trinity River Basin

Evaluation of alternative water supplies potentially available from the Trinity River basin was conducted and included consideration of Lake Livingston as well as Joe Pool Reservoir. The largest single-purpose reservoir in Texas at 83,000 surface acres, Lake Livingston was completed in 1971 as the result of a contract between the Trinity River Authority (TRA) of Texas and the city of Houston. TRA financed and constructed the lake, along with Lake Livingston Dam, and continues to own and operate both. Lake Livingston has a normal pool elevation of 131 feet msl,

impounds 1.8 million AF of water, and supplies water to four surrounding counties, plus the city of Houston.

Lake Livingston is an existing reservoir on the Trinity River in Region H. The TRA and the City of Houston hold the water rights for Lake Livingston. The TRA has indicated that as much as 200,000 AF/YR might be available to water suppliers in Region C from the lake.

Since Lake Livingston is in the Trinity River Basin, no interbasin transfer permit would be needed, but a transmission system would be required for UTRWD to receive water from it. Livingston is not a recommended strategy for any Region C supplier, but it was an alternative strategy for DWU, the NTMWD, and the TRWD in the 2011 Region C Water Plan. It is not a recommended or alternative strategy for any suppliers in the 2016 Plan.

Lake Livingston is operated by the TRA to meet the service demands of the City of Houston and other local users in the Trinity Basin and in the Neches-Trinity Coastal Basin. Region H may be considering other potential uses of the supply from Lake Livingston. Lake Livingston is about 180 miles from the Metroplex.

Livingston is used primarily to store water and the Wallisville Saltwater Barrier is to control the migration of salt water from Trinity Bay. Lake Livingston and Wallisville permitted yields are 1,255,500 AF/YR and 89,700 AF/YR respectively. The sum of these permitted yields is the combined yield of the system (1,345,200 AF/YR). Additional permitted run-of-the-river water supplies downstream of Lake Livingston total 220,230 AF/YR. These supplies are associated with the water rights agreements established at the time of Lake Livingston permitting.

Lake Livingston is dependent upon return flows from upstream Region C in the upper Trinity Basin. As a result of its downstream location, Lake Livingston indirectly benefits from growth in the Dallas–Fort Worth Metroplex. As upstream demands increase in Region C, it is anticipated that the importation of out-of-basin supplies will increase, providing additional return flows to the lower basin. Although return flows will likely increase over time, the timing of developing reuse supplies may have an adverse effect on the Lake Livingston water rights, temporarily reducing the in-basin return flows.

The firm yield of the Lake Livingston water rights is expected to decrease from the full permitted yield of 1,344,000 AF/YR year in the year 2010 to 1,265,000 AF/YR in the year 2030. The decrease in firm yield is the result of increasing amounts of reuse projected in the upper basin, reducing the amount of return flows available to Region H.

The firm yield is then projected to increase after 2030 as Region C begins to import water supplies to meet growing demands. By the year 2050 the permitted yield of Lake Livingston is projected to be firm. The results of the study are summarized below:

- Minimum upper basin net return flows of 253,055 AF/YR projected in 2030
- Minimum return flows available to Region H in 2030 of approximately 185,500 AF/YR
- Firm yield of Lake Livingston water rights are reduced in decades 2020, 2030 and 2040
- Minimum firm yield of Lake Livingston water rights is approximately 1,265,000 AF/YR in 2030
- Minimum level of return flows required to make Lake Livingston water rights firm is approximately 285,000 AF/YR in 2060

The firm yield of Lake Livingston is reduced in the decades 2020, 2030 and 2040 due to insufficient return flows from the upper Trinity Basin, as shown in **Table 2-8**.

Table 2-8: Lake Livingston Firm Yield (AF/YR)

Return Flows	2010	2020	2030	2040	2050	2060
Firm Yield	1,344,000	1,289,000	1,265,000	1,294,000	1,344,000	1,344,000
Reduction in Yield	0	-55,000	-79,000	-50,000	0	0

By 2020, increased reuse diversions in Region C are projected to reduce return flows available to Region H and consequently to reduce the firm yield of Lake Livingston during a drought-of-record by 55,000 AF/YR. By 2030, projected in-basin return flows are projected to be reduced to 253,055 AF/YR, which is the minimum level expected during the planning period. Under these assumed conditions, the firm yield of Lake Livingston in 2030 is projected to be 1,265,000 AF/YR, approximately 79,000 AF/YR less than the currently permitted diversion under the existing water rights permit.

The minimum level of return flows required to make the permitted yield of the Lake Livingston water rights 100% reliable during drought-of-record is approximately:

- 280,000 AF/YR required in 2010 – 2040 to maintain permitted diversions.
- 280,500 AF/YR required in 2050 and 2060

The City of Houston has a permit to divert 902,800 AF/YR from Lake Livingston and 38,000 AF/YR from the Wallisville Saltwater Barrier. The TRA has a permit to divert 351,600 AF/YR from Lake Livingston and 51,600 AF/YR from the Wallisville Saltwater Barrier. Not all of this water would be available to Region H. Of the amount that is owned by the TRA, approximately 26,900 AF/YR is committed outside of Region H.

Reuse within Region C in the Trinity Basin would impact the yield of Lake Livingston. Thus significant reuse of these flows may affect the water rights of San Jacinto River Authority (SJRA), TRA, and City of Houston. Indirect reuse permits are increasingly being requested within the state, allowing the use of the bed and banks of the receiving stream to carry treated effluent to a downstream diversion point. Unlike direct reuse, this practice is considered a separate diversion and requires a separate water right permit. These permits typically allow the rediversion of a percentage of the discharged volume, with the difference being allocated to meet carriage losses and instream flow requirements.

Water from Lake Livingston was not a recommended strategy for any Region C supplier in the 2016 Region C Water Plan, but was an alternative strategy for DWU, the NTMWD, and the TRWD in the 2011 Region C Water Plan (p 4D.12). This alternative would require a contract with TRA. TRA was contacted to discuss this alternative and TRA stated that they do not intend to, nor will they take steps to, permit the sale of firm-yield Lake Livingston water in the upper Trinity River basin. Correspondence with TRA is included in **Appendix A-6**. In addition, the TRA's reuse water entitlement associated with Lake Livingston is not sufficient to make a sale of that water to UTRWD a practicable alternative.

Due to failure of Criterion 2, the Lake Livingston Alternative was not carried forward for detailed evaluation in this DEIS.

Joe Pool Lake is a 7,400-acre impoundment located in the south part of the Dallas-Fort Worth Metroplex. The lake is located partially in Grand Prairie, Dallas, Cedar Hill, Mansfield, and Midlothian and encompasses part of Dallas, Ellis, and Tarrant Counties. The main body of the lake in located in-between SH 360 and FM 1382 about one mile south of Interstate Highway (IH) 20. Joe Pool Lake is mostly fed by Mountain Creek and Walnut Creek and drains north into Mountain Creek leading into Mountain Creek Lake. The Mountain Creek Water Shed is in the Upper Trinity River Basin and has a length of 37 miles and a total drainage area of 304 square miles. There are 64 miles of shoreline at normal conservation pool of 522 feet msl. Impoundment began in January 1986.

Currently Joe Pool Lake serves as a reservoir for the City of Midlothian for their public water supply. Several other entities have water interests in Joe Pool Lake, but are not currently using the water resources. The City of Midlothian has a water intake structure in the southeast leg of the lake. They pull anywhere from 1.0 million gallons per day of water in the winter months to 9.0 million gallons per day in the summer months. The Trinity River Authority of Texas also has a water intake structure in Cedar Hill State Park, but it currently not in use.

According to *Reallocation of Storage in Federal Reservoirs for Future Water Supp*ly (TWDB, 2006b), Joe Pool had a dependable yield of 26,450 AF, and with USACE maximum reallocation authority the dependable yield could reach 30,548 AF.

Due to failure of Criterion 2, the Joe Pool Lake Alternative was not carried forward for detailed evaluation in this DEIS.

Summary

Table 2-9 provides the results of the initial screening of the alternatives discussed above. All of the 15 off-site alternatives failed at least one of the five criteria and therefore none were advanced for further study.

Table 2-9: Summary of Alternatives Screening

Optional Source, Infrastructure Component or Alternative	Criteria					Advance
	No. 1	No. 2	No. 3	No. 4	No. 5	
No Action						Yes
Lake Ralph Hall - APA						Yes
Marvin Nichols Reservoir	-	-	No	-	No	No
Wright Patman Lake	-	-	No	-	No	No
Additional DWU Supplies	-	-	No	-	-	No
Oklahoma Water	-	-	No	-	-	No
Toledo Bend Reservoir	-	-	No	-	-	No
Lake Texoma	-	-	No	-	-	No
George Parkhouse Reservoir (N)	-	No	No	-	No	No
George Parkhouse Reservoir (S)	-	-	No	-	No	No
Gulf of Mexico	-	-	-	No	-	No
Cypress Creek Basin	-	-	No	-	-	No
Precipitation Enhancement	No	No	No	-	-	No
Groundwater Imports	No	-	No	-	-	No
Lower Bois d'Arc Reservoir	-	-	-	-	No	No
Lake Fastrill	No	No	No	-	-	No
Lake Livingston/Joe Pool Lake/Trinity River Basin	-	No	-	-	-	No

2.4.4 Alternatives Carried Forward for Detailed Analysis

A broad and varied range of alternatives were identified and evaluated in light of the overall project purpose defined in **Chapter 1** of the EIS. Thorough consideration and evaluation of the factors that surround the proposed action and definition of the project purpose and development of alternatives screens have yielded the narrow results. Development of the screens are based on valid

logistical reasons as well as impacts to aquatic resources. Inclusion of alternatives that may have greater impacts to waters of the U.S. in the DEIS to maintain a broader range can occur but would imply that such options are viable. In light of the requirements of 40 CFR 230.10 and 230.12(a)(3), carrying forward such options would be confusing and an unnecessary expenditure of funds and effort. Consideration was given to whether the project purpose statement was written too narrowly as detailed in **Section 1.10** and concluded to be appropriate. Additionally, screening criteria derived from the purpose statement were also concluded to be appropriate for the type of project and applicable to practicability and reasonability analysis. The practicability screening process detailed in **Section 2.3** revealed that only one alternative was practicable and that several other alternatives would be more damaging than the proposed action.

3.0 Affected Environment

This chapter describes the environment that would be affected by the construction and operation of the Proposed Action and the No Action Alternatives. The environmental baseline information summarized in this chapter was obtained from field studies conducted in the project area, published sources, unpublished materials, and communication with relevant government agencies and private individuals with knowledge of the area. The affected environment for individual resources was defined based on the area of potential direct and indirect environmental impacts of the Proposed Action. Direct effects are caused by the action and occur at the same time and place. Indirect effects are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable. For some resources, such as geology and soils, land use, ownership, public lands, cultural resources, hazardous materials, biological resources, visual, noise, paleontology, and recreation, the affected area was determined to be the physical location and immediate vicinity of the areas to be disturbed by the project as pertinent to the project component. For other resources, such as water resources, groundwater, air quality, climate change, environmental justice, and socioeconomics, the affected environment comprised a larger area (i.e. watershed, airshed, Fannin County, etc.). The terms "effects" and "impacts" as used in this Environmental Impact Statement (EIS) are synonymous.

This chapter is organized by environmental resource. **Sections 3.1** through **3.19** describe the existing conditions associated with each resource. Numerous technical reports were prepared as support documents to this Draft EIS and are located in the **Appendices**. Copies of these technical reports are available for review at the following locations:

1. Ladonia City Hall, 100 Center Plaza, Ladonia, TX 75449.
2. Wolfe City Public Library, 102 TX-11, Wolfe City, TX 75496.
3. Commerce Public Library, 1210 Park Street, Commerce, TX 75428.
4. Honey Grove Library, 500 N 6th Street, Honey Grove, TX 75466.
5. Bonham Public Library, 305 E 5th Street, Bonham, TX 75418.
6. Greenville Public Library, 1 Lou Finney Lane, Greenville, TX 75401
7. Upper Trinity River Water District, 900 North Kealy Street, Lewisville, TX 75067.
8. U.S. Army Corps of Engineers, Fort Worth Regulatory Office, 819 Taylor Street, Fort Worth, TX 76102.

3.1 Land Use and Ownership

Fannin County, Texas is a rural county located in north Texas near the Texas-Oklahoma border. The county is a lightly populated agricultural area with Bonham being the seat and the main source of employment. The county's land use includes residential, light industrial and commercial but is

predominantly agricultural with vast hay and pasture land. Row crops can be found more prominently in the eastern half of the county and deciduous trees are found near the lakes, creeks, streams, and residential areas. According to the USDA's 2012 Census of Agriculture Fannin County increased the number of farms from 1,252 in 2007 to 1,445 farms in 2012 (Texoma Council of Governments [TCOG], 2015).

Historical Land Use

Fannin County grew steadily from the Civil War to the turn of the 20th Century. Agriculture was the main source of income with cotton and corn being the leading crops. In 1900 the county had a population of 51,793. After the turn of the century the population slowly decreased. The depression brought a loss of farm values of over 40 percent and pushed a decline in the number of farms. Cotton and corn production dropped sharply during the 1950s and took with it a large part of the population. The population and number of farms continually declined until only 22,705 people resided in the county in 1970. During this period corn and cotton farms were changing to cattle ranches. The population slowly started to rebound in the 1970s with an increase in manufacturing, banking, retail, and cattle farms (TCOG, 2015). In 2002 the county had 1,976 farms and ranches covering 483,446 acres, 59 percent of which were devoted to crops, 32 percent to pasture, and 8 percent to woodland (Handbook of Texas Online, 2010).

Existing Land Use

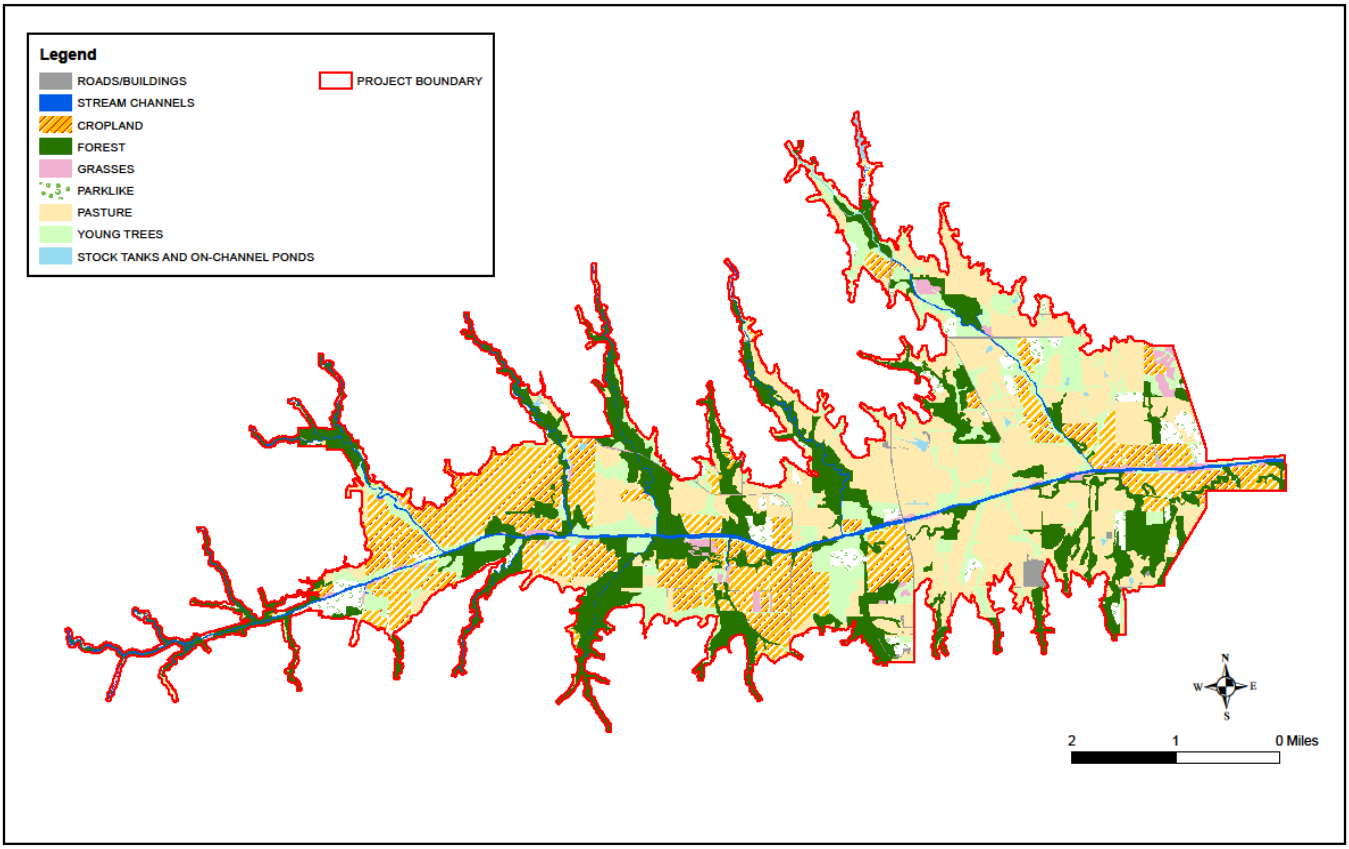
Approximately 30.2 percent of the project area is pasture, 22.4 percent forest, 21.9 percent cropland, and 14.0 percent young trees (UTRWD, 2018b). The remainder consists of road/buildings, stream channels, grasses, parklike, stock tanks, and on-channel ponds). **Table 3-1** and **Figure 3-1** shows the existing land uses within the project area. The data for this table and figure were developed from aerial imagery obtained from Texas Natural Resources Information Systems; National Agriculture Imagery Program 1 Meter Resolution Natural Color – 2016 Aerial Imagery for Collin, Hunt, and Fannin Counties.

Table 3-1: Existing Land Use within the Project Area

Land Use	Acres	Percentage
Roads/Buildings	128	1.07%
Stream Channels	378	3.17%
Cropland	2,604	21.9%
Forest	2,673	22.43%
Grasses	180	1.51%
Parklike	538	4.52%
Pasture	3,603	30.24%
Young Trees	1,669	14.01%
Stock Tanks	79	0.66%
On-Channel Ponds	63	0.53%
Total	**11,915**	100.00%

Source: UTRWD, 2018b

Figure 3-1: Existing Land Use within the Project Area



The 384-acre pipeline footprint consists primarily of pasture (180 acres), cropland (80 acres) and forested areas (74 acres). The remainder consists of roads and buildings, stream channels, grasses, park-like areas, and young trees.

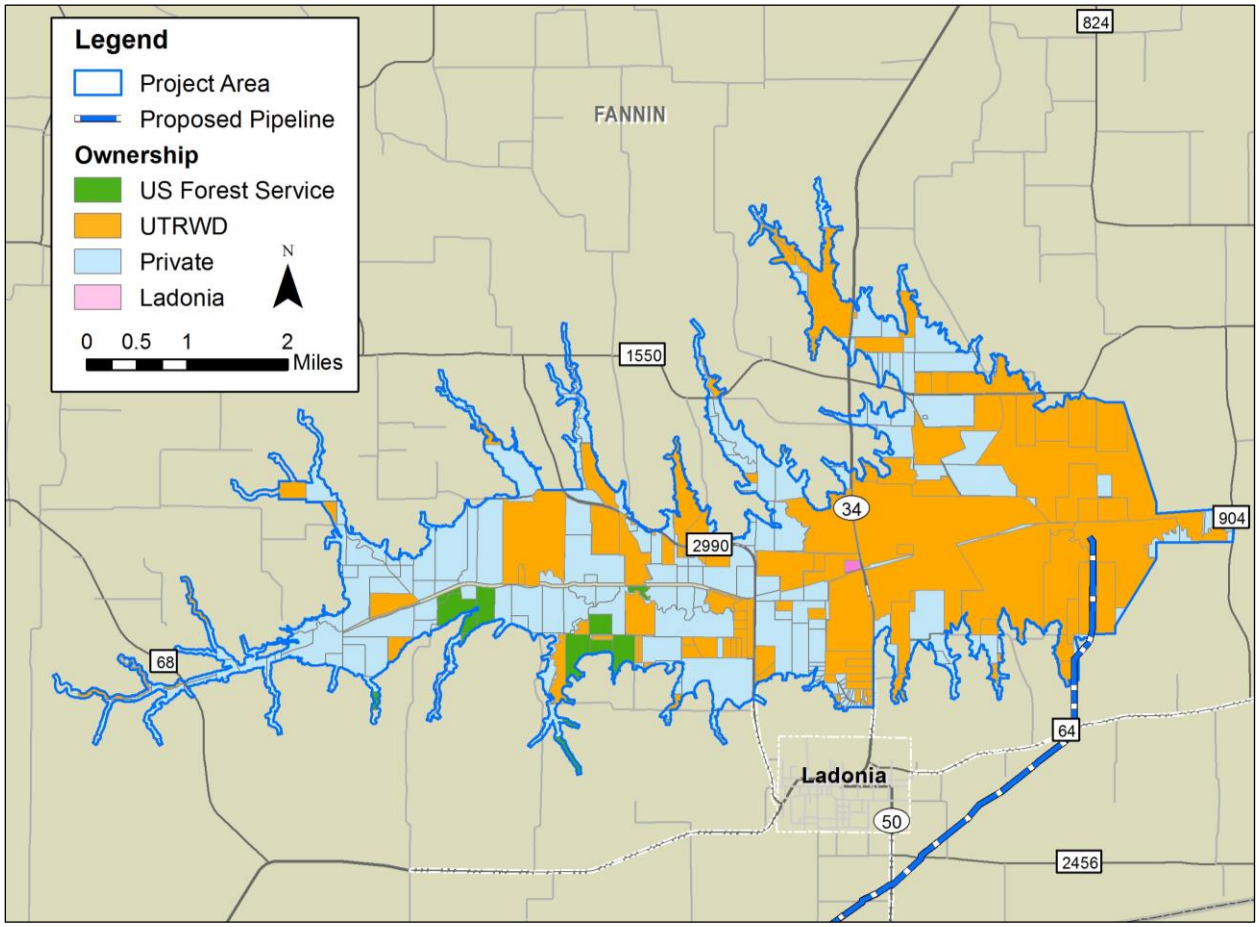
The 4.5-acre footprint of the proposed balancing reservoir consists primarily of grassland. The balancing reservoir would be constructed adjacent to the north side of the existing Irving balancing reservoir.

Ownership

All lands within the project area will be acquired by the applicant during the planning and pre-construction phases. The applicant continues to take ownership of all project lands through either voluntary sale or through governmental processes as stated in law, regulation or policy, e.g. acquisition of the Caddo National Grasslands through land exchange. As of May 2017, UTRWD has purchased a little over half of the project area. All land purchases have been made from willing sellers. UTRWD has purchased all but one of the homes within the project boundary. The remainder is primarily private land, with the exception of a few parcels owned by the City of Ladonia and the U.S. Forest Service. **Figure 3-2** shows the ownership of parcels within the project

area. As with other lands within the project area, the applicant intends to take ownership of these Federal lands in the planning and pre-construction phases of this project.

Figure 3-2: Ownership within the Project Area



Source: Alan Plummer Associates, Inc., 2018.

The pipeline footprint consists of private land other than the tracts where the pipeline footprint overlaps the proposed project already owned by UTRWD as shown in **Figure 3-2**.

3.2 Public Lands

Federal Lands

The Caddo National Grasslands WMA is administered by the US Forest Service and is managed under a cooperative agreement with Texas Parks and Wildlife. The WMA is divided into two units, the 13,360 acre Bois d' Arc Creek Unit and the 2,780 acre Ladonia Unit. The Bois d' Arc Creek Unit comprises six separate land tracts and the Ladonia Unit has twelve land tracts. (TPWD, n.d.-a). The larger Bois d'Arc Unit is located in northern Fannin County, and the smaller Ladonia Unit is located west of Ladonia in the southwest portion of the project area, within the reservoir footprint.

There are no Indian reservations, military bases, national parks or wildlife refuges in Fannin County. There are no national forests, military bases, national parks, Indian reservations, or wildlife refuges in the areas potentially affected by the dam inundation or the pipelines (Federal Highway Administration [FHWA], 2017).

There are no federal lands in the pipeline footprint.

State Lands

Bonham State Park is the largest state-owned property in Fannin County (**Figure 3-3**). The park is located to the southeast of Bonham in the Blackland Prairie Region, approximately seven miles northwest of the project area. The terrain features rolling prairies and woodlands composed of Texas Oak, eastern red cedar, bois d'arc and eve's necklace. The park also has a 65-acre man-made lake, which was completed in 1936. The shoreline provides habitat for beaver, raccoon, opossum and songbirds.

Lake Tawakoni State Park is a 376.3-acre park located in Hunt County. However, it is in the southeast corner of the county, far from the pipeline footprint. There are no state parks in Collin County.

There are no state public lands within the proposed dam, reservoir, spillways, pump station, pipeline footprint, or balancing reservoir.

County Lands

There are no county lands within the proposed dam, reservoir, spillways, pump station, pipeline footprint, or balancing reservoir.

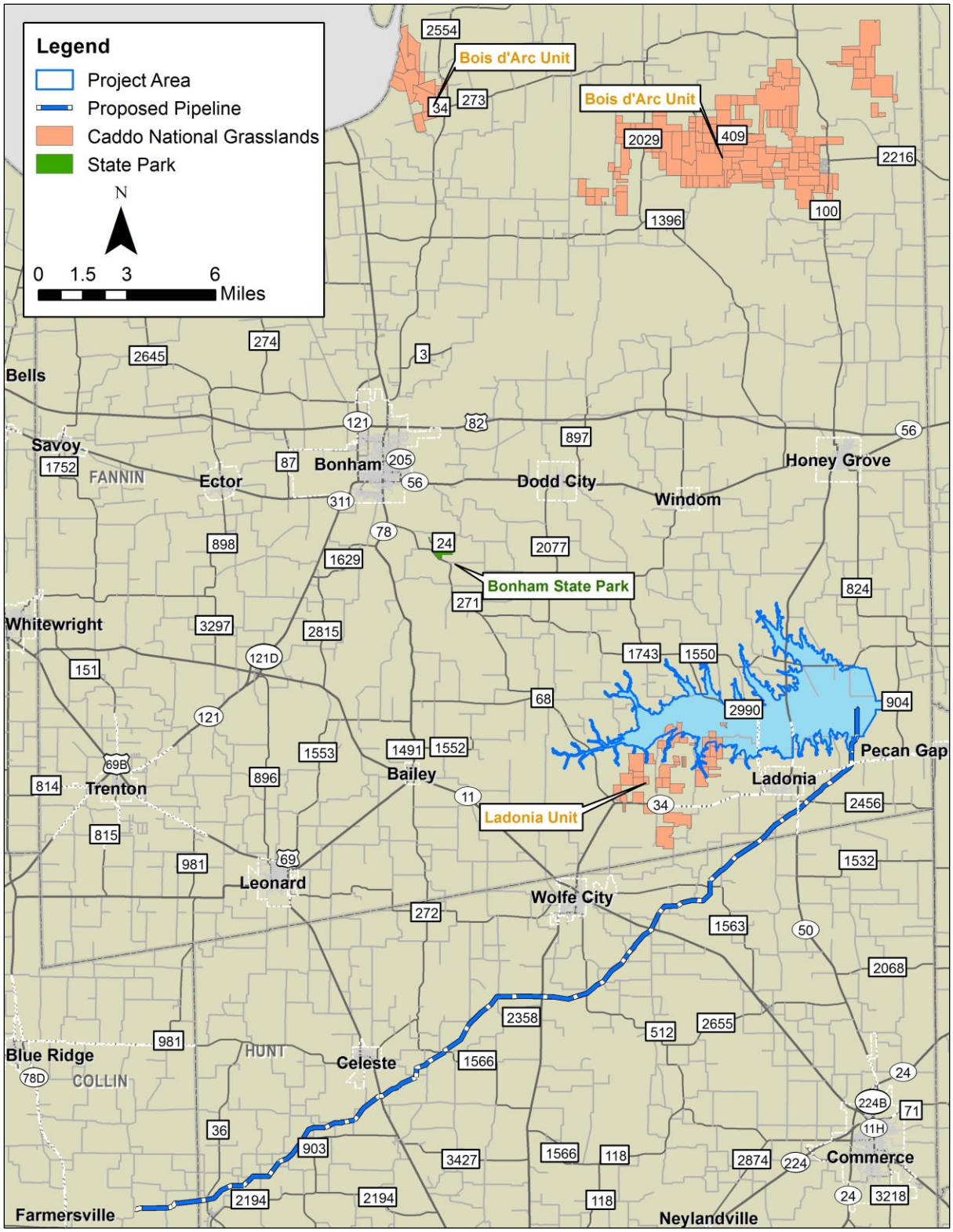
City Lands

The Ladonia Fossil Park (aka Pete Patterson Fossil Park) is located two miles north of downtown Ladonia on SH 34 north and west of the bridge spanning the North Sulphur River. The 15-acre park sits on the bank of the river channel and provides an entrance into hunting grounds that have yielded a variety of fossils from the Cretaceous and Pleistocene Periods. Ladonia Fossil Park is located in the footprint of the proposed Lake Ralph Hall. This feature is discussed more in **Section 3.16**.

Other Public Lands

In addition, the North Texas Municipal Water District (NTMWD) owns land associated with the future LBCR reservoir, currently under construction.

Figure 3-3: Public Lands

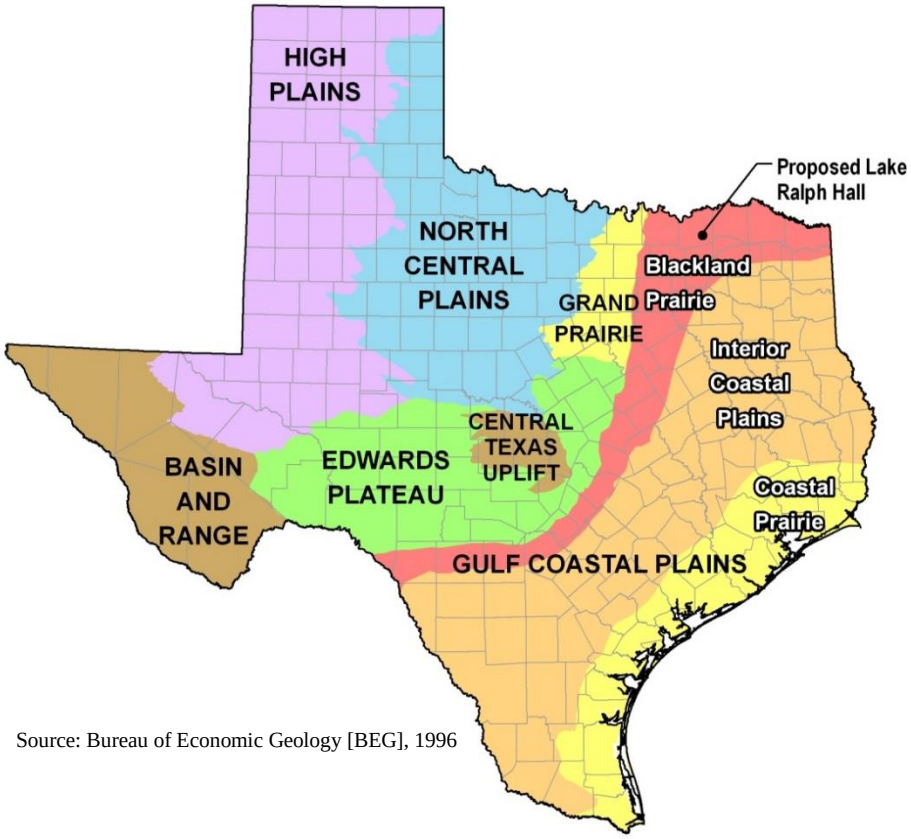


Sources: USFS; TPWD

3.3 Physiography and Topography

Physiography is the study of physical patterns and processes of the Earth, such as the forces that produce and change rocks, oceans, weather, and global flora and fauna patterns. Geologists have studied the landforms of Texas and divided it into distinctive physiographic provinces. Each province consists of an integrated geological history of depositional and erosional processes that are distinguished by characteristic geologic structure, rock and soil types, vegetation, and climate. The elevations and shapes of its landforms contrast significantly with those of landforms in adjacent regions (Bureau of Economic Geology [BEG], 1996). The proposed Lake Ralph Hall and Lake Ralph Hall Raw Water Pipeline Alignment lie within the Gulf Coastal Plains physiographic province. The Gulf Coastal Plains include three subprovinces named the Coastal Prairies, the Interior Coastal Plains, and the Blackland Prairies (**Figure 3-4**).

Figure 3-4: Physiographic Provinces of Texas



Source: Bureau of Economic Geology [BEG], 1996

The Blackland Prairies are bounded on the southeast by the Interior Coastal Plains and by the Grand Prairie to the west. The Blackland Prairies consist of deep, black, fertile clay soils, in contrast with the thin red and tan sandy and clay soils of the Interior Gulf Coastal Plains. The Blackland Prairies have a gentle undulating surface that is cleared of most natural vegetation and cultivated for crops (BEG, 1996). The Lake Ralph Hall project boundary is located wholly within the Blackland Prairie region.

The Lake Ralph Hall Raw Water Pipeline Alignment lies within the Blackland Prairie region and runs from southeast Fannin County through northwest Hunt County ending in eastern Collin County. Throughout this area stream valleys are shallow and drainages divide well rounded surfaces. The northwestern part of Hunt County drains into the Trinity River (East Fork) and northeastern Hunt County and southeastern Fannin County both drain into tributaries of the Sulphur River. Southeastern Fannin County drains to the North Sulphur River and South Sulphur River. Northeastern Hunt County drains to the South Sulphur River. Bottomlands in these areas are not usually farmed because of seasonal flooding (UTRWD, 2006b).

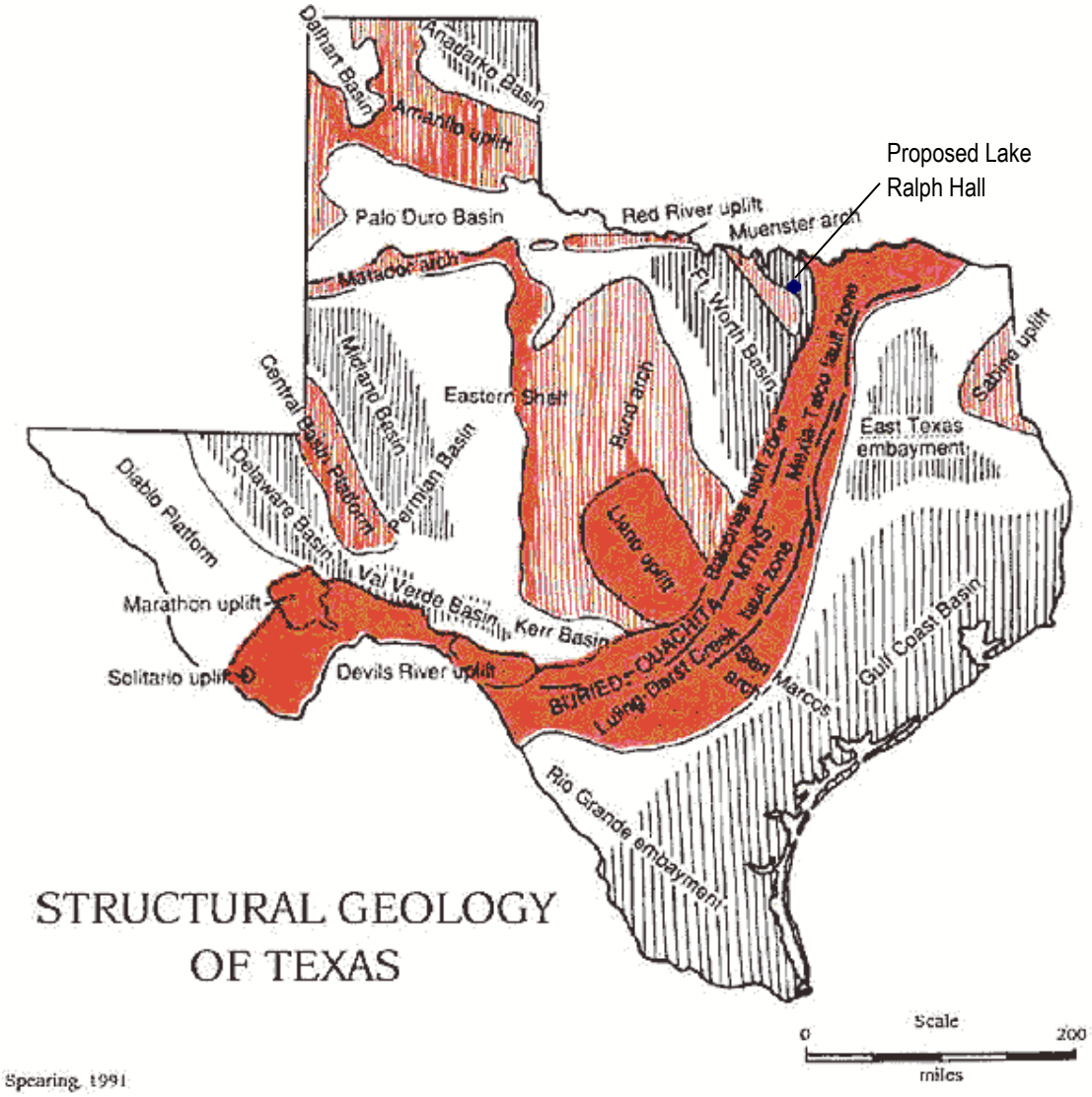
Elevations within the Proposed Lake Ralph Hall Alternatives range from 170 to 185 feet national geodetic vertical datum (NGVD) or from approximately 470 to 620 feet above mean sea level (AMSL), and the area is characterized by flat prairie lands that are cut by the major east/west trending North Sulphur River and by minor north/south trending tributaries to the North Sulphur River. Elevations along the Lake Ralph Hall Raw Water Pipeline Alignment range from approximately 500 to 730 feet AMSL.

3.4 Geology and Soils

3.4.1 Regional Geologic Setting

The proposed Lake Ralph Hall project area lies within the Ouachita Fold Belt, a buried mountain range that extends from southeast Oklahoma to the Big Bend area of West Texas (**Figure 3-5**). Other major structural elements in East-Central Texas include several major fault zones and basins. Coincident with the buried Ouchita Fold Belt is a hingeline along which parallel fault zones occur (Davis et al. 1989). These fault zones are the Balcones Fault Zone, Luling Fault Zone, and Mexia Fault Zone. In addition to these fault zones, other major structural elements in the East-Central Texas area are the East Texas Embayment, Sabine Uplift, and the Gulf Coast Basin.

Figure 3-5: Structural Geology of Texas



The Ouachita Fold Belt marks the edge of the North American continent at the end of the Jurassic and beginning of Cretaceous periods 144 million years ago (Spearing, 1991). During the Jurassic and lower Cretaceous periods, clastic and carbonate rocks were deposited along the fringes of this shallow sea. Carbonate rocks (limestone and dolomite) in this area are composed primarily of calcium and magnesium carbonate. The carbonate rocks, which were derived from the shells of various living organisms, developed in a complex of patch reefs, barrier reefs, and lagoonal environments. In upper Cretaceous time, shale, chalk, marl, and limestone were deposited, which are represented by the Eagle Ford, Austin, Taylor, and Navarro Groups (Worrall and Snelson, 1989). The maximum aggregate thickness of these units in the area is approximately 1,900 feet (Proctor et al., 1974).

At the close of the Cretaceous period, approximately 60 million years ago, uplift of the Rocky Mountains began and the deposition of carbonates ceased. Large river systems began carrying

sediment eroded from the Rocky Mountains as they were uplifted. These river systems generally trended from northwest to southeast, and delta complexes were built over the Cretaceous deposits.

The geologic units relevant to the proposed Lake Ralph Hall project area are Cretaceous-age deposits of the Taylor and Austin Groups. The geologic units generally thicken toward the southeast and dip slightly toward the Gulf of Mexico (**Figure 3-6**). The underlying geological formations of the Lake Ralph Hall Raw Water Pipeline Alignment consists mostly of late Cretaceous-age deposits as well as some Pleistocene and Holocene-age deposits.

3.4.2 Site Geology

The bedrock units that crop out in the North Sulphur River basin are from the Cretaceous-age Gulf Series. Both the land surface and the rock units dip slightly to the southeast, which results in successively younger formations being exposed as the North Sulphur River flows east and southeast. From west to east, exposed in ascending order are the Austin and Taylor Groups. The Roxton Limestone and the Gober Chalk are the two uppermost units of the Austin Group that crop out along the north side of the North Sulphur River Basin. Although the geologic map (**Figure 3-7 and Figure 3-8**) shows a narrow band of Roxton Limestone on the north side of the North Sulphur River, field observation and mapping, and the respective lithologic descriptions of the Roxton Limestone and Gober Chalk (BEG, 1966), suggest that it is the Gober Chalk that is actually observed in the beds of the headwaters of the North Sulphur River and the south flowing tributaries (Allen, Bear, Pot, Brushy, Pickle, Davis, Bralley Pool, Merrill, and Baker Creeks).

The downstream limit of the Roxton/Gober Chalk outcrop limits the upstream extent of the induced incision of the tributaries. Erosion of the Roxton/Gober Chalk is primarily due to surficial weathering, but the rate of erosion is low. The uppermost unit of the Taylor Group is the Ozan Formation, a 425-foot thick dark gray calcareous, poorly bedded clay (shale) with varying amounts of silt and glauconite and some thin siltstone and limestone beds. The rock is compact, highly jointed, and highly erodible and travels when exposed to weathering (Kleinfelder, 2005).

A geotechnical site investigation (**Appendix B**) was conducted to identify and characterize the soils and rock materials at the project site (UTRWD, 2017c). The site investigation included the collection borings at five locations along the dam alignment and five locations within the borrow area. Boring maximum depths along the dam alignment ranged from 60 feet to 100 feet and consisted of fat clay, marl, fat clay with sand, fat clay with gravel, and lean clay with sand. Borings in the borrow area were collected to a maximum depth of 25 feet and consisted of sandy lean clay, fat clay, and lean clay.

Figure 3-6: Geology of Texas