Whitney Lake Reallocation Study, Bosque and Hill Counties, Texas

DRAFT Integrated Feasibility Report and Environmental Assessment

EAXX-202-00-M2P-1752585360

U.S. ARMY CORPS OF ENGINEERS
FT. WORTH DISTRICT
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Executive Summary

The following is an integrated reallocation report and environmental assessment completed by the U.S. Army Corps of Engineers (USACE), Ft. Worth District (SWF) that presents the results of a water supply storage reallocation study. This study evaluated and compared an array of potential water supply storage alternatives focused on reallocation of storage from other authorized uses of the lake and recommends a tentatively selected plan. In addition, the report documents possible impacts to environmental, socioeconomic and cultural resources of implementing the tentatively selected plan pursuant to environmental laws and regulations. The study evaluated requests for additional water supply storage in Whitney Lake and Dam to generate municipal and industrial (M&I) water supply for the Brazos River Authority, the study's non-federal sponsor.

The Whitney Lake and Dam is a multipurpose dam and reservoir operated primarily for flood control, hydroelectric power and water supply. Whitney Lake and Dam is an integral part of a USACE nine-lake system of reservoirs that provide flood risk management on the Brazos River and its tributaries. Whitney Lake and Dam's strategic location on the main stem of the Brazos River provides for managing of floods originating in the upper Brazos River Basin. Conservation storage is managed for hydropower generation and municipal and industrial water supply (M&I). The conservation pool lies between elevations 520 ft and 533 ft. The storage space below elevation 520 ft serves as powerhead reserve and sedimentation and is considered the inactive pool. Currently, BRA has the only water supply contract at Whitney Lake and Dam for approximately 57,292 acre-feet of storage.

The Project Delivery Team (PDT) evaluated and screened a suite of alternatives and selected a final array to include:

- No Action Alternative or Future Without Project – Whitney Lake and Dam operations remain the same and follow the current Water Control Manual
- Reallocation within the Conservation Pool
- Reallocation from the Flood Pool
- Reallocation from the Powerhead Reserve/Inactive Pool
- Combination of Conservation Pool and Flood Pool
- Combination of Conservation Pool and Power

The tentatively selected plan transfers 72,817 ac-ft of storage from the conservation pool and 111,537 ac-ft of storage from the powerhead reserve/inactive pool. This reallocation would change the bottom of the conservation pool by 8 ft from an elevation of 520 ft to 512 ft. The top of the conservation pool would remain the same at an elevation of 533 ft. The PDT considers reallocation of storage, as described in Section 5, as the most efficient means to satisfy the current and projected water demands for the Brazos River Authority. The water reallocation would allow a water storage agreement amendment to be immediately executed for 184,354 AF of conservation pool storage after the final approval of this water reallocation report. No new federal infrastructure or facilities will be required for the plan. Cultural resource surveys around Lake Whitney and Dam will need to occur prior to implementation as described in the Programmatic Agreement. No significant impacts to environmental resources are expected.

Based on the analysis, the tentatively selected plan is the most economically justified alternative of those evaluated. There would be no impacts to flood risk management at Whitney Lake and Dam, but there would be a small impact to hydropower generation. Hydropower operations at Whitney Lake and Dam are noteworthy among USACE projects because the Southwestern Power Administration (SWPA)'s customers primarily utilize the project's capacity to provide spinning reserve capacity to the regional power market operated by The Electric Reliability

Corporation of Texas (ERCOT). Reallocation of storage in Whitney Lake and Dam impacts the provision of both energy and reserves in the ERCOT market. Generally speaking, most energy produced at the dam is the result of water supply and flood control related releases through the powerhouse, and releases for power production itself are relatively infrequent. In general, energy generation driven by power customer demand is limited at Whitney Lake and Dam in favor of spinning reserves.

For the reallocation from hydropower storage, generation impacts are relatively small to modest, and generally positive – reallocation away from hydropower storage actually *increases* total hydropower generation across most alternatives – due to the unique hydropower operating regime at Whitney Lake and Dam. The TSP creates the greatest change, with an average annual increase in energy output of 9% over the baseline. It is important to note that because hydropower storage is utilized primarily to provide reserves rather than energy, an increase in generation does not necessarily reflect the preference of SWPA or its customers. Thus, these changes may not be viewed as positive by these parties regardless of the minor increases in energy produced and revenues collected. Longer-term impacts to SWPA and hydropower utilization at the project may be impacted in ways that are neither marginal nor captured by the hydropower analysis in this report. Other hydropower operational risk exists under the TSP and is discussed in the report and Appendix D and D.1.

As a test of financial feasibility, annual costs of the reallocated storage were compared to the annual costs of the non-federal action most likely to be taken in lieu of a federal action that produces a similar quantity and quality of water as the tentatively selected plan. For the purposes of the Whitney Lake Reallocation study, this was determined to be the construction of a new reservoir upstream of Whitney Lake and Dam. Annualized cost for storage reallocation is $4.4 million versus $28.5 million[1] for the least cost and most likely alternative (a new reservoir). Thus, storage reallocation is the National Economic Development (NED) plan.

[1] Annualized over 50 years, FY25 price levels and discount rate

DRAFT FINDING OF NO SIGNIFICANT IMPACT

DRAFT INTEGRATED FEASIBILITY REPORT AND ENVIRONMENTAL ASSESSMENT FOR THE

WHITNEY LAKE REALLOCATION STUDY

BOSQUE AND HILL COUNTIES, TEXAS

The U.S. Army Corps of Engineers, Fort Worth District (USACE) has conducted an environmental analysis in accordance with the National Environmental Policy Act of 1969, as amended. The Integrated Feasibility Report (IFR) and Environmental Assessment (EA) dated June 2025 for the Whitney Lake Reallocation Study identifies possible municipal and industrial (M&I) water supply storage reallocation opportunities and feasibility in Bosque and Hill Counties. The final recommendation is contained in the Draft IFR/EA dated July 2025.

The IFR/EA incorporated herein by reference evaluated various alternatives that would reduce the risk for future water shortages in the region in the study area. The recommended plan is the Total Net Benefit Plan and includes:

- Reduce risk for future water shortages
- Increase M&I storage at Whitney Lake and Dam

In addition to a No Action alternative, seven alternatives were evaluated that involved adjustments to reservoir storage allocation between water supply and hydropower generation. Alternative 2 proposed allocating 67 percent of the storage between elevations 520 and 533 feet to water supply and 33 percent to hydropower. Alternatives 2a and 2c also adjusted storage allocation between these elevations, proposing a 50/50 split (Alternative 2a) and a 37.5/62.5 split (Alternative 2c) between water supply and hydropower, respectively. Alternative 3 examined increasing the top of the conservation pool from 533 to 536 feet, with 39 percent of the resulting storage dedicated to water supply and 61 percent to hydropower. Alternative 4 assessed decreasing the conservation pool from 520 to 518.4 feet, allocating 29 percent to water supply and 71 percent to hydropower. Alternative 5 involved raising the conservation pool to 534.5 feet, with 56 percent allocated to water supply and 44 percent to hydropower. Finally, Alternative 6 proposed lowering the bottom of the power pool to 512 feet (with a top of 533 feet), resulting in a 65 percent allocation to water supply and a 35 percent allocation to hydropower.

For all alternatives, the potential effects were evaluated. A summary assessment of the potential effects of the recommended plan are listed in Table 1:

Table 1: Summary of Potential Effects of the Proposed Project

Resource	No significant impact	No significant Impact as a result of mitigation	Resource unaffected by the project
Aesthetics	☒	☐	☐
Air Quality	☐	☐	☒
Wetlands	☒	☐	☐
Aquatic Habitat	☐	☐	☒
Terrestrial Habitat	☒	☐	☐
Protected Species	☐	☐	☒
Cultural Resources	☐	☐	☐
Recreation	☒	☐	☐
Hazardous, Toxic and Radioactive Waste	☐	☐	☒
Hydrology and Hydraulics	☒	☐	☐
Land Use and Protected Lands	☐	☐	☒
Noise	☐	☐	☒
Socioeconomics & Other Social Effects	☒	☐	☐
Topography, Geography, and Soils	☐	☐	☒

Resource	No significant impact	No significant Impact as a result of mitigation	Resource unaffected by the project
Water Quality	☒	☐	☐
Climate Instability	☐	☐	☒

All practicable and appropriate means to avoid or minimize adverse environmental effects have been analyzed and incorporated into the recommended plan.

No compensatory mitigation is required as part of the recommended plan.

Public review of the draft IFR/EA and Finding of No Significant Impact (FONSI) is anticipated to be complete in August 2025. All comments submitted during the public review period and responses will be incorporated into the Final IFR/EA.

Pursuant to Section 7 of the Endangered Species Act of 1973, the USACE has determined that the Proposed Project will have no effect on federally listed species or their designated critical habitat.

Pursuant to section 106 of the National Historic Preservation Act of 1966, as amended, the U.S. Army Corps of Engineers has begun a programmatic agreement which is currently underway for this study and anticipated to be finalized prior to the issuance of the Final IFR/EA.

Pursuant to the Clean Water Act of 1972, as amended, for this study, neither Sections 404 nor 401 are triggered due to no discharged of dredged material into the Waters of the U.S.

All applicable environmental laws were considered, and coordination with appropriate agencies and officials is ongoing.

The technical and environmental criteria used in the formulation of alternative plans were those specified in the Water Resources Council's 1983 Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies. All applicable laws, executive orders, regulations, and local government plans were considered in the evaluation of alternatives. Based on this report, the reviews by other Federal, State, and local agencies, Tribal Nations, input of the public, and the review by my staff, it is my determination that the recommended plan would not cause significant adverse impacts on the quality of the human environment; therefore, preparation of an Environmental Impact Statement is not required.

Date

JOSHUA M. HAYNES, PMP
LTC, EN
Acting Commander

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This report includes an Environmental Assessment integrated into the Main Report that complies with requirements of the USACE and Council of Environmental Quality (CEQ) and reduces duplication and paperwork.

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Acronyms

Acronyms	Definition
AAEQ	Average Annual Equivalent
ACHP	Advisory Council on Historic Preservation
APE	Area of Potential Effects
BMP	Best Management Practices
BRA	Brazos River Authority
CEQ	Council of Environmental Quality
CFR	Code of Federal Regulations
CWA	Clean Water Act
EA	Environmental Assessment
EO	Executive Order
EPA	United States Environmental Protection Agency
EQ	Environmental Quality
ER	Engineer Regulation
ESA	Endangered Species Act
FCSA	Feasibility Cost Share Agreement
FONSI	Finding of No Significant Impact
FWCA	Fish and Wildlife Coordination Act
FWOP	Future Without Project Condition
HTRW	Hazardous, Toxic, and Radioactive Waste
IPAC	Information, Planning, and Conservation System
LER	Lands, Easements, and Rights-of-way
LERRD	Lands, Easements, Rights-of-way, Relocations and Disposal Areas
NAA	No Action Alternative
NED	National Economic Development
NEPA	National Environmental Policy Act
NFS	Non-Federal Sponsor
NHPA	National Historic Preservation Act
NRHP	National Register of Historic Places
NWI	National Wetlands Inventory
O&M	Operation and Maintenance
OSE	Other Social Effects
PA	Programmatic Agreement
PAL	Planning Aid Letter
PAR	Planning Aid Report
RED	Regional Economic Development
ROM	Rough Order of Magnitude
SWPA	Southwestern Power Administration
THPO	Tribal Historic Preservation Officer
TSP	Tentatively Selected Plan
US	United States
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service
WQC	Water Quality Certification
WUGs	Water User Groups
WRDA	Water Resources Development Act

Whitney Lake Reallocation Study, Hill and Bosque Counties, Texas

1. Introduction

The U.S. Army Corps of Engineers, Ft. Worth District (USACE) has prepared the Whitney Lake Reallocation Study, Hill and Bosque Counties, Texas Draft Integrated Feasibility Report and Environmental Assessment (IFR/EA) to present the results of a water supply storage reallocation study. The overarching propose of the study is to evaluate a request for additional water supply storage at Whitney Lake and Dam to generate municipal and industrial (M&I) water supply for the Brazos River Authority (BRA). The report evaluated and compared an array of potential water supply alternatives including reallocation of storage from other authorized uses and recommends a tentatively selected plan. In addition, the report documents possible impacts to regional environmental, socioeconomic, and cultural resources of implementing the selected plan pursuant to 33 CFR 230 Procedures for Implementing National Environmental Policy Act (NEPA).

The Brazos River Authority is the non-Federal Sponsor (NFS) for the reallocation study. Created by the Texas Legislature in 1929, the BRA is one of the largest river authorities in the State of Texas and is tasked with developing and managing water resources in a hydrologically complex river basin. Today, BRA's staff of more than 250 develop and distribute water supplies, provide water and wastewater treatment, monitor water quality, and pursue water conservation through public education programs.

1.1. USACE Planning Process

USACE has a six-step iterative planning process which is used in water resources development studies. The first step in this process is identifying problems and opportunities followed by defining the objectives and constraints that will guide efforts to solve those problems and achieve those opportunities. The Project Delivery Team (PDT) and the NFS held a charette in Waco, Texas in June 2023 to gather feedback and discuss possible problems, opportunities, objectives and constraints for the Whitney Lake Reallocation Study. The following section covers the results of that charrette as well as other planning considerations.

1.2. Study Authority

This draft report is an interim response to the study authority. The Whitney Lake Reallocation study is authorized under Section 216 of the Flood Control Act of 1970, Public Law 91-611 (33 U.S.C. § 549a), and the Water Supply Act of 1958, Pub. L. 85-500, Title III, as amended, 43. U.S.C 302 Flood Control Act of 1958, Public Law 85-500, Title III, as amended, (43 U.S.C. 390b).

Section 216 of the Flood Control Act of 1970 states:

> *The Secretary of the Army, acting through the Chief of Engineers, is authorized to review the operation of projects the construction of which has been completed and which were constructed by the Corps of Engineers in the interest of navigation, flood control, water supply, and related purposes, when found advisable due to significantly changed physical or economic conditions, and to report thereon to Congress with recommendations on the advisability of modifying the structures or their operation, and for improving the quality of the environment in the overall public interest.*

The Water Supply Act of 1958, as amended, authorizes USACE to reallocate storage space to M&I water supply and states:

> *"It is declared to be the policy of the Congress to recognize the primary responsibilities of the States and local interests in developing water supplies for domestic, municipal, industrial, and other purposes and that the Federal Government should participate and cooperate with States and local interests in developing such water supplies in connection with the construction, maintenance, and operation of Federal navigation, flood control, irrigation, or multiple purpose projects."*

In addition, the Water Resources Development Act of 2020, Public Law 116-260, Sec 202(e) 2020 specifically directed USACE to expediate a reallocation study at Whitney Lake and Dam which states:

> *"Water Resources Development Act of 2020, Public Law 116-260, Sec. 202(e) ("REALLOCATION STUDIES. —The Secretary shall expedite the completion of a study for the reallocation of water supply storage, carried out in accordance with section 301 of the Water Supply Act of 1958 (43 U.S.C. 390b), for the following: … (2) Lake Whitney, Texas")*

1.2.1. Project Authority

Congressional authority for construction of the Whitney Reservoir Project for flood control and other purposes is contained in the Flood Control Act approved August 18, 1941 (P.L. 77-228). The pertinent part of which reads as follows:

> *"Section 3. That the following works of improvement for the benefit of navigation and the control of destructive flood waters and other purposes are hereby adopted and authorized in the interest of national security and the stabilization of employment, and shall be prosecuted as speedily as may be consistently with budgetary requirement, under the direction of the Secretary of War and the supervision of the Chief of Engineers in accordance with the plans in their respective reports hereinafter designated and subject to the conditions set forth therein: Provided, that penstocks or other similar facilities adapted to possible future use in the development of hydroelectric power shall be installed in any dam herein authorized when approved by the Secretary of War upon the recommendation of the Chief of Engineers and of the Federal Power Commission:*
>
> *The plan for Whitney Reservoir on the Brazos River in Texas, for flood control and other purposes in accordance with the recommendation of the Chief of Engineers in House Document Numbered 390, Seventy-sixth Congress, first session, is approved and there is hereby authorized $5,000,000 for the initiation and partial accomplishment of the project."*

In House Document 390, the Chief of Engineers recommended construction of the Whitney Reservoir Project on the Brazos River, Texas for the control of floods, the development of hydroelectric power, and for other beneficial uses, as outlined in the report of the District Engineer. Completion of the Whitney Reservoir Project and power generation was authorized by the Flood Control Act of 1944 (P.L. 78-534), which reads in part as follows:

> *"In addition to previous authorizations, there is hereby authorized the completion of Whitney Reservoir in accordance with the plan approved in the Act of August 18, 1941, for the Brazos River Basin, at an estimated cost of $15,000,000."*

The Southwestern Power Administration, which was created by the Secretary of the Interior in 1943, is designated as the agency to market available surplus electric power and energy, pursuant to Section 5 of the Flood Control Act of 1944 at Whitney Reservoir. The project authorization was modified in the Public Law 230, 85th Congress, approved August 30, 1957 (P.L. 85-230) to make available 50,000 acre-feet (ac-ft) of storage for domestic and industrial use, which reads as follows:

> *"To increase the storage capacity of the Whitney Dam and Reservoir and to make available fifty thousand acre-feet of water from the reservoir for domestic and industrial use.*
>
> *Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled. That the Whitney Reservoir project approved by the Flood Control Act approved August 18, 1941, is hereby modified to authorize the Secretary of the Army, acting through the Chief of Engineers, to allocate fifty thousand acre-feet of water supply storage in Whitney Reservoir, Texas, in such manner as to provide the best overall use of the project.*
>
> *SEC. 2. The Secretary of the Army, acting through the Chief of Engineers, is authorized to enter into agreements with local interests for payment of the costs of the water supply storage, including annual operation and maintenance costs, based on an equitable cost allocation to be made by the Chief of Engineers: Provided, That the term of the contract shall not exceed the economic life of the project or fifty years, whichever is less. Approved August 30, 1957."*

1.3. Study Area

The Brazos River originates in Curry County, New Mexico approximately 40 miles west of the Texas boundary line and flows in a southeasterly direction for approximately 1,210 miles to a point near Freeport, Brazoria County, Texas where it empties into the Gulf of Mexico. The watershed lies in the central portion of Texas. The watershed of the Brazos River above Whitney Lake and Dam has a total drainage area of 26,606 square miles of which 17,656 square miles is contributing and 8,950 square miles are non-contributing. The Brazos River Basin is the second largest river basin by area in Texas and is the state's third longest river with the largest average annual flow volume of any river in the state.

Whitney Lake and Dam is located on the Brazos River at river mile 442.4. The reservoir is approximately 38 river miles upstream from Waco, Texas, 19 miles southwest of Hillsboro and 81 miles by highway southwest from Dallas, Texas (Figure 1). The closest municipality is Whitney, Texas. The non-contributing area for Whitney Lake and Dam consists of the drainage above the confluence of the Salt Fork and Double Mountain Fork of the Brazos River, but there is appreciable contributing area upstream of this confluence. In the vicinity of Whitney Lake and Dam, the slope of the Brazos River is approximately two feet per mile. Four fairly large tributaries that flow into the Brazos River system, including Bosque River, Little River, Yegua Creek and Navasota River. These tributaries flow into the Brazos River below the Whitney Lake and Dam site.

The basin includes all or part of 70 Texas counties within 42,000 square miles and has numerous smaller tributary rivers (Double Mountain, Salt, and Clear Forks, Paluxy, Bosque, Nolan, Little, and Navasota rivers) and dozens of smaller rivers and tributaries (Figure 2). Except for the cities of Abilene and Lubbock, areas of upper basin in the Texas Panhandle rely primarily on groundwater (Ogallala Aquifer) while communities in the central and lower portions of the basin use more surface water including water from reservoirs on the Brazos mainstem, the Little River and Aquilla River.

The Brazos River basin is crossed by a network of highways and railroads, and major cities within the basin include Lubbock, Waco, Temple, Belton, and Freeport. Major metropolitan areas such as

Dallas/Fort Worth, Austin, and Houston lay just outside the watershed boundary. Numerous oil and gas fields are located within the basin and oil refineries are found near the fields. There is a concentration of refineries and associated petroleum industries at Freeport and nearby Houston and along the waterway between those cities. Most of the Whitney Lake and Dam watershed lies within the Cross Timbers ecoregion to the west, and the Texas Blackland Prairie ecoregion to the east. The Brazos River basin supports numerous industries, including agricultural and livestock farming, industrial manufacturing and oil production, and commercial and retail activity. The population of the basin was approximately 1,900,000 in 2010 and is now approximately 2,300,000 as of 2020.

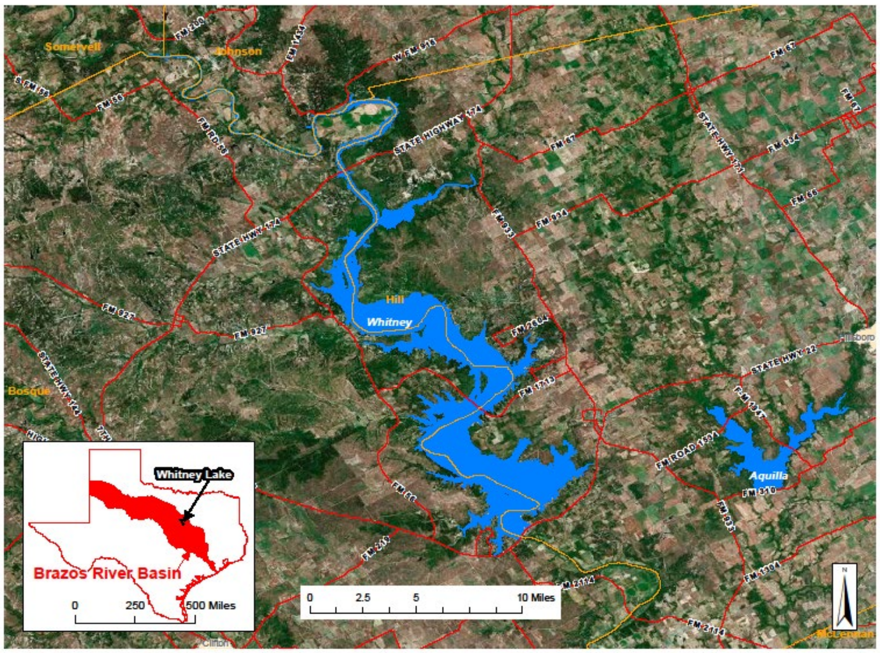

Figure 1. Whitney Lake Location

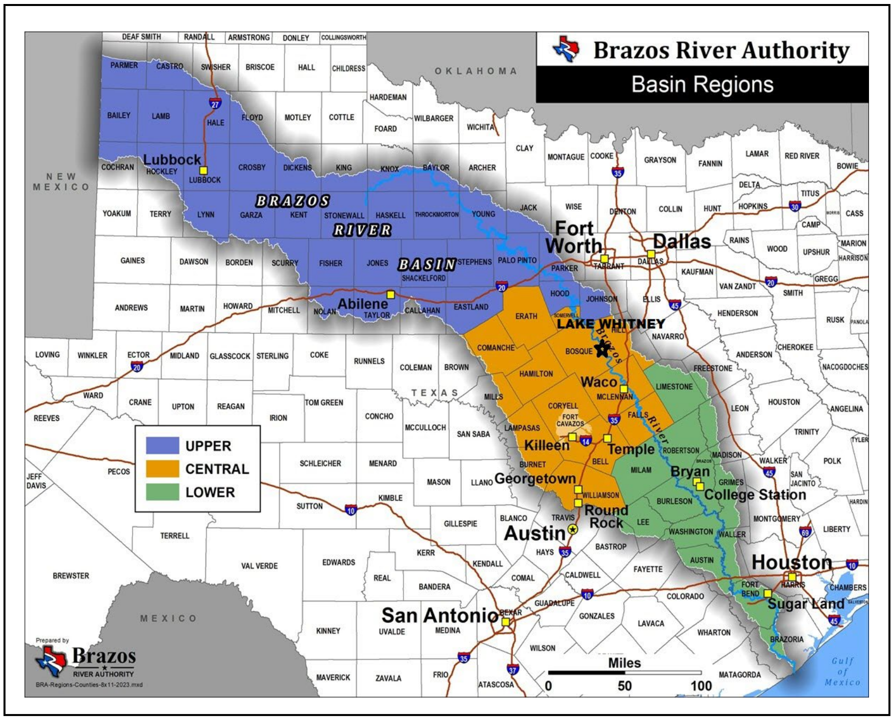

Figure 2. Brazos River Basin and Brazos River Authority Statutory Boundaries

Source: Brazos River Authority

1.4. Study Sponsor

The study sponsor - Brazos River Authority (BRA) - is a regional, wholesale, raw, and surface water provider to a variety of municipal, industrial, and agricultural water users in the Brazos River Basin and the San Jacinto-Brazos Coastal Basin. The BRA exists to develop, manage, and protect the water resources of the Brazos River Basin, and this imperative is enshrined in both the BRA's strategic plan and enabling legislation. The BRA leverages a suite of water rights to operate the system of 11 reservoirs and 40 river reaches (Figure 2) to generate and maintain a reliable, contractable water supply for over 170 current contract holders and potential future customers. The BRA can operate its water supply resources as a system in response to spatiotemporally variable hydrological and demand conditions, thereby promoting efficiency. Pursuing systematic efficiency both allows and incentivizes the BRA to integrate new supplies that enhance overall system performance to meet growing regional water needs.

1.5. Background and History

The construction of Whitney Lake and Dam began in May 1947 and was completed in December 1951 with an initial top of conservation pool elevation of 520 ft. Deliberate impoundment began in December 1951. Commercial power operation began in June 1955. In the design of the project, it was recognized that less flood control storage might be required later when additional flood control reservoirs were constructed in the watershed and experience was gained in the lake operation. Accordingly, provision was made in the design of the powerhouse and all electrical equipment for operation of the project at elevation of 533.0 feet (top of conservation pool at 533 ft). After the construction of Whitney Lake and Dam, the top of power pool elevation was modified three times. The ultimate project conservation pool elevation was raised to elevation 533 ft in May 1972, where it currently is today.

U.S. Army Corps of Engineers (USACE) owns and operates Whitney Lake and Dam. The reservoir's storage has allocations for flood control storage within the flood pool (~ 1.3 million ac-ft) and water supply and hydropower storage within the conservation pool (~ 260,000 ac-ft). To date, conservation pool storage has been primarily employed for hydropower purposes, however, the BRA holds the water supply storage contract, and maintains the water right, for water supply storage of approximately 57,000 ac-ft. The conservation pool was originally authorized by congress and designed to hold approximately 379,000 ac-ft; however, after the BRA completed two water supply reservoirs upstream, Possum Kingdom Lake and Lake Granbury, and the USACE completed Stillhouse Hollow Reservoir, approximately 248,000 ac-ft of flood control storage was reallocated to conservation storage for hydropower use in 1972.

Whitney Lake and Dam is part of BRA's mainstem system of reservoirs, where storage and releases from BRA's two upstream reservoirs are used in conjunction with Whitney Lake and Dam storage to supply BRA's customers along the Brazos River further downstream. These mainstem reservoir supplies can also offset water supply releases from other tributary reservoirs if the mainstem system has more hydrologic availability. Balancing reservoir supply and use with hydrologic availability and demand conditions across the basin, i.e. system operations, allows BRA to realize the most system supply available given the prevailing conditions each year.

Hydropower operations at Whitney Lake and Dam can influence both water supply and demand conditions from day to day. For much of the reservoir's life, hydropower services were marketed by the designated power marketing agency, Southwestern Power Administration (SWPA), in such a way that when peak periods of water demand coincided with peak periods of energy demand (e.g. hot and dry conditions), hydropower generation would be employed to meet the energy demands while producing a coincident supply of water downstream. Over the past decade, the way hydropower services are marketed at Whitney Lake and Dam changed to where hydropower releases are no longer routinely being made when water and energy demands coincide. This change in hydropower operations has shifted more of the burden of meeting downstream water demand to BRA's water supply storage. Given that water demand has also substantially increased over the past decade, the current allocation of water supply storage at Whitney Lake and Dam is insufficient.

1.5.1. Related Projects

The Whitney Dam and Lake Project is an integral part of the USACE plan for flood control on the Lower Brazos River and its tributaries. The plan presently consists of nine USACE flood control projects, known as Whitney Dam, Aquilla Dam, Waco Dam, Proctor Dam, Belton Dam, Stillhouse Hollow Dam, North San Gabriel Dam, Granger Dam, and Somerville Dam. The dams are operated to control floods, conserve water, regulate stream flow for water supply and navigation on the Brazos River downstream, generate hydroelectric power, fish and wildlife, and recreation. Whitney Lake and Dam is strategically located on the main stem of the river so that it reduces the risks from floods which originate in the upper basin. The BRA also owns and operates three dams in the Brazos River basin for purposes of water conservation: Morris Sheppard Dam (Possum Kingdom Lake), DeCordova Bend Dam (Lake Granbury), and Sterling C. Robertson Dam (Lake Limestone).

1.5.2. Dam Safety Action Classification

The USACE Dam Safety Program makes use of a risk classification system named Dam Safety Action Classification (DSAC) to help guide key decisions within the program. The classification system portrays the need for urgency of action and the priority for responding to risk associated with USACE dams. This classification scale ranges from DSAC 1, representing most risk and priority, to DSAC 5, representing the least risk and priority for funding. The classification assigned to a project is determined by looking at the combination of the likelihood of dam failure and the consequences of dam failure. This combination of factors results in an understanding of the overall risk presented by the dam. Specific hypothetical types of dam failures, the condition of the dam, frequency and intensity of precipitation and flooding, and factors that could affect life loss and other consequences are considered in the evaluation. The risk of a project and assigned DSAC is re-evaluated every 10 years during a Periodic Assessment or more frequently by other types of studies. Whitney Dam is currently assigned a DSAC rating of "4" or "low urgency" by the USACE Dam Safety Program. The most recent approved Periodic Assessment of the Dam performed in 2015 supports this rating. In 2025, a Periodic Assessment was started for the Whitney Lake and Dam and at the time of this report was pending completion.

1.6. Purpose and Need

The purpose of this study is to assess possible reallocation scenarios at Whitney Lake and Dam for providing additional municipal and industrial (M&I) water supply storage that could be used to assist in meeting the immediate and future needs for water supply in the Brazos River Basin. Due to increasing populations, industrial infrastructure growth, and lack of additional, readily available, water supply storage for M&I uses, water supply shortages currently exist and are projected to continue for the Brazos River basin in the coming decades.

1.7. Problems and Opportunities

The water resource problem to be addressed is the unreliable supply of water in the Brazos River Basin region and insufficient supply to meet increased demand that is projected for the region due to population growth.

Texas has gained more residents than any other state since 2000. Many parts of Texas continue to experience significant regional population and industrial growth, and this trend is expected to continue into future decades[2]. Growth at this scale has generated increasing water demands that exceed the capacity of many existing local water supplies to meet these regional needs. All the while, existing supplies have declined over time due to sedimentation and depletion. The Brazos River Basin includes some of the fastest growing regions in the State[3]. On average, more water flows through the Brazos River Basin than any other Texas river system[4]; however, all of the reliable surface water supply in the Brazos River Basin is considered to be fully allocated[5,6] as there are no remaining unappropriated river flow volumes that persist through the drought of record.

Opportunities include:

- There is an opportunity to redistribute the water supply within the Brazos River Basin to make a more efficient system. This could allow for demand to be meet in a less environmentally impactful way.
- There is an opportunity to holistically examine the authorized purposes of Whitney Lake and evaluate how they could work together in different ways.

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[2] 2022 State Water Plan | Texas Water Development Board

[3] Region G Draft 2026 RWP. Vol. 1 available at: 2026 Regional Water Plans | Texas Water Development Board

[4] TWDB available at: View all Texas River Basins | Texas Water Development Board

[5]Wurbs, Ralph A. 2020. "Institutional Framework for Modeling Water Availability and Allocation" Water 12, no. 10: 2767. https://doi.org/10.3390/w12102767

[6]Brazos G Regional Water Plan. 2021. Available at: 2021 Regional Water Plans | Texas Water Development Board

- There is an opportunity to enhance downstream fish habitat.
- There is an opportunity to provide the Brazos River Basin region with additional water supply storage.

1.8. Objectives and Constraints

Planning objectives are used to describe the intended purposes and outcomes of the planning process. The Whitney Lake Reallocation Study objective is to determine if there is an economically viable alternative to meet the current and future water supply demand for the Brazos River Authority.

Primary Objectives include:

- Reduce the risk for future water supply shortages in the region by increasing M&I storage at Whitney Lake and Dam over the 50-year analysis period for the Brazos River Basin region.

Planning Constraints. Planning constraints are restrictions that can limit the extent of the planning process. These constraints can be legal, policy-related, or study-specific. The PDT identified the following constraints:

- Ensure there is no induced or significantly increased flood damages or any increased life safety risk.
- Water supply storage reallocation should minimize effects to other authorized project purposes.
- Water supply storage reallocation should not negatively impact downstream channel stability.
- The Brazos River Authority will need to acquire water rights from the State of Texas for any additional water supply storage in Whitney Lake.

1.9. Study Scope

The study scope is to evaluate water storage reallocation at Whitney Lake to determine if it is a viable option for meeting both immediate and future water needs. This report identifies the estimated cost for reallocated storage and compares that estimated cost to that of other available alternatives. An Environmental Assessment (EA) has been prepared in accordance with the National Environmental Policy Act (NEPA) of 1969, and serves as compliance for other pertinent laws related to this study, such as the Fish and Wildlife Coordination Act, Endangered Species Act, etc. The EA evaluates the environmental effects associated with project alternatives including the No Action alternative.

2. Existing and Future Without Project Conditions

2.1. Period of Analysis

The period of analysis for this study is a 50-year timeframe (2027-2077), assuming the report will be approved in fiscal year (FY) 2027 and the water supply agreement will be executed in FY27.

2.2. General Setting

Whitney Lake and Dam is a unit of river improvement works in the Brazos River Basin. Whitney Lake has 2,100,400 acre-feet of storage that is utilized for flood control, water supply, and hydroelectric power generation. The conservation pool, with top of elevation 533.00 msl, is fully allocated and has historically been referred to as the “power pool”. Allocation of storage in Whitney Lake and Dam includes 57,292 acre-feet for water supply, 202,926 ac-ft for power drawdown storage, and 356,976 acre-feet of powerhead reserve/inactive pool. An acre-foot of water is equivalent to one foot of water spread over one acre of land. The pool of record was reached on May 29, 1957 at an elevation of 570.25 msl and the record low was 509.26 msl on November 1, 1956.

Figure 3 provides a conceptual image of the different pools within Whitney Lake and Dam.

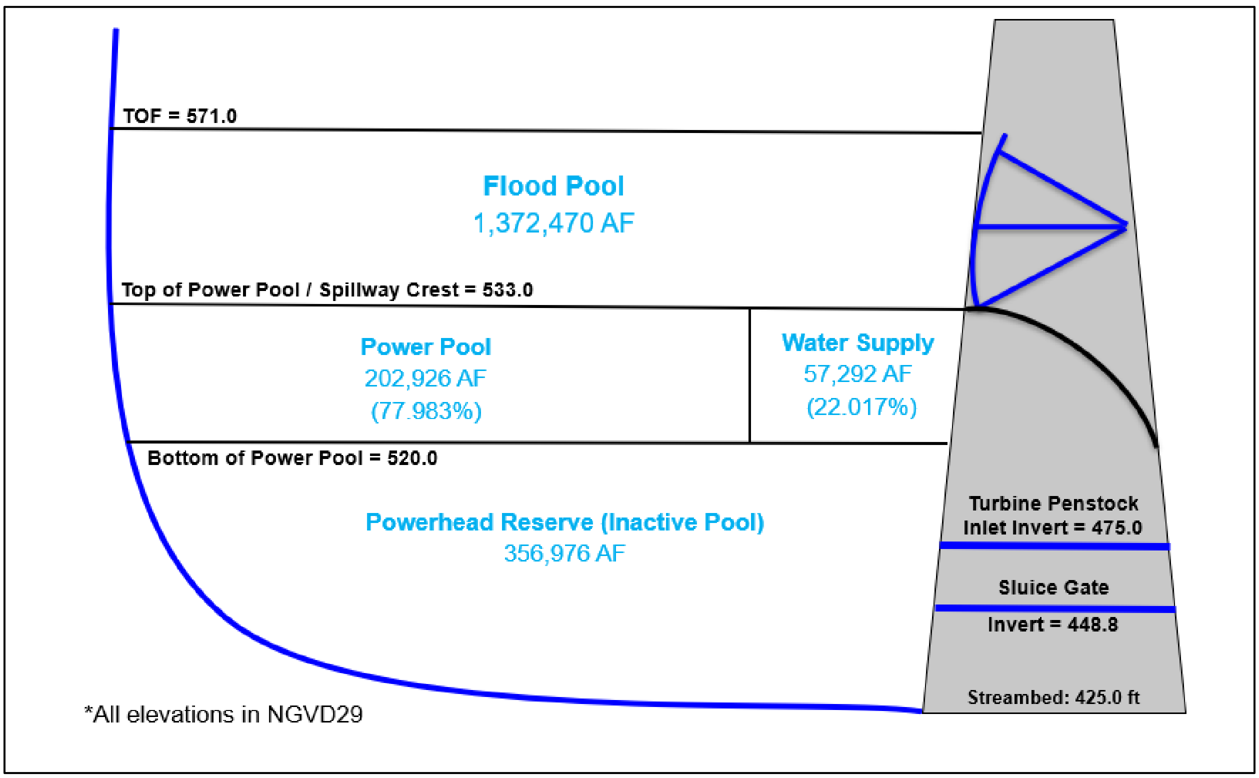

Figure 3. Conceptual image of different pools within Whitney Lake and Dam

2.3. Natural Environment

Whitney Lake and Dam lies in a region characterized by moderate winters and comparatively long summers. In spring, summer, and fall, prevailing winds are from the south and southwest. The mean annual temperature in the vicinity of the dam site is 67 degrees (°) Fahrenheit (F).

The maximum recorded temperature at Hillsboro, Texas was 113° F. The recorded low was 1° below zero. The growing season is normally from the latter part of March to the middle of November. The mean annual precipitation over the contributing portion of the Brazos River Basin above the Whitney Lake and Dam site is approximately 24.8 inches. Whitney Lake and Dam is located within the Cross Timbers ecological region in north-central Texas. This region is a transitional area between tall grass prairies and oak savannas and is characterized by areas with a high density of trees and irregular plains and prairies. Due to steep topography around Whitney Lake wetlands generally occur near the rivers and flatter areas on the eastern side of the lake. Whitney Lake and Dam provides habitat for an abundance of fish and wildlife species.

The lake provides a quality fishery as well as quality wildlife habitat on public land associated with the project. Whitney Lake and Dam provides fishing opportunities for the boater and for the bank angler. USACE manages approximately 23,783 acres of federal land at Whitney Lake and Dam. There are 22 designated wildlife management areas with approximately 16,278 acres designated as multiple resource management lands.

Currently, USACE operates six class A campgrounds, four class C campgrounds, and three day use parks operated with other facilities operated by state, private entities, and local governments that have approximately one to 1.5 million visitors annually (Whitney Lake Master Plan, 2016). Whitney Lake and Dam is located on river mile 442.4 and the reservoir encompasses a surface area of more than 23,500 acres under normal operating conditions.

2.4. Physical Environment – Project Description and Reservoir Regulation

The Whitney Lake and Dam is a multipurpose dam and reservoir operated primarily for flood risk management and hydroelectric power development. Additional project purposes include water supply, recreation, and fish and wildlife habitat. Whitney Lake and Dam is an integral part of a USACE nine-lake system of reservoirs that provide flood risk management on the Brazos River and its tributaries. Whitney Lake and Dam’s strategic location on the main stem of the Brazos River provides for managing of floods originating in the upper basin. The following sections provide a description of the reservoir and its regulation.

2.4.1. Reservoir Project Description

Construction began on May 12, 1947, deliberate impoundment began December 10, 1951, and commercial hydropower operation began June 1, 1955. Whitney Lake and Dam consists of a 1,674-foot-long concrete gravity section; 8,201 feet of rolled earth fill principal embankments; and 7,820 feet of earth fill dikes. Top of the concrete gravity section is at elevation 584.0 feet; top of the earthen embankments are at elevation 580 feet. Crest of the ogee spillway is at elevation 533.0 feet, and it is equipped with 17 each 40-foot wide by 38- foot high tainter gates. The sluice gate outlet works consist of 16 each 5-foot wide by 9-foot-high conduits through the base of the concrete gravity section, all with invert elevation 448.83 feet. Each conduit is equipped with a hydraulically operated sluice gate. The powerhouse is located just downstream from the right bank concrete abutment. Power intakes consist of two 16-foot-diameter steel penstocks with intake inverts at elevation 476.0. Flows through the penstocks are controlled by one 17-foot wide by 30-foot-high gate in each penstock. The Kopperl Levee was constructed as part of the original authorization in lieu of relocating the town of Kopperl, Texas. The levee is located approximately 21 miles upstream and is an appurtenant structure of the Whitney Lake and Dam.

The total project area at Whitney Lake encompasses 52,693 acres. Of this total area, USACE acquired 43,571 acres in fee simple title. In addition, 9,122 acres were encumbered with a perpetual flowage easement. The real estate fee take line is based on a guide contour elevation of 550.0 feet, while the flood flowage easement was based on a guide contour elevation of 573.0 feet. This level was determined by routing the Spillway Design Flood through the reservoir starting at the top of conservation pool elevation of 533.0 feet.

2.4.2. Reservoir Capacities

The storage capacity allocations of Whitney Lake and Dam are presented in Table 1. All elevations in the report are in the National Geodetic Vertical Datum (NGVD) of 1929. The reservoir has a maximum depth of 108 ft and 225 miles of shoreline when the pool is at the top of conservation (533 ft).

Table 1. Whitney Lake and Dam Storage Capacities

Feature	Elevation [ft, NGVD]	Surface Area [ac]	Cumulative Storage Volume [ac-ft]	Incremental Storage Volume [ac-ft]
Top of Dam	580.0	56,720	2,466,900	376,300
Max Design Pool/ Top of Surcharge	573.0	51,300	2,090,600	100,900
Top of Flood Pool	571.0	49,820	1,989,660	1,372,470
Top of Conservation/ Power Pool	533.0	23,210	617,190	260,220
Top of Power Head Reserve/Inactive Pool	520.0	15,640	356,980	N/A

Note: Values up to elevation 533.0 based on 2016 volumetric survey. Values above elevation 533.0 are from historic surveys.

2.4.3. Regulation of Conservation Storage

Conservation storage is regulated for hydropower generation and municipal and industrial water supply (M&I). The conservation pool lies between elevations 520.0 and 533.0 feet. The storage space below elevation 520.0 serves for power head reserve and sedimentation and is considered the inactive pool. Water above elevation 533.0 is released for flood risk management purposes in accordance with the reservoir regulation plan. Whitney Lake and Dam has no required minimum rate of release; however, approximately 50 cubic feet per second (cfs) passes downstream due to gate leakage.

Hydropower generated at Whitney Lake and Dam is marketed by the Southwestern Power Administration (an agency of the U.S. Department of Energy [SWPA]). Hydroelectric generating facilities were installed at Whitney Lake and Dam with a capacity of each of the two original turbines at 15 megawatts (MW). A turbine rehabilitation project occurred in 2014 – 2015 with rehabilitation of both turbines. Capacity of each rehabilitated turbine is currently 22 MW, making total capacity 44 MW.

Currently, one contract is in place for water supply storage at Whitney Lake and Dam. The United States Government entered into a contract with the Brazos River Authority (BRA), an agency for the State of Texas, for water storage space in Whitney Lake, June 3, 1982. The contract allows the BRA the right to utilize an undivided 22.017 percent (estimated to contain 50,000 ac-ft after adjustment for sediment deposits) of the usable storage space in Whitney

Lake and Dam between elevations 520.0 feet above mean sea level and 533.0 feet above mean sea level, which usable conservation storage space is estimated to contain 260,220 ac-ft. The undivided 22.017 percent of the total usable storage space between elevations 520.0 and 533.0 is to be used to impound water for present demand or need for municipal and industrial water supply. The remaining percent of conservation storage space is 77.983 and is owned by SWPA and used for hydropower generation.

The BRA currently contracts for 57,292 ac-ft of storage for municipal and industrial (M&I) water supply between elevations 520.0 and 533.0 feet at Whitney Lake and Dam. From this storage, the BRA is allowed to divert and use 18,336 ac-ft per year (ac-ft/yr) for M&I purposes. This amount was determined to be the dependable yield related to a storage of 50,000 ac-ft during the water rights adjudication process in the 1980s. However, their authorization with the State of Texas allows them to exceed this amount through the BRA System Operation Order, with maximum diversions of 25,000 ac-ft/yr for municipal water supply and 25,000 ac-ft/yr for industrial purposes from Whitney Lake and Dam. All diversions beyond the 18,336 ac-ft/yr in any given year are charged against BRA priority rights in other reservoirs in the BRA system.

Currently, all withdrawals from Whitney Lake and Dam occur downstream of the reservoir, as there are no M&I water intakes on the reservoir itself.

2.4.4. Regulation of Flood Control Storage

Whitney Lake and Dam is an integral part of the USACE Brazos River Reservoir System of nine projects which contribute to flood risk management on the Lower Brazos River. Whitney Lake and Dam is the most upstream of these flood risk management projects and has more than twice the flood pool storage space of the second largest project (Belton Lake). Located on the main stem of the Brazos River, Whitney Lake and Dam manages flood runoff from the upper 49% of the contributing drainage area of the Brazos River Basin. Releases from Whitney Lake and Dam are coordinated with releases from the other eight reservoirs, insofar as practicable, to maintain approximately the same amount of flood pool storage space available at each project.

2.4.5. Recreation & Fish and Wildlife

USACE has developed recreation and fish and wildlife facilities at the Whitney Lake and Dam with the other established purposes for flood risk management and the conservation pool regulation. Water is not controlled at Whitney Lake and Dam for recreation and fish and wildlife. Recreation and fish and wildlife are considered incidental benefits of operating the lake for the primary purposes of hydropower, flood risk management, and water supply.

2.4.6. Current Flood Risk Management and Hydropower Generation Purposes

The USACE Brazos River Reservoir System was built in part to address destructive flooding in the Brazos River Basin. Flood releases from all the projects are coordinated on a system basis to furnish flood risk management to the basin as a whole. As part of the original project purposes, Whitney Lake includes hydropower production which went online in 1955. For 50 years, the Whitney powerhouse operated as a peaking plant providing electricity when system demand is approaching the capacity of the base load plants during peak times. After the 2014-2015 turbine rehabilitation project, an ancillary service known as Rapid Response Service, or sometimes called Ready Reserve, became available to SWPA and their power customers. This service has Whitney Lake and Dam's turbines continuously spinning, ready for an emergency call from the electric grid operators. When the call comes from the grid operators to begin generating at Whitney Lake and Dam, the turbines will be able to achieve full electric generation much quicker than a normal peaking-power plant, due to being in Rapid Response mode.

Hydropower operations at Whitney Lake and Dam are noteworthy among USACE projects because SWPA's customers primarily utilize the project's capacity to provide spinning reserves capacity to the regional power market operated by The Electric Reliability Corporation of Texas (ERCOT). Generally speaking, most energy produced at Whitney Lake and Dam is the result of water supply and flood control related releases through the powerhouse, and releases only for power production itself are relatively infrequent. Releases for hydropower production typically occur on fewer than 20 days per year, since spinning reserves does not release water downstream, but does provide the ERCOT grid valuable insurance during unforeseen periods.

In turn, ERCOT is noteworthy as a "energy-only" organized wholesale electricity market; in this region, generators are compensated through energy and ancillary services provision only, without a separate capacity market, unlike other deregulated US markets.

Although a formal sedimentation study has not been conducted for Whitney Lake and Dam, comparison of results of the most recent (2005) volumetric survey of Whitney Lake to the 1959 re-survey indicates the experienced annual average rate of sedimentation over the intervening 46-year period has been about 1,600 ac-ft per year, about half the approximately 3,200 ac-ft per year anticipated in the original design (DPR of September 1945). Thus, the design sedimentation storage allocation in Whitney Lake and Dam, originally estimated to suffice for about 80 years, may be expected to suffice for a significantly longer period. Aside from the inaccuracy inherent in estimating a long term rate of sedimentation, a part of the difference between the projected and the experienced rate of sedimentation in Whitney Lake may be attributable to the construction of Granbury Lake on the main stem of the Brazos River upstream of Whitney Lake as well as construction of several smaller reservoirs on Brazos River tributaries between Granbury Lake and Whitney Lake (see Figure 2 for location map). Impoundment of Granbury Lake began in September of 1969.

The project currently meets its flood risk management and hydropower purposes and is expected to meet its flood risk management and hydropower purposes in the future without-project condition. The project remains an integral part of the Brazos River Reservoir System. Sedimentation storage allocation in Whitney Lake and Dam is estimated to suffice for longer than the originally estimated 80 years in the future without-project condition.

2.4.7. Recreation and Fish & Wildlife

Approximately 13,500 acres of government-owned land surrounding Whitney Lake and Dam are dedicated as natural areas. Primarily used for flood storage, this land is also intended for low impact public use with a minimum of facilities provided. Lands surrounding Whitney Lake and Dam have multiple use designations for parks, hunting, and wildlife areas. Many recreation facilities including private floating boat slips and USACE boat ramps are impacted under reservoir water level fluctuations. Impacts are expected to continue to occur in the future without-project condition as lake levels fluctuate. Multiple facilities are directly dependent on water access to be usable.

2.4.8. Drought Contingency Plan

USACE Ft. Worth Water Management, has developed a Drought Contingency Plan for the Brazos River Basin. The plan identifies at least four drought stages, triggered by specific, monitored criteria. The plan includes quantified targets for water use reduction and defined response measures. The plan emphasizes coordination between State and Federal Government representatives through an Interagency and Intergovernmental Drought Management Committee (IDMC). Clear procedures are established for handling third-party requests and ensuring thorough review of proposed actions, based on the drought level. The plan prioritizes public information and transparent communication regarding water management decisions. The document demonstrates a proactive approach to water resource management, emphasizing preparedness for drought conditions and a structured process for decision-making. It highlights the importance of data-driven criteria, interagency collaboration, and public engagement. Key recommendations from the plan include to continuously monitor the defined drought indicators to ensure timely activation of appropriate response stages, follow established procedures for reviewing third-party requests and ensure adequate documentation and coordination, maintain open communication channels with the public and affected stakeholders throughout the drought management process and to periodically review and update the plan to reflect changing conditions and best practices in water management.

2.5. Water Supply and Demand in Study Area

To reallocate storage space at a USACE reservoir, sponsors should demonstrate a “present or anticipated future demand or need” for physical water per Water the Supply Act, although the USACE does not ensure, provide or guarantee physical water. This is the responsibility of the sponsor requesting storage and applicable state water law and policy apply. The qualifier “present” should be taken in the context of developing or expanding water supply infrastructure, which can take years – if not decades in some cases – given planning, permitting and construction. Needs for water are expressed as the difference between existing supplies and projected short-term and long-term water demands. This section discusses current and future water supply and demand in the study area.

For the water supply needs analysis, the PDT incorporated data from the Brazos G Regional Water Plan developed as part of the Texas state and regional water planning process created established in 1998. The water planning process in Texas is overseen by the Texas Water Development Board (TWDB) and driven by a ‘bottom up’ approach, wherein the State Water Plan is derived from local and regional input organized through 16 Regional Water Planning (RWP) groups on a 5-year planning cycle. The Brazos River Basin is among the largest river basins in Texas and extends over several of these RWP group areas, covering the majority of Region G, a significant portion of Regions H and O, and sections of Regions B, C, and K (Figure 4).

The BRA has served as the planning group sponsor for the Region G RWP Group since the RWP process began in 1997. As such, the BRA plays an integral role in the development of the Region G Regional Water Plan and the State Water Plan. Given the breadth of the water supply system, the BRA must work closely with the TWDB and the RWP process to assess the needs of current and potential future customers and evaluate new water supply opportunities. The BRA is named as the sponsor of several WMSs recommended by the Region G and H RWP Groups. Of these WMSs, none have more potential to address near-term regional water needs across the BRA water supply system than reallocation at Whitney Lake.

The RWP process leverages demographic data and coordination with local water user groups (WUGs) to produce decadal projections of population and water demand growth distributed across different types of water use. These WUG demands are compared to existing available water supplies (surface water and groundwater) to determine outstanding water needs for municipal, industrial, and agricultural uses. Ultimately, the RWP process identifies and assesses potential water management strategies (WMSs) that could be implemented to meet needs. All WMSs have an associated sponsor who is willing to pursue, and who is in a position to benefit from, the WMS. For a sponsor to obtain TWDB funding to implement a WMS, the strategy must be recommended in the regional and state water plan. The regional efficacy and potential for public benefit of a particular WMS is often heavily influenced by both the sponsor’s ability to handle the costs and complexity of WMS implementation and capacity to integrate the WMS into an existing water supply system.

WMSs range across many different supply sources, e.g. surface water, groundwater, desalination, conservation, and reuse. The feasibility of a particular supply source as a regional WMS is determined in part by the legal and practical accessibility to that source. All supply sources are bound by property or authorization rights or other legal, procedural, or regulatory constraints that limit access to only those who possess the right of use or have the ability to attain the right of use. Therefore, aside from the essential engineering challenges to develop and deliver water supply, WMS sponsors must also satisfy the legal and procedural requirements to gain the right to access and distribute water in accordance with the regulatory framework associated with the supply source of the WMS.

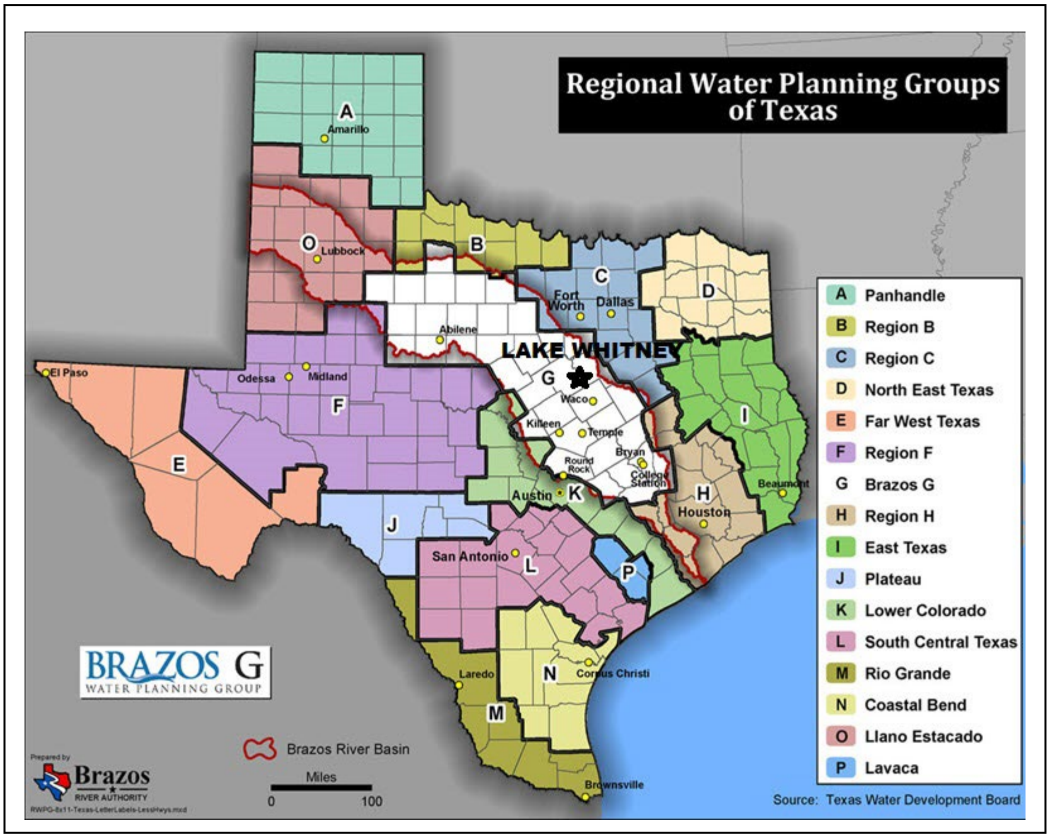

Figure 4. Brazos G Regional Water Planning Area and Brazos River Basin
Source: Brazos River Authority

2.5.1. Demographic Growth in the Brazos River Basin

Region G is one of 16 Regional Water Planning Areas created by Texas Senate Bill 1 (1997). Regional Water Planning Groups (RWPGs) develop regional water plans to ensure adequate long-term water supplies with administrative oversight and technical assistance from the Texas Water Development Board (TWDB), and funds appropriated by the Texas Legislature. Regional water plans form the foundation of the Texas State Water Plan developed and presented to the state legislature every five years.

Region G primarily comprises the lower and central portions of the basin which have differences in socioeconomics and water resources. The upper basin relies mostly on groundwater and its economy is based on agriculture and rural in nature whereas the central lower portions are in some of the fastest growing and economically diverse areas of Texas. The state has experienced substantial growth both in Houston and particularly along Interstate Highway 35 corridor. The I-35 corridor is a major part of the larger socioeconomic center of Texas that forms a triangle between San Antonio, Austin, DFW and Houston. Based on U.S. Census data, this area consists of 36 of the state's 254 counties, 68 percent of the state's current population and 88 percent of new population in Texas from 2010 through 2020 growth mostly in the form of net migration from other areas of the nation.

The state economy is the primary draw for people coming to Texas. I-35 runs from the border city of Laredo, Texas through San Antonio, Austin, DFW and communities in the Brazos River Basin including Waco, Killeen, and Temple. In short, cities and regions along I-35 in Texas are experiencing massive growth due to business-friendly local and state policies, skilled workforces, lower costs of living and taxes relative to other areas of the nation, and a location along a major domestic and international transportation corridor. Table 2 summarizes historical and projected population for counties in Region G.

Table 2. Historical and Projected Population in Regional Water Planning Area G (Brazos River Basin)

County	General Location Relative to Lake Whitney	Metropolitan Statistical Area*	2000	2020	Historical Percent Change	2030	2070	Projected Percent Change
Williamson	Downstream	Austin	198,780	560,419	182%	683,047	1,490,951	54%
Bell	Downstream	Killeen-Temple	232,319	371,956	60%	433,618	688,107	37%
Brazos	Downstream	College Station	152,415	227,654	49%	282,453	484,546	42%
McLennan	Downstream	Waco	207,943	252,211	21%	272,216	342,757	21%
Johnson	Upstream	Dallas Fort Worth	122,223	173,835	42%	200,573	325,967	38%
Taylor	Upstream	Abilene	125,841	140,675	12%	147,183	162,423	9%
Coryell	Downstream	Killeen-Temple	74,978	86,105	15%	97,771	146,240	33%
Hood	Upstream	na	35,952	61,316	71%	71,099	92,339	23%
Erath	Upstream	na	33,001	42,135	28%	46,923	61,844	24%
Hill	Adjacent	na	28,854	37,828	31%	40,277	45,989	12%
Washington	Downstream	na	30,373	36,199	19%	38,516	43,880	12%
Grimes	Upstream	na	23,552	29,441	25%	32,179	39,867	19%
Palo Pinto	Upstream	na	26,448	30,535	15%	32,771	37,579	13%
Milam	Downstream	na	23,851	26,234	10%	27,793	32,629	15%
Limestone	Downstream	na	21,527	25,136	17%	26,615	31,152	15%
Lampasas	Downstream	na	15,976	21,800	36%	24,100	30,741	22%
Roberston	Downstream	College Station	16,000	19,694	23%	22,035	30,009	27%
Jones	Upstream	na	20,139	21,424	6%	22,676	25,446	11%
Bosque	Adjacent	Waco	8,422	20,310	141%	22,184	24,362	9%
Lee	Downstream	na	15,657	19,131	22%	21,511	23,889	10%
Burleson	Downstream	College Station	16,470	18,539	13%	19,946	23,022	13%
Falls	Downstream	Waco	14,902	19,413	30%	20,397	21,364	5%
Eastland	Upstream	na	18,297	19,289	5%	19,712	19,732	0%
Nolan	Upstream	na	14,686	16,134	10%	17,039	19,325	12%
Young	Upstream	na	13,414	15,432	15%	16,281	18,770	13%
Comanche	Upstream	na	14,026	14,502	3%	15,078	16,814	10%
Callahan	Upstream	na	12,905	14,482	12%	15,504	16,700	7%

County	General Location Relative to Lake Whitney	Metropolitan Statistical Area*	2000	2020	Historical Percent Change	2030	2070	Projected Percent Change
Somervall	Upstream	na	6,809	9,482	39%	10,594	12,958	18%
Stephens	Upstream	na	9,674	9,927	3%	10,293	10,693	4%
Hamilton	Downstream	na	8,229	8,562	4%	8,703	8,703	0%
Haskell	Upstream	na	5,395	5,913	10%	5,973	6,285	5%
Knox	Upstream	na	4,253	3,847	-10%	4,003	4,325	7%
Fisher	Upstream	na	4,344	4,001	-8%	4,001	4,001	0%
Shackleford	Upstream	na	3,302	3,558	8%	3,666	3,667	0%
Throckmorton	Upstream	na	1,850	1,646	-11%	1,646	1,646	0%
Stonewall	Upstream	na	1,693	1,501	-11%	1,504	1,504	0%
Kent	Upstream	na	859	798	-7%	816	816	0%
Non MSAs	na	na	395,066	480,253	22%	519,273	611,294	15%
MSAs	na	na	1,170,293	1,890,811	62%	2,201,423	3,739,748	41%
Total	na	na	1,565,359	2,371,064	51%	2,720,696	4,351,042	37%

Per the U.S. Census Bureau, a metropolitan statistical area (MSA) is a geographical region with a relatively high population density at its core and close economic ties throughout the region. Source: Historical data from U.S. decennial Census, and projections developed by the Texas Water Development Board and Texas Demographic Center.

2.5.2. Water Supply Needs Analysis

This section compares forecasted water use with existing water supplies to assess water needs on the part of the project sponsor. As noted in the introduction, this study is unique in that the sponsor is one of the largest water suppliers in Texas and, instead of relying on Whitney Lake and Dam solely for local supply, or relying only on Whitney Lake and Dam for its water supply need, BRA relies upon Whitney Lake and Dam as one component of a larger system consisting of eleven reservoirs that manage water for customers through the entire Brazos River Basin. Therefore, needs must be assessed regionally rather than for a single community or user. The BRA provides raw water from surface supplies to customers throughout an entire river basin, many of which are projected to have unmet water needs now and, in the future, and many of whom rely on surface water from the BRA.

Much of the BRA's surface water comes from the Brazos River (both run of river and from impounded water), which BRA operates as a water supply system in conjunction with eight USACE reservoirs, including Lake Whitney. Thus, reallocating storage space in Whitney Lake and Dam for municipal and industrial use could benefit BRA customers throughout the basin. Another consideration is that the needs analysis focuses on surface water supplies and Regional Water Planning Area G with boundaries that approximate portions of the upper, central, and lower areas of BRA's statutory boundaries. The upper portion of the basin is largely rural where groundwater is the primary supply source. The remainder of this section summarizes existing and projected water use, water supplies, and water needs.

Data Sources and Methods

The TWDB and Brazos Region G Regional Water Planning Group developed supply, demand, water needs, and other relevant data used in this study. Since 1997 via the passage of state Senate Bill 1, Texas has conducted a regional and state water plan(s) on a 5-year cycle with the goal of ensuring adequate water supplies able to withstand growth pressures and future droughts in a region prone to severe drought.

During each five-year planning cycle, regional water planning groups, supported by the TWDB, evaluate population projections, water demand projections, and existing water supplies. Each planning group then identifies potential water shortages under drought of record supply conditions (water needs), recommends water management strategies (with cost estimates) to address those potential shortages, and determines the socioeconomic impacts of not addressing the identified water needs. Each new state water plan, which considers a 50-year horizon, must reflect and respond to changes in population, water supplies, technological improvements, economic shifts, project viability, and state policy.

For the water supplies, demands and needs, the TWDB has aggregated different sectors (water user groups or WUGs) of the economy for analysis: 1) irrigation, livestock, municipal, manufacturing, mining, and steam electric.

- Irrigation and livestock WUGs are county level estimates of consumptive agricultural water use. Given that reallocation of storage in USACE operated reservoirs must be for purposes specified by law and policy, agricultural uses are not tabulated or discussed further in this report.

- Municipal WUGs include incorporated municipalities and political subdivisions as defined by state law (e.g., water supply corporations, water supply districts, municipal water districts) that provide potable water and water treatment to respective service areas.

Unlike other WUGs, these are not aggregated to the county level. In Region G, there are 553 municipal WUGs.

- Manufacturing water use is aggregated to the county level for non-disclosure and generally consist of large facilities such as refineries, food processors, and data centers that use large volumes of process and or cooling water. Some manufacturers are connected to public water systems, but recorded separately when aggregating. Some are self-supplied in terms of both treated process water and raw water with their own surface water rights or groundwater wells. Facilities that use relatively small volumes of process water or none are included in municipal WUGs if they are connected to a public potable water system.

- Mining is similar to manufacturing in terms of aggregation and recording. Many mining operations are self-supplied such as aggregate quarries, but a notable exception are companies involved in hydraulic fracturing operations, which a major energy development in the past few decades in Texas with both domestic and international impacts to oil and gas markets. Drilling fracking wells consumes substantial amounts of water that must fairly good quality. In some areas, oil and gas companies purchase treated water from public suppliers and truck to well pads when drilling a new well.

- Steam-electric (county level) consists of consumptive use to produce thermal electric steam power, which comprises most electricity generation for the Texas grid (ERCOT). Most power plants have off channel retention basins for cooling water and divert water from run of river or impounded sources as needed during dry periods.

Existing Supplies

In Texas, the differences in legal accessibility between different water supplies are most pronounced when comparing the two most abundant water supplies – surface water and groundwater. Groundwater is a private property right[7] whereas surface water is owned by the state and held in trust for the citizens of Texas[8]. Groundwater Conservation Districts (GCDs) across the state monitor the permitting and development of groundwater by private owners, whereas surface water is regulated by the Texas Commission on Environmental Quality (TCEQ) based on the granting of water rights using the prior appropriation doctrine. For a sponsor, questions of WMS cost, complexity, and where the WMS supply can be used are inextricably linked to the authorization process. Surface water has a distinct advantage over groundwater as a regional supply because there is an existing regulatory framework in place to permit the use of surface water anywhere within a river basin and sometimes between basins. Groundwater, in contrast, varies vastly across the State as each GCD is empowered to set their own permitting systems, but otherwise have very limited authority. Since groundwater is a private property right, the costs associated with widespread development varies greatly across the State, and development costs can be significantly higher due to issues with groundwater chemistry, temperature, and transmissivity. This makes surface water the most accessible and affordable supply on a regional scale.

Streamflow in the Brazos River and its tributaries, along with reservoirs in the Brazos River Basin, Colorado River Basin, and Trinity River Basin, comprise the surface water supply of the Brazos G Area. Diversions and use of this surface water occurs throughout the entire area. However, the supply of surface water varies greatly through the area due to the large variation

[7] Texas Water Code Section 36.002
[8] Texas Water Code Section 11.021

in rainfall and a correspondingly large variation in evaporation rates. The principal tributaries to the Brazos River in the planning area are the Clear Fork, the Double Mountain Fork, the Salt Fork, Bosque River, Little River, Navasota River, Little Brazos River and Yegua Creek. Three major water supply reservoirs in the region are owned and operated by the BRA, the U.S. Army Corps of Engineers operates nine, and the remaining major reservoirs are owned and operated by the West Central Texas Municipal Water District, the City of Abilene, and Texas Utilities. The western part of the area is dependent on surface water sources, largely due to limited quantities of groundwater.

In Texas, surface water is held in trust for the people by the State of Texas; specifically, the Texas Commission on Environmental Quality administers surface water rights under the prior appropriation doctrine.[9] The BRA holds most water rights in the basin and all municipal and industrial (M&I) water supply storage space in Lake Whitney. At the time of the Brazos G Regional Water Plan of 2022, there were 1,090 active water rights in the basin with total authorized diversions of approximately 3.0 million acre-feet per year. The most notable new water right issued in the Brazos River Basin since is the BRA's System Operations Permit authorizing a combined diversion amount of up to 334,345 acre-feet per year at numerous locations within the Brazos G and Region H (includes the Houston area) regional water planning areas.

Portions of six major and eleven minor aquifers extend into the Brazos G Area. Major aquifers supply large amounts of water to large areas of the State, while minor aquifers supply large amounts of water to small areas or provide small supplies to wide areas. About, 74 percent of the groundwater in Region G comes from four major aquifers: Brazos Valley Alluvium, Carrizo-Wilcox, Seymour, and Trinity. Fewer than half of the aquifers in the region have potential for further development. Seven of them extend only slightly into the planning area. Aquifers with potential for further development are in the southeastern part of the region.

[9] While groundwater is an important water supply source throughout the Brazos Basin, the state nor the BRA regulates groundwater pumping. Texas law recognizes the doctrine of absolute ownership (also known as the rule of capture), which means that landowners may withdraw water from wells on their property in unlimited quantities as long as the water is for beneficial uses and pumping is not malicious in nature.

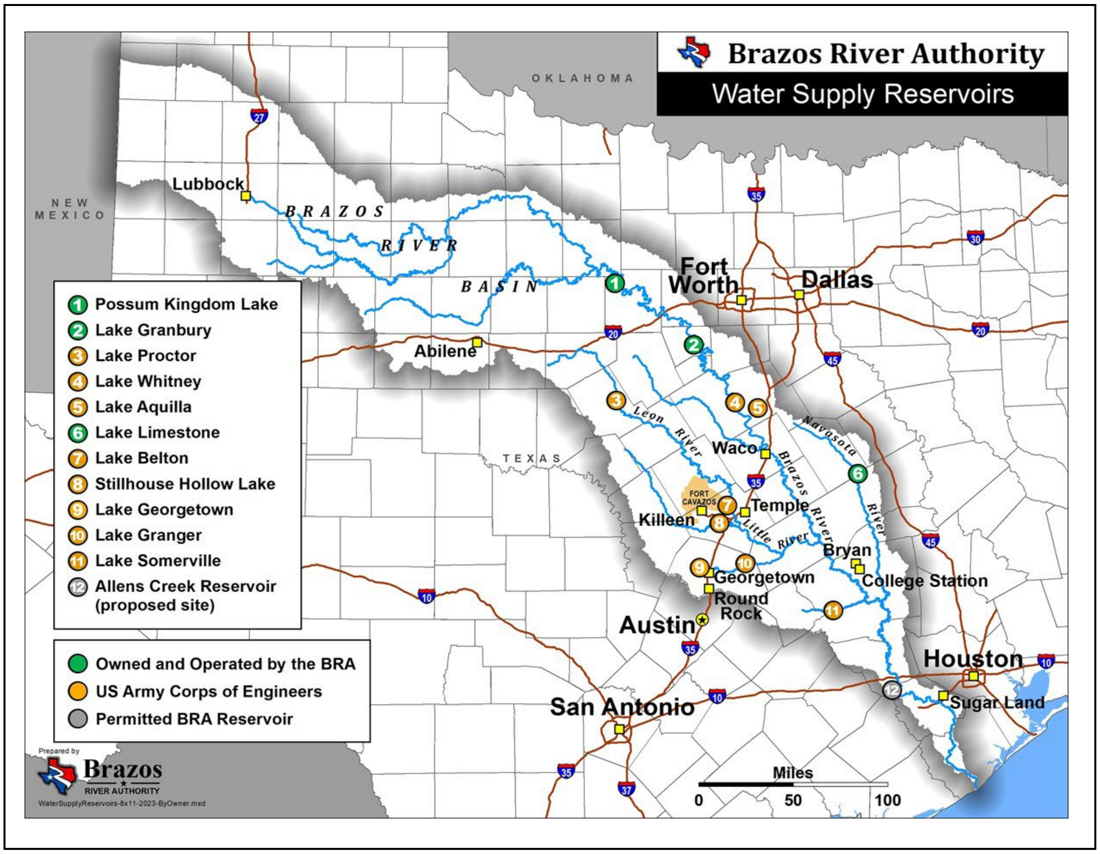

Figure 5. Major Reservoirs in the Brazos River Basin
Source: Brazos River Authority

Current and Projected Municipal and Industrial Water Use

Water demand projections are taken directly from the 2022 Region G Regional Water Plan. As a major element of the water planning process in Texas, TWDB staff develop demand projections for WUGs, and provide the estimates to each planning group who then review the demands and may request modifications.

Baseline data for M&I projections is largely drawn from the TWDB Water Use Survey that gathers data from businesses and communities using groundwater, surface water, or reclaimed water supplies. Data for municipal water suppliers also rely on the Texas Water System Service Boundary Viewer to assess factors such as build out limitations and per water capita use. Subject matter experts from organizations such as the Bureau of Economic Geology at the University of Texas and other technical advisors, prepare water demands for other sectors such mining and steam-electric under contract to the TWDB or with RWPGs. The process and methods for developing water demand estimates is formal and well vetted and undergoes internal agency technical review and review by the RWPGs. After the review process, planning groups vote and formally adopt the numbers; and in turn, submit them to the TWDB governing board for final review and approval. Public comments are accepted and considered by the TWDB governing board.

Total water demands in Region G are expected to increase by nearly 42 percent over the next few decades with the greatest increase both in terms of volume and rate is municipal (public water supply) use followed by manufacturing. By 2070, total water use in the region is expected grow from nearly 0.7 acre-feet per year in 2020 to 1.0 million (Table 3). Projections indicate that municipal and steam-electric water use as percentages of the total water use will increase from 2010 to 2070, while respective shares of irrigation, manufacturing, mining, and livestock water use are expected to decline (Tables 3 – 7).

Table 3. Historical and Projected Municipal and Industrial Water Demands Regional Water Planning Area G by Water Use Sector (1,000s of Acre-feet per year, Brazos River Basin)

Sector	2000	2020	Projected: 2030	Projected: 2040	Projected: 2050	Projected: 2060	Projected: 2070	Percent Change
Municipal	311.29	406.48	455.22	510.23	571.26	638.05	707.78	73%
Manufacturing	60.52	12.70	16.18	16.18	16.18	16.18	16.18	27%
Steam-electric	97.92	232.89	232.89	232.89	232.89	232.89	232.89	0%
Mining	4.38	61.59	66.27	59.34	58.42	58.92	60.84	-1%
Total	474.12	713.65	770.56	818.64	878.75	946.03	1017.69	42%

Source: Region G 2022 Regional Water Plan

Table 4. Historical and Projected Municipal and Industrial Water Demands Regional Water Planning Area G by Water Use Sector (1,000s of acre-feet per year, Brazos River Basin)

County	Metropolitan Statistical Area*	2020	Projected: 2030	Projected: 2040	Projected: 2050	Projected: 2060	Projected: 2070	Percent Change
Williamson	Austin	97.2	116.3	141.0	170.2	207.1	244.0	151.0%
Bell	Killeen-Temple	64.1	72.9	82.3	91.9	102.2	112.3	75.3%
Brazos	College Station	42.3	50.4	59.3	68.2	73.5	81.8	93.6%
McLennan	Waco	52.4	55.6	58.4	61.6	65.2	68.8	31.1%
Johnson	Dallas Fort Worth	26.9	30.4	34.5	39.4	44.7	50.3	86.7%
Taylor	Abilene	24.2	24.6	25.0	25.4	25.9	26.2	8.6%
Coryell	Killeen-Temple	14.6	16.0	17.6	19.1	20.8	22.5	53.8%
Robertson	College Station	3.5	3.6	3.6	3.8	3.9	4.0	16.2%
Bosque	Waco	3.6	3.7	3.7	3.6	3.7	3.8	5.3%
Burleson	College Station	3.0	3.3	3.4	3.5	3.5	3.6	18.4%
Falls	Waco	3.0	3.1	3.2	3.3	3.4	3.5	17.7%
Non MSA counties	na	71.7	75.5	78.3	81.3	84.3	87.0	85.45%
MSAs	na	334.8	379.7	431.9	489.9	553.8	620.8	21.27%
Total	na	406.5	455.2	510.2	571.3	638.0	707.8	74.13%

Source: Region G 2022 Regional Water Plan

Table 5. Historical and Projected Manufacturing Water Demands Regional Water Planning Area G by Water Use Sector (1,000s of acre-feet per year, Brazos River Basin)

County	2020	Projected: 2030	Projected: 2040	Projected: 2050	Projected: 2060	Projected: 2070	Percent Change
McLennan	4.79	7.46	7.46	7.46	7.46	7.46	55.6%
Johnson	1.58	1.87	1.87	1.87	1.87	1.87	18.7%
Brazos	1.77	1.78	1.78	1.78	1.78	1.78	0.6%
Williamson	0.81	0.96	0.96	0.96	0.96	0.96	18.6%
Bell	0.64	0.69	0.69	0.69	0.69	0.69	6.9%

Taylor	0.59	0.67	0.67	0.67	0.67	0.67	14.7%
Washington	0.58	0.58	0.58	0.58	0.58	0.58	1.0%
Nolan	0.45	0.53	0.53	0.53	0.53	0.53	17.9%
Limestone	0.32	0.38	0.38	0.38	0.38	0.38	17.4%
Grimes	0.33	0.33	0.33	0.33	0.33	0.33	0.0%
Lampasas	0.20	0.22	0.22	0.22	0.22	0.22	9.1%
Fisher	0.16	0.19	0.19	0.19	0.19	0.19	17.8%
Burleson	0.12	0.12	0.12	0.12	0.12	0.12	0.0%
Other	0.37	0.41	0.41	0.41	0.41	0.41	10.7%
Total	12.70	16.18	16.18	16.18	16.18	16.18	27.4%

Source: Region G 2022 Regional Water Plan

Table 6. Historical and Projected Mining Water Demands Regional Water Planning Area G by Water Use Sector (1,000s of acre-feet per year, Brazos River Basin)

County	2020	Projected: 2030	Projected: 2040	Projected: 2050	Projected: 2060	Projected: 2070	Percent Change
Robertson	9.91	11.75	12.00	12.00	12.00	12.00	18.6%
Limestone	10.32	9.93	9.87	10.34	10.81	11.43	-3.8%
Williamson	5.16	6.25	7.36	8.56	9.78	11.19	21.0%
Bell	3.24	3.98	4.60	5.35	6.11	6.97	22.8%
McLennan	2.54	3.00	3.06	3.51	3.83	4.22	18.2%
Stephens	5.06	5.14	4.46	3.83	3.26	2.77	1.5%
Hood	2.08	2.44	2.22	2.13	2.04	2.06	17.2%
Bosque	1.97	2.07	1.89	1.87	1.83	1.82	5.0%
Johnson	4.13	2.79	1.52	1.01	1.16	1.34	-32.4%
Somervell	1.11	1.28	1.15	1.06	1.00	0.97	15.0%
Brazos	1.09	1.61	1.43	1.14	0.92	0.81	48.0%
Hill	1.63	1.19	0.78	0.40	0.44	0.47	-27.2%
Other counties	13.34	10.68	6.08	5.05	4.14	3.50	-63.8%
Total	61.59	66.27	59.34	58.42	58.92	60.84	-1.2%

Source: Region G 2022 Regional Water Plan

Table 7. Historical and Projected Steam-electric Water Demands Regional Water Planning Area G by Water Use Sector (1,000s of acre-feet per year, Brazos River Basin)

County	2020	Projected: 2030	Projected: 2040	Projected: 2050	Projected: 2060	Projected: 2070	Percent Change
Robertson	4.71	4.71	4.71	4.71	4.71	4.71	0%
Limestone	2.88	2.88	2.88	2.88	2.88	2.88	0%
Williamson	0.42	0.42	0.42	0.42	0.42	0.42	0%
Bell	15.02	15.02	15.02	15.02	15.02	15.02	0%
McLennan	4.12	4.12	4.12	4.12	4.12	4.12	0%
Stephens	17.71	17.71	17.71	17.71	17.71	17.71	0%
Hood	1.92	1.92	1.92	1.92	1.92	1.92	0%
Bosque	22.94	22.94	22.94	22.94	22.94	22.94	0%
Johnson	13.52	13.52	13.52	13.52	13.52	13.52	0%
Somervell	32.25	32.25	32.25	32.25	32.25	32.25	0%
Brazos	0.50	0.50	0.50	0.50	0.50	0.50	0%

Hill	45.87	45.87	45.87	45.87	45.87	45.87	0%
Other	70.36	70.36	70.36	70.36	70.36	70.36	0%
Total							

Source: Region G 2022 Regional Water Plan

Water Needs

When existing water supplies—water that is already anticipated to be legally and physically available during a drought of record—are less than the projected water demands required to support regular economic and domestic activities, potential water shortages exist. These potential water shortages are referred to as identified water supply needs in Texas state and regional water planning. Given the rapid growth occurring in portions of the Brazos River Basin, particularly along the I-35 corridors regional water needs are substantial (Table 8). Municipal needs are expected to increase from about 65,000 acre-feet per annum in 2030 to 291,000 in 2070, a 345 percent increase.

Whitney reallocation offers a distinct approach to providing additional water storage because it can make a large, new surface water supply available from an existing reservoir in an upstream location along the Brazos River mainstem with minimal environmental impacts. What makes it exceptional is how this new supply can be accessed and utilized by the sponsor and its customers across the basin. The BRA is uniquely positioned to incorporate the TSP into its current suite of water rights because it already participates in the legal and regulatory (i.e. TCEQ) processes by which Texas surface water is made available for use, and it has a long-standing partnership with the USACE for water supply storage across the basin. Therefore, the BRA is the only entity that can ensure the most efficient use of this new M&I water supply by leveraging it to improve its water supply system's efficiency, distributing the costs of reallocation into its system water rate which in turn reduces costs to individual users, and making it available to a broad array of WUGs in the basin.

Table 8. Projected Water Supply Needs in Regional Water Planning Area G by Water Use Sector (1,000s of Acre-feet per year, Brazos River Basin)

Water Use Sector	Water Needs: 2030	Water Needs: 2040	Water Needs: 2050	Water Needs: 2060	Water Needs: 2070	Percent Change
Municipal	65.41	109.50	163.77	221.87	290.97	344.8%
Manufacturing	3.46	3.09	2.72	2.38	1.92	-44.6%
Steam-electric	72.82	72.91	73.01	73.10	73.20	0.5%
Mining	31.80	28.93	29.69	30.75	33.01	3.8%
Total	173.49	214.42	269.18	328.11	399.09	130.04%

Source: Region G 2022 Regional Water Plan

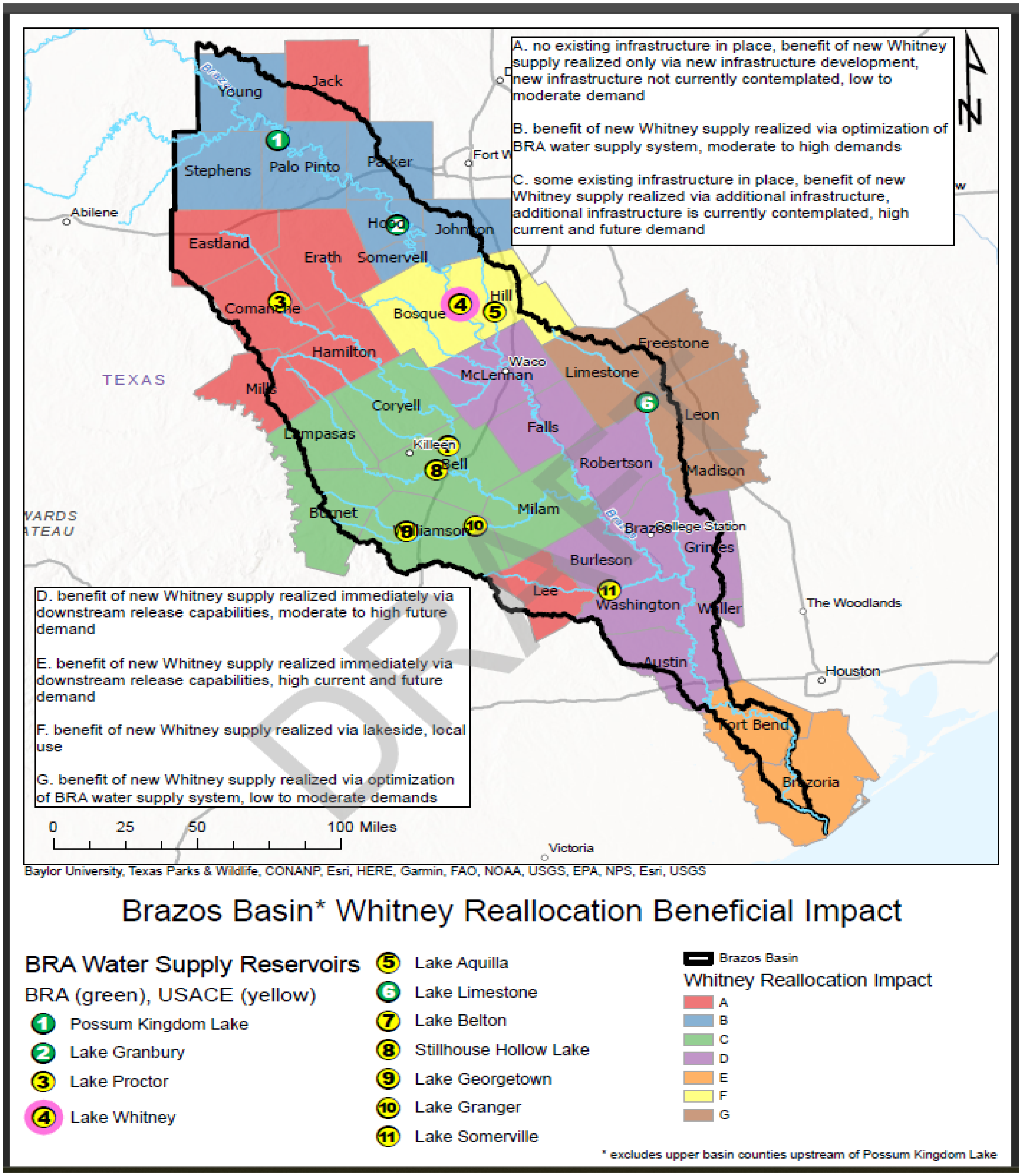

Figure 6. Counties that could Benefit from Reallocating Storage in Lake Whitney. Source: Brazos River Authority

Table 9. Counties that could Benefit from Reallocating Storage in Lake Whitney

County	2030	2040	2050	2060	2070	Percent Change	Potential Benefits of Reallocation
Bosque	2,352	2,194	2,187	2,189	2,225	-5%	Immediate lakeside local use
Hill	4,446	4,462	4,537	4,586	4,686	5%	
Total	6,798	6,656	6,724	6,775	6,911	2%	
Comanche	15,910	15,742	15,734	15,692	15,780	-1%	Require new infrastructure not under development Immediate use via downstream releases
Eastland	930	686	471	275	189	-80%	
Erath	13	7	8	156	355	2631%	
Hamilton	12	14	16	19	21	75%	
Lee	176	13	13	11	12	-93%	
Total	17,041	16,462	16,242	16,153	16,357	-4%	
Brazoria	30,230	34,856	40,217	46,362	53,376	77%	Immediate use via downstream releases
Fort Bend	65229	81,186	94,382	109,017	123,598	89%	
Limestone	8,146	8,076	8,555	9,071	9,832	21%	
Total	103,605	124,118	143,154	164,450	186,806	80%	
McLennan	7,009	7,559	8,554	9,632	13,303	90%	Immediate use via downstream releases
Robertson	16,338	17,335	18,050	18,262	18,502	13%	
Washington	1,986	2,033	2,107	2,147	2,212	11%	
Falls	148	161	188	209	233	57%	
Grimes	563	432	301	186	151	-73%	
Brazos	5,388	13,452	21,470	25,702	33,389	520%	
Burleson	372	387	385	383	393	6%	
Total	31,804	41,359	51,055	56,521	68,183	114%	
Bell	7,840	12,353	18,118	24,117	31,530	302%	Some existing infrastructure in place, but would require some new infrastructure that is currently under consideration and in the planning stage
Coryell	3,105	3,686	4,665	6,025	8,885	186%	
Lampasas	1,185	1,443	1,725	2,009	2,347	98%	
Milam	32,795	33,335	33,062	33,086	33,215	1%	
Williamson	40,898	64,229	92,921	129,522	166,289	307%	
Total	85,823	115,046	150,491	194,759	242,266	182%	
Young	2,277	2,389	2,567	2,761	2,979	31%	Immediate realization via system optimization
Somervell	36,175	36,216	36,292	36,388	36,509	1%	
Stephens	3,680	2,997	2,367	1,800	1,316	-64%	
Hood	2,220	2,691	3,160	3,753	5,146	132%	
Johnson	4,252	5,877	9,866	15,113	20,597	384%	
Palo Pinto	4,119	4,118	4,212	4,300	4,423	7%	
Total	52,723	54,288	58,464	64,115	70,970	35%	

Source: Brazos River Authority and 2022 Brazos G Regional Water Plan

Consideration of Water Efficiency

Demands developed by the TWDB and reviewed and incorporated into regional water plans consider passive water efficiency (i.e., conservation), Over the last few decades, water fixtures and appliances have become more efficient, and this trend should continue. As efficiency increases in coming decades, both passively through the construction of new buildings and natural replacement of aging fixtures, there will likely some reductions in water use as older building are phased out.

In general, USACE planning guidance suggests assessing the potential for water efficiency as a viable alternative in the plan formulation process. Although water efficiency is generally not suitable as a standalone measure in addressing future water needs in high growth areas, in can be part of a combined plan if conditions warrant, particularly if GPDC is high relative to other water supply systems.

Water efficiency is a major element of state and regional water planning in Texas and is incorporated as “water management strategies” in regional water plans to reduce future water needs. In fact, conservation is considered first as a water management strategy for all entities with identified needs before any other water supply management strategies. The 2022 Brazos G Regional Water Plan recommended 103,439 acre-feet per year of municipal conservation savings and another 38,315 acre-feet per year for wastewater reuse. Conservation savings are in addition of those already included in demand projections to account for passive water conservation. Efficiency savings for municipal users in Region G reflected a 1 percent annual reduction in per capita consumption to meet a target of 140 gallons per capita per day (GPCD). Efficiency recommendations for several entities in Williamson County (Austin MSA) are more aggressive and call for a reduction to a target 120 GPCD by 2070.

Consideration of Risk and Uncertainty for Water Supply and Demand

Risk and uncertainty are important considerations in any planning study. Water supply and other large infrastructure projects generally involve long periods of analysis given that alternatives to address associated problems and opportunities are difficult and costly to plan and build. Given the long period of analysis, uncertainty is an important factor in developing water use forecasts.

Uncertainty includes knowledge uncertainty (i.e., unknown non-random factors that will influence water use in the future), and natural variability that involves random influences on future water use. Risk measures the potential impacts or outcomes of uncertainty in light of consequences and the likelihood of a consequence happening. Risks associated with uncertainty involve over or underestimating future water use, which could affect the planning decision in terms of how much water is required in the near term and over the long term. The assumption of different growth rates addresses some uncertainty regarding the number of future customers and economic conditions. Other factors adding uncertainty are changing climate conditions and future water use efficiency. In 2016, the Water Research Foundation sponsored a study that ranked major sources of risk and uncertainty as specified by managers and technical staff at public water supply providers throughout the nation. Unsurprisingly, the largest sources of uncertainty identified are future population and number of customers followed by climate instability and the economy. Future water efficiency and water use behavior were also identified by many respondents.

Table 10. Sources of Uncertainty Related Future Water Use as Identified by Public Water Suppliers in the United States.

Source of Uncertainty	Percent of Respondents
Future Population or Number of Customers	59%
Climate Instability	47%
Future Economic Conditions	41%
Irrigation and Outdoor Water Use Behaviors	40%
Future Water Efficiency Technologies	28%
Characteristics of Individual Large Customers	22%
Future Regulations or Legislation regarding Water Use	18%
Other (please specify)	16%
Cumulative Effects of Existing Plumbing Standards	15%
Potential Need to Serve Neighboring Communities	12%

Source: Kiefer, J.C., Yoe, C., Clayton, J.M., and Leonard, J.C. "Uncertainty in Long-term Water Demand Forecasts: A Primer on Concepts and Review of Water Industry Practices." Water Research Foundation. 2016.

Future levels of economic activity and population along with climate instability are the key sources of uncertainty. Future variation in service populations and economic development are reflected in different future water use scenarios (i.e., high, medium and low growth) as described previously potential impacts of future changing climate conditions are also uncertain; however, a major study sponsored by the Water Research Foundation estimated potential climate impacts to six major regional water supplies; three from more arid westerns states including Colorado, Nevada, and Southern California and three much more humid and wetter area including Ontario (Canada), Florida and Massachusetts. Data in Table 10 show a clear pattern. Scientists estimate that a changing climate will have greater impacts on temperature and precipitation, and thus water use, in the western half of North America than the eastern half. Change in average estimated demand for the three eastern utilities ranges from 1.2 percent to 5.3 percent, and for the western utilities 3.5 percent to 23.2 percent. In the 2090 scenario, change in demand for eastern suppliers ranges from 2.0 to 9.9 percent and 5.2 to 45.0 percent for western utilities. Impact to Texas were not explicitly identified in the study, but results suggest that demands could be substantially higher in long-term.

Table 11. Estimated Change in Average Annual Water Use for Selected Water Supply Systems due to Climate Instability (2055 and 2090)

Utility	Change in Avg Estimated Demand (2055) Minimum	Change in Avg Estimated Demand (2055) Maximum	Change in Avg Estimated Demand (2090) Minimum	Change in Avg Estimated Demand (2090) Maximum
Colorado Springs Utilities (Colorado)	5.9%	23.2%	7.7%	45.0%
Durham Region (Ontario Canada)	1.6%	4.3%	2.0%	8.3%
Massachusetts Water Regional Authority	1.7%	5.0%	2.5%	9.1%
Southern Nevada Regional Authority	3.9%	9,4%	5.2%	15.5%
San Diego County (California)	3.5%	12.7%	9.2%	23.7%
Tampa Bay Water (Florida)	1.2%	5.3%	2.1%	9.9%

Source: Kiefer, J.C., Clayton, J.M., Dziegielewski, B., and Henderson, J. "Changes in Water Use Under Regional Climate Change Scenarios." Water Research Foundation. 2018.

3. Plan Formulation and Evaluation

Plan formulation and evaluation of alternatives for this study were conducted in accordance with the Corps Planning Guidance Notebook (Engineer Regulation 1105-2-100) and the Corps' Water Supply Handbook. In addition, the Policy for Conducting Civil Works Planning Studies (ER 1105-2-103) was followed.

Based on guidance and policy, USACE has a well-defined six-step process used to identify and respond to problems and opportunities associated with federal water resources planning objectives, and specific state and local concerns:

1) Identify problems and opportunities (Chapter 1)
2) Inventory and forecast conditions (Chapter 2)
3) Formulate alternative plans (Chapter 3)
4) Evaluate alternative plans (Chapter 3)
5) Compare alternative plans (Chapter 3)
6) Select recommended plan (Chapter 5)

The remainder of this section describes each step of the process as it applies to this study.

3.1. Planning Framework

The Whitney Lake Reallocation Study created a unique situation for a USACE water supply study. Historically, a non-federal sponsor will request a specific volume of storage and then USACE develops alternatives centered on the requested storage volume. The requested storage volume relates to the immediate need of the project sponsor for water supply storage. As described in Section 2, the Brazos River Authority (BRA) manages water on a regional scale and the immediate and future need for water supply is so great in the region that a reallocation from Whitney Lake and Dam will not fully meet their needs. A reallocation from Whitney Lake and Dam is still important though as this water could readily be used with other BRA infrastructure to help optimize the system as a whole. Lake Whitney's location within the basin is a prime spot to provide BRA with multiple options to distribute water on a regional scale. BRA estimates that upwards of 30 counties within the region could benefit from additional water supply from Whitney Lake and Dam.

Therefore, the USACE PDT developed alternatives based on a range of potential storage volumes, rather than a requested storage volume. The team focused on developing alternatives that the sponsor could support and that would minimize impacts to other authorized purposes.

3.2. Assumptions

Key assumptions made during the plan formulation include:

- Hydropower use today will be the same in the future. This means that Whitney Lake and Dam is assumed to operate mainly for spinning reserves.
- The hydropower load dataset is a key component of the reservoir simulation (Riverware) analysis. The dataset is assumed to be the most accurate information about hydropower operations currently available.
- USACE's Hydroelectric Design Center analysis on turbine operations is the best available information at this point and is sufficient for the purposes of this study. It is assumed that the Whitney Lake and Dam turbines can operate at an elevation of 512 ft.

3.3. Management Measures

Alternatives are features, actions and/or activities that addresses the study problems and objectives, while avoiding constraints and taking advantage of opportunities. They are generally comprised of structural and nonstructural measures. Measures are the building blocks of alternatives. In this study, structural measures and alternatives are physical features and modifications to the dam, spillway, and appurtenant facilities that address the future water supply needs of the region, such as a new reservoir. Nonstructural measures and alternatives are actions and activities that address future water supply needs without physical additions or modifications to the dam, spillway, and appurtenant facilities, such as the reallocation of water storage and water conservation. The following structural and nonstructural measures were identified in coordination with the NFS:

Construct a single purpose reservoir (structural) – The measure involves the NFS constructing a new reservoir to create a new water source to meet demand without Federal government involvement. This reservoir would be located upstream of the Possum Kingdom reservoir. The cost of construction for this measure was based on a 65,000 acre-feet reservoir as developed as one of the mitigation measures in the 2016 Brazos G Regional Water Plan.

Ground water development (structural) – Ground water development would look like developing a series of wells to access water contained in an aquifer or fractured rock. A pipe and pump would be used to pull water out of the ground, and a screen filters out unwanted particles that could clog the pipe. This measure could be accomplished without involvement of the Federal government.

Water supply from another existing reservoir (structural) – This measure involves the conveyance of water from one reservoir to another through the construction of pipes and pumping infrastructure. This measure could be accomplished without Federal government involvement.

Dredge Whitney Lake (structural) – The measure involves USACE removing material at the lake bottom from the Whitney Reservoir to increase its overall storage. The additional storage would then be passed onto the NFS to meet future demand. These dredged materials from the lake bottom would be placed in an environmentally acceptable disposal site.

Raise Whitney Dam height (structural) – This measure involves USACE raising the existing Whitney Dam to increase overall storage volume of the project. The additional storage would then be passed onto the NFS to meet future demand. Adjustment to Whitney Dam appurtenant facilities may also be required.

Flood storage reallocation (nonstructural) – This measure involves the USACE reassigning existing water storage from the Whitney Lake flood pool to water supply, which can then be used to meet future needs.

Conservation pool storage reallocation (nonstructural) – This measure involves the USACE reassigning existing water storage at Whitney Lake to water supply, which can then be used to meet future needs.

Sedimentation/inactive storage reallocation (non-structural) – This measure involves the USACE reassigning existing water storage at Whitney Lake from the inactive pool to water supply. The additional supply is then used for future demand.

Water conservation/reduce system losses (non-structural) – This measure involves the practice of using water efficiently to reduce unnecessary water usage. It is currently used by the NFS as an initial step in reducing overall demand for water supply. Examples of this measure include conservation pricing, leak detection and education programs.

Change in dam operations (non-structural) – The measure involves the USACE changing Whitney Lake project operations to increase overall water supply. There are no physical changes to the dam or spillway.

Wholesale water supply purchase (non-structural) – This measure involves the purchase of water supply from another utility. The NFS can accomplish it without involvement from the Federal government.

3.3.1. Measure Evaluation

Measures were evaluated qualitatively against the study objective and other preliminary criteria, including if the NFS was already pursing the action, effectiveness, and would the measure meet the study objectives. Existing information and best professional judgement were used to evaluate the cost efficiency criterion. Each measure was compared and then assigned a favorable or unfavorable qualitative rating. Evaluation of the measures determined that several were already being pursued by the NFS (constructing a single purpose reservoir, water supply from an existing reservoir, water conservation, reducing system losses, and wholesale purchases). Those measures were not carried forward. Raising the dam height, dredging the lake, and changing dam operations would not meet the study objectives of reducing the risk of water shortages in the region and therefore were not carried forward since the measures would need to be combined with a reallocation. In addition, raising the dam height would require essentially rebuilding the dam and would likely be cost prohibitive and environmentally-damaging. Changing dam operations may be able to provide additional water through downstream releases, but without an accompany reallocation, it would likely not be consistent. Dredging the lake could create more storage volume, but sedimentation rates have been lower than expected at Whitney Lake and Dam, so the area would be minimal. Groundwater development was deemed not cost effective based on the volume required and was not carried forward. Table 12 shows the results of the measures evaluation.

Table 12. Measures evaluation

	Meet objectives (Y/N)	**Is the sponsor already pursuing? (Y/N)**	**Likely to be cost effective (Y/N)**	**Carried forward (Y/N)**
Construct a single purpose reservoir	Y	Y	-	No
Groundwater development	Y	N	N	No
Water supply from another existing reservoir	Y	Y	-	No
Dredge the lake	N	-	-	No
Raise the dam height	N	-	-	No
Reallocate from the flood pool	Y	N	Y	**Yes**
Reallocate from the conservation pool	Y	N	Y	**Yes**
Reallocate from the powerhead reserve/inactive pool	Y	N	Y	**Yes**

Water conservation	Y	Y	-	No
Reduce system losses	Y	Y	-	No
Change in dam operations	N	-	-	No
Wholesale purchases	Y	Y	-	No

3.4. Preliminary Array of Alternatives and Evaluation

Preliminary alternatives focused on scaling three specific measures. This was manipulating the elevation of the top of the conservation pool (changing elevation 533 ft), manipulating the bottom of the conservation pool at elevation 520 ft (reallocation from powerhead reserve/inactive) and manipulating the proportion of storage between the authorized users of water supply and hydropower between elevation 520 ft and 533 ft.

A ”no action” alternative, designated as Alternative 1, was also developed to serve as a baseline of comparison for the other alternatives under NEPA. This no action alternative was generally defined as a continuation of the existing operations for Whitney Lake and Dam, included scheduled water releases from the dam. Alternative 1 is considered the Future Without Project Condition under NEPA.

Alternative 2 focused on manipulating the proportion of storage between elevation 520 ft and 533 ft. A series of alternatives were developed examining different scales. These include:

Alternative 2 – Storage between elevation 520 ft and 533 ft is divided 67% water supply and 33% hydropower

Alternative 2a – Storge between elevation 520 ft and 533 ft is divided 50/50 between water supply and hydropower

Alternative 2b – Storage between elevation 520 ft and 533 ft is divided 33% water supply and 67% hydropower. This alternative was dropped prior to Riverware modeling since it would likely not provide sufficient water supply storage to meet the study’s objective.

Alternative 2c – Storage between elevation 520 ft and 533 ft is divided 37.5% water supply and 62.5% hydropower. This alternative was developed to be highly sensitive to the hydropower load dataset which is a key Riverware input. This alternative ensures that the account for hydropower does not fully empty during the period of record analysis. It was developed later in the alternative formulation process after initial Riverware runs.

Alternative 3 – Raise the conservation pool 3ft from 533 ft to 536ft. This alternative was developed to provide a similar storage volume as Alternative 2a. Hydropower storage would remain the same and the additional storage from the flood pool reallocation would be allocated to water supply.

Alternative 4 – This alternative examined the viability of providing hydropower and water supply storage below elevation 520 ft. Currently the storage below 520 ft is used for powerhead reserve (water so the turbines can operate) and sedimentation storage.

Alternative 5: This alternative is a combination of alternative 2a plus raising the flood pool an additional 1.5 ft.

Alternative 6: This alternative is a combination of alternative 2a plus lowering the turbine operating elevation. This alternative went through several iterations for the lowering of the conservation pool element. A series of elevations were examined ranging from 510 ft to 520ft. Significant coordination with the Hydroelectric Design Center took place and the development of this alternative is discussed in more detail in Section 5.2. More information about the various iterations for alternative 6 are provided in the paragraph below.

Lowering the conservation pool refinements

Several refinements to optimize the scale of lowering the conservation pool occurred concurrently during the preliminary screening and analysis of the final array of alternatives. Typically, water at Whitney Lake and Dam is released through the turbines for any type of needed water release (releases required for flood pool control, hydropower, or water supply). There is an option to use the sluice gates for non-hydropower releases, but these are used very infrequently such as in instances of extreme flood events.

Operating the Whitney Lake and Dam turbines at a lower operating elevation was thoroughly discussed within the PDT and with the USACE Hydroelectric Design Center (See Appendix D.1 for the Hydroelectric Design Center's analysis of turbine operation). Ultimately, elevations between 510 ft and 520 ft were explored. Initially, lowering the conservation pool was model at an elevation of 518.4 ft (Alternative 4). Through additional analysis between BRA and the USACE Hydroelectric Design Center this element was refined to an elevation of 512 ft and used as part of Alternative 6.

Preliminary Screening

Each alternative was initially screened based on the study objective. Consideration was also given as to how well each alternative measured against the four USACE Planning Guidance Notebook (PGN) planning criteria (acceptability, completeness, effectiveness, and efficiency).

Table 13 presents the evaluation. The "no action" alternative did not meet the study objective. All other action alternatives met the study objective. In terms of the four PGN criteria, all action alternatives in the final array were evaluated as "acceptable" and "complete". Alternative 3 and 5 were considered "maybes" for effectiveness and efficiency due to the unknown costs associated with modifications to Whitney Dam. In addition to the PGN criteria, the PDT qualitatively assessed the preliminary alternatives based on likely impacts to other authorized purposes, the potential impacts to dam/life safety, and likelihood of environmental impacts. Alternatives 2, 2a, 2c, 4, and 6 were not anticipated to have negative impacts to the criterion so were carried forward to the final array. Alternative 3 and 5 were anticipated to have some impact to dam safety and environmental impact, but the PDT decided to carry these alternatives forward for detailed analysis in order to make a decision based on quantitative data.

Table 13. Screening of Preliminary Alternatives

	Alt 1	**Alt 2 -**	**Alt 2a**	**Alt 2C**	**Alt 3**	**Alt 4**	**Alt 5**	**Alt 6**
	NAA/FWOP	Conservation pool: 2/3 water supply and 1/3 hydropower	Conservation pool: 50/50	Conservation Pool: Energy focus	Flood Pool: Increase 3ft	Conservation pool: decrease 1.6 ft	Combo: Conservation (50/50) and Flood increase 1.5ft	Combo: Cons conservation (50/50) and lower conservation pool 8 ft
Study Objective	Alternative does not meet the objectives of the study.	Alternative meets the study objective.	Alternative meets the study objective.	Alternative meets the study objective.	Alternative meets the study objective.	Alternative meets the study objective.	Alternative meets the study objective.	Alternative meets the study objective.
Acceptability	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Completeness	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Effectiveness	No	Yes	Yes	Yes	Maybe	Yes	Maybe	Yes
Efficiency	No	Yes	Yes	Yes	Maybe	Yes	Maybe	Yes
Impact to other authorized purposes	No	Not likely	Not likely	Not likely	Maybe	Not likely	Maybe	Maybe
Dam/Life Safety	No	No	No	No	Maybe	No	Maybe	No
Environmental Impacts	No	Not likely	Not likely	Not likely	Maybe	No	Maybe	Not likely
Carried Forward to final array ?	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**

3.5. Final Array of Alternatives

Six preliminary action alternatives were carried forward into the final array and evaluated. Each alternative was evaluated based on the study objective, the PGN Criteria, their overall cost, and benefits (i.e., Comprehensive Benefits Analysis). The results of the alternative analysis is presented in Table 38 and Table 39 (Section 5). All action alternatives, if implemented, would require revisions to the Whitney Lake and Dam Water Control Manual.

3.5.1. Alternative 1 - No Action Alternative or Future Without Project

The No Action Alternative represents the current and expected conditions and reservoir operations at Whitney Lake and Dam as reflected in the current Water Control Manual. Currently, water supply is allocated 22% of the storage between elevation 520 ft and 533 ft while hydropower is allocated 78% of the storage space as specified in the Whitney Lake and Dam Water Control Manual. Figure 7 presents a conceptual image of the No Action Alternative.

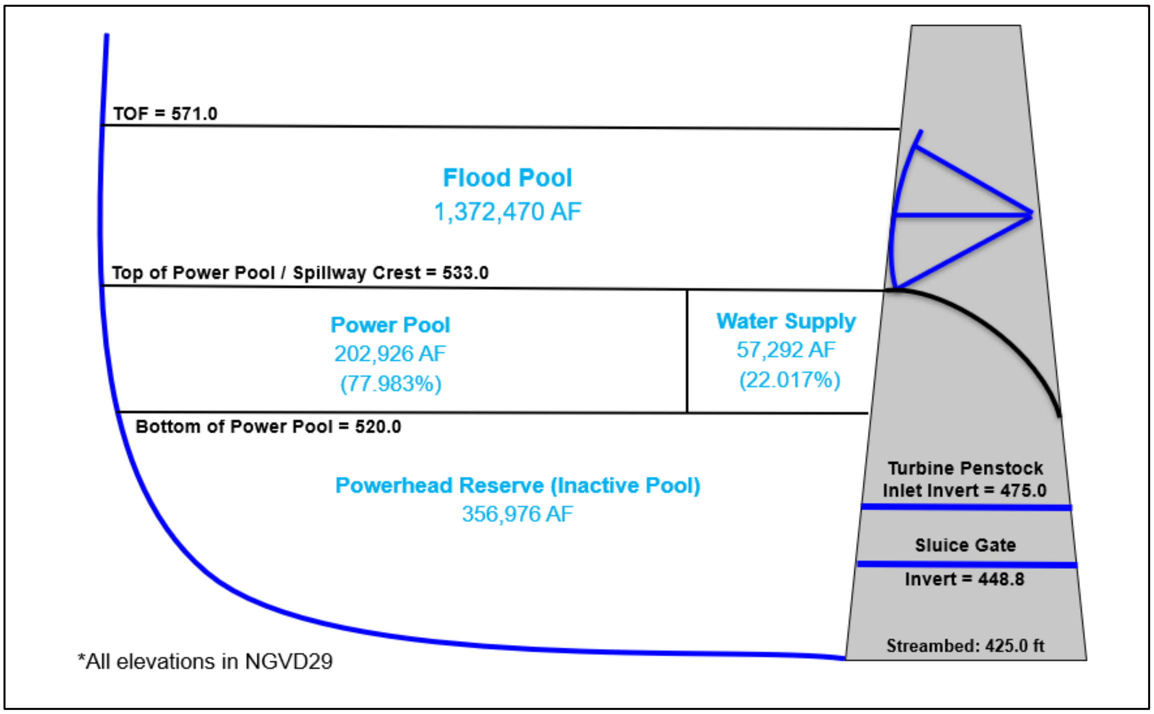

Figure 7. Alternative 1 - No Action Alternative

3.5.2. Alternative 2 – Conservation Pool (67% Water Supply and 33% Hydropower)

Alternative 2 would allocate 67% of the storage to water supply between elevation 520 ft to 533 ft while hydropower would be allocated 33% of the storage. Figure 8 presents a conceptual image of Alternative 2.

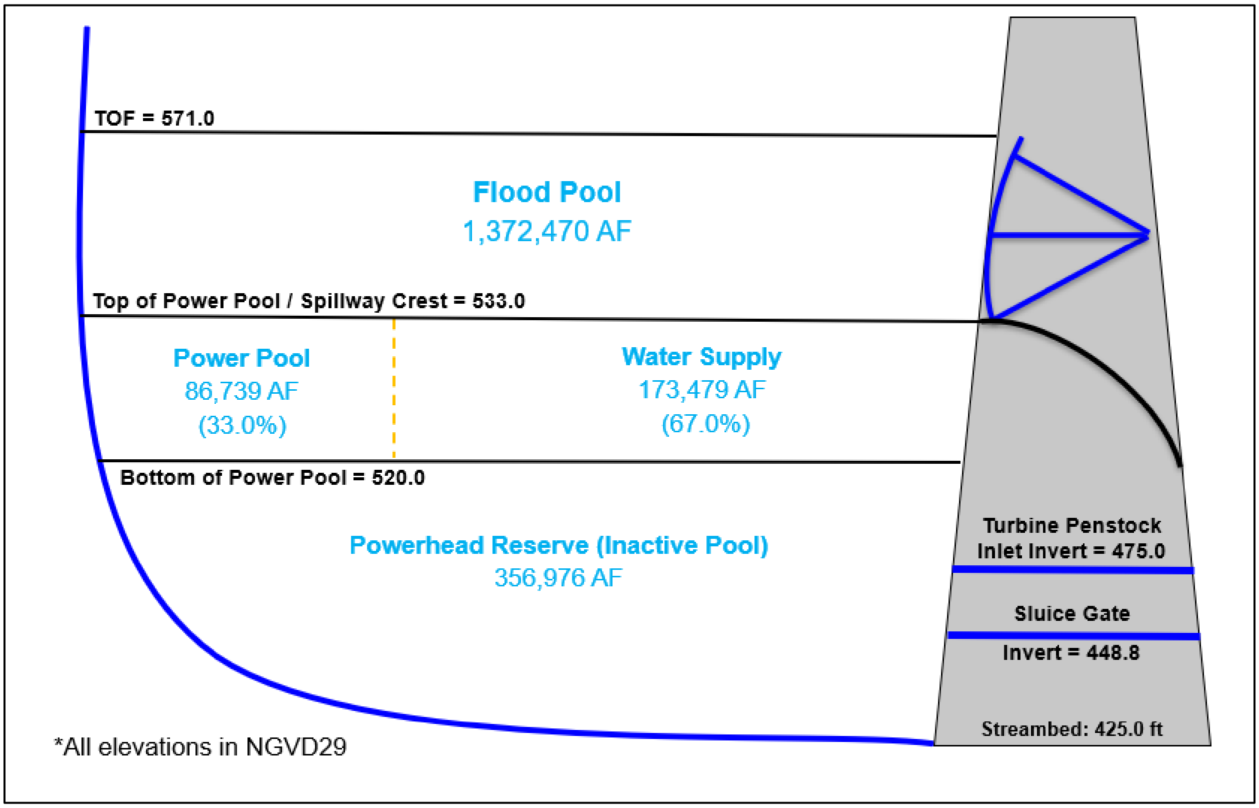

Figure 8. Alternative 2 - 67% Water Supply and 33% Hydropower

3.5.3. Alternative 2a – Conservation Pool (50% Water Supply and 50% Hydropower)

Alternative 2a would evenly split the storage (50/50) from elevation 520 ft to 533 ft between water supply and hydropower. Figure 9 presents a conceptual image of Alternative 2a.

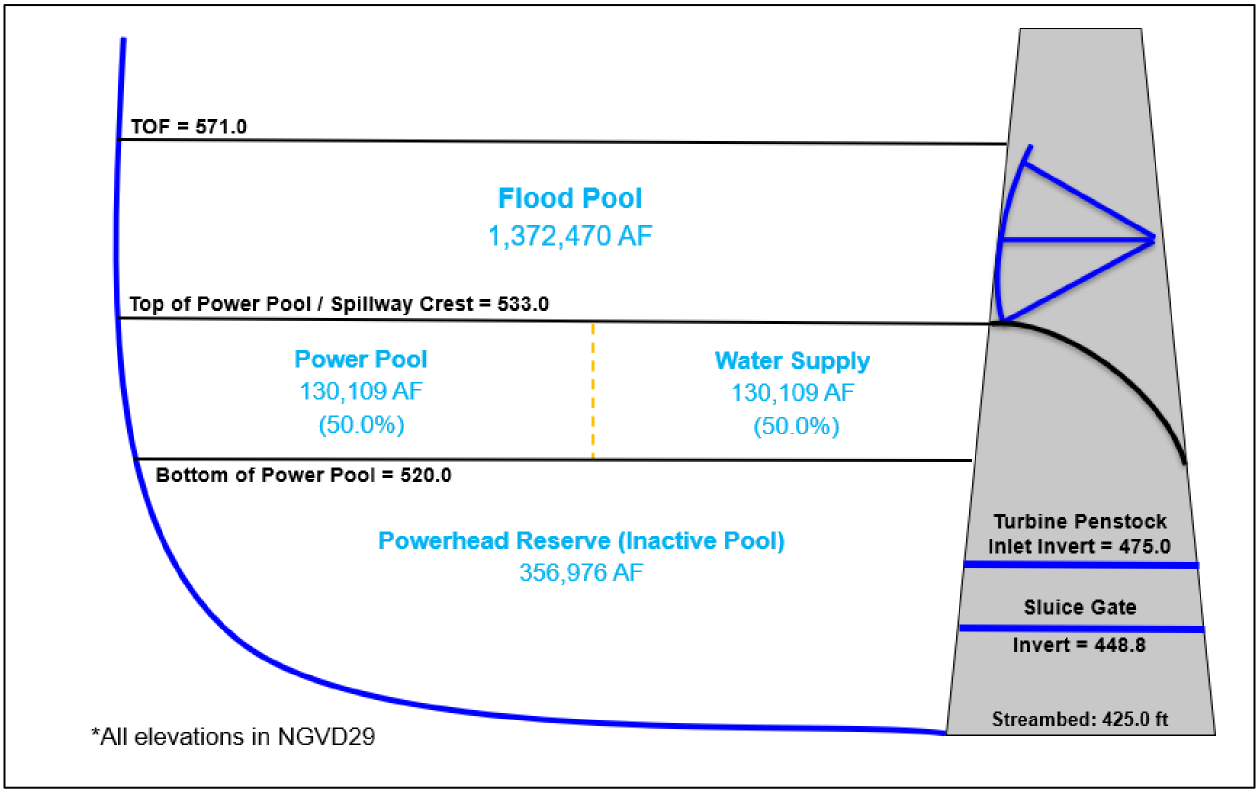

Figure 9. Alternative 2a – 50% Water Supply and 50% Hydropower

3.5.4. Alternative 2c – Conservation Pool (Energy Focus)

Alternative 2c is highly dependent on a hydropower load dataset which the USACE received from SWPA. Percentages were determined based on when the hydropower storage account would almost empty. The intent of this alternative was to ensure SWPA's storage account would not run out of water during the period of record analysis. In alternative 3, water supply is allocated 34% of the storage space between elevation 520 ft and 533 ft while hydropower is allocated 66% of the storage. Figure 10 illustrates a conceptual image of Alternative 2c.

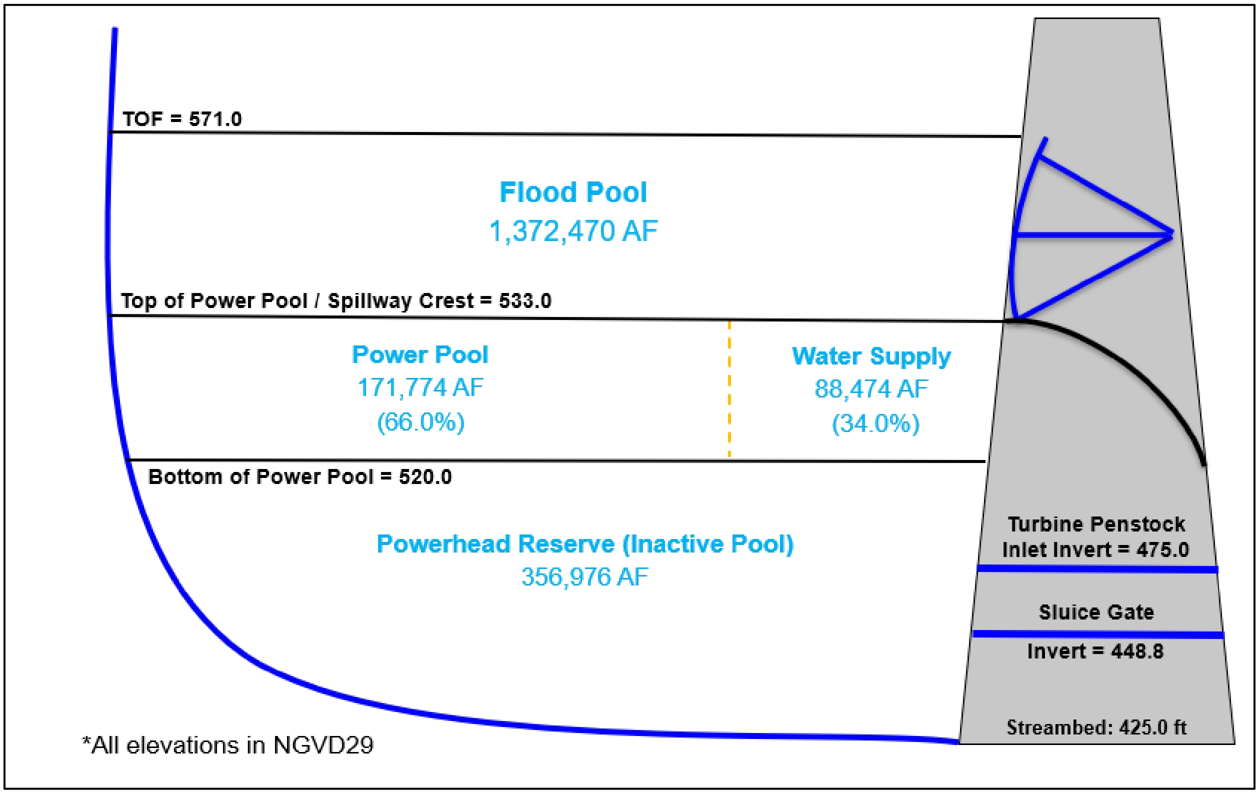

Figure 10. Alternative 2c – Energy Focus

3.5.5. Alternative 3 – Flood Pool (increase top of conservation 3ft)

For this alternative, the top of the conservation pool is increased from an elevation of 533 ft to an elevation of 536 ft. The additional storage is allocated to water supply. Water supply would be allocated 39% of the storage between elevation 520 ft to 536 ft and hydropower would be allocated 61%. Figure 11 shows a conceptual image of Alternative 3.

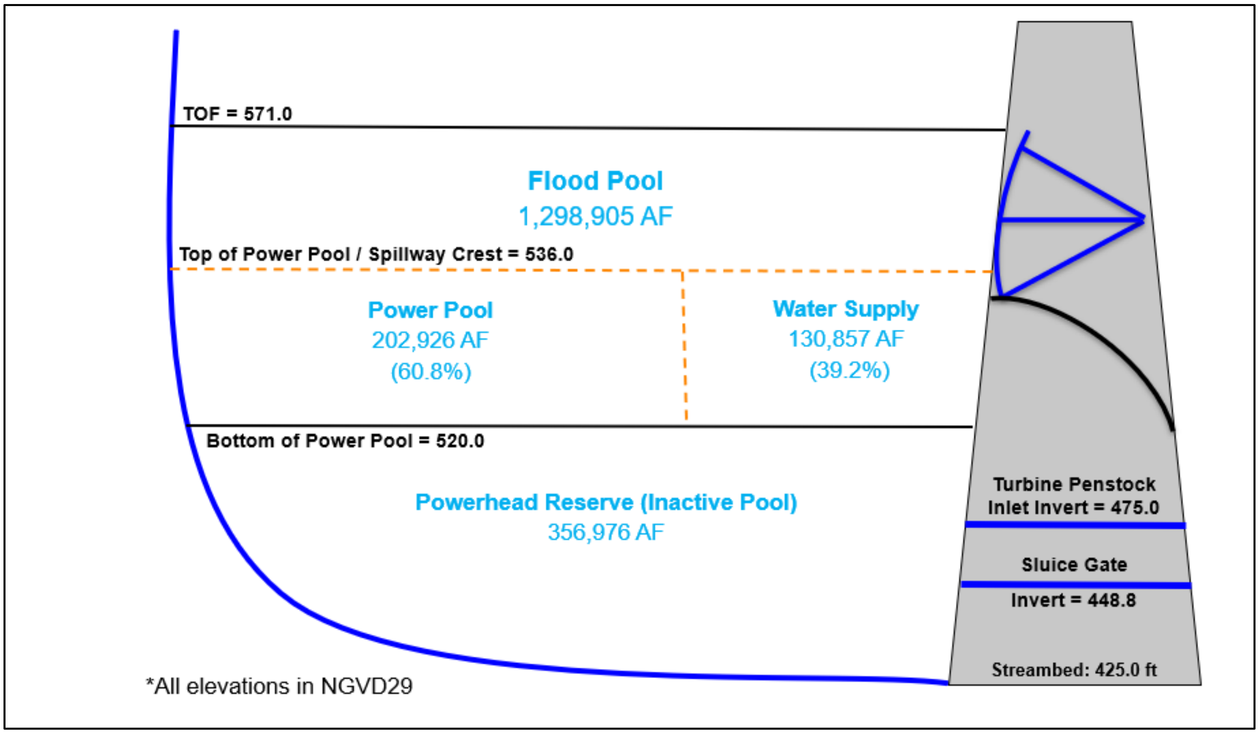

Figure 11. Alternative 3 – Increase the top of the conservation pool by 3ft

3.5.6. Alternative 4 – Powerhead Reserve/Inactive Pool (Decrease the bottom of the conservation pool from 520 ft to 518.4 ft)

Alternative 4 lowers the conservation pool from an elevation of 520 ft to 518.4 ft and allocates the additional storage to water supply and hydropower. Between elevation 518.4 ft and 533 ft BRA would be allocated 29% of the storage while hydropower would be allocated 71%. Figure 12 provides a conceptual image of Alternative 4.

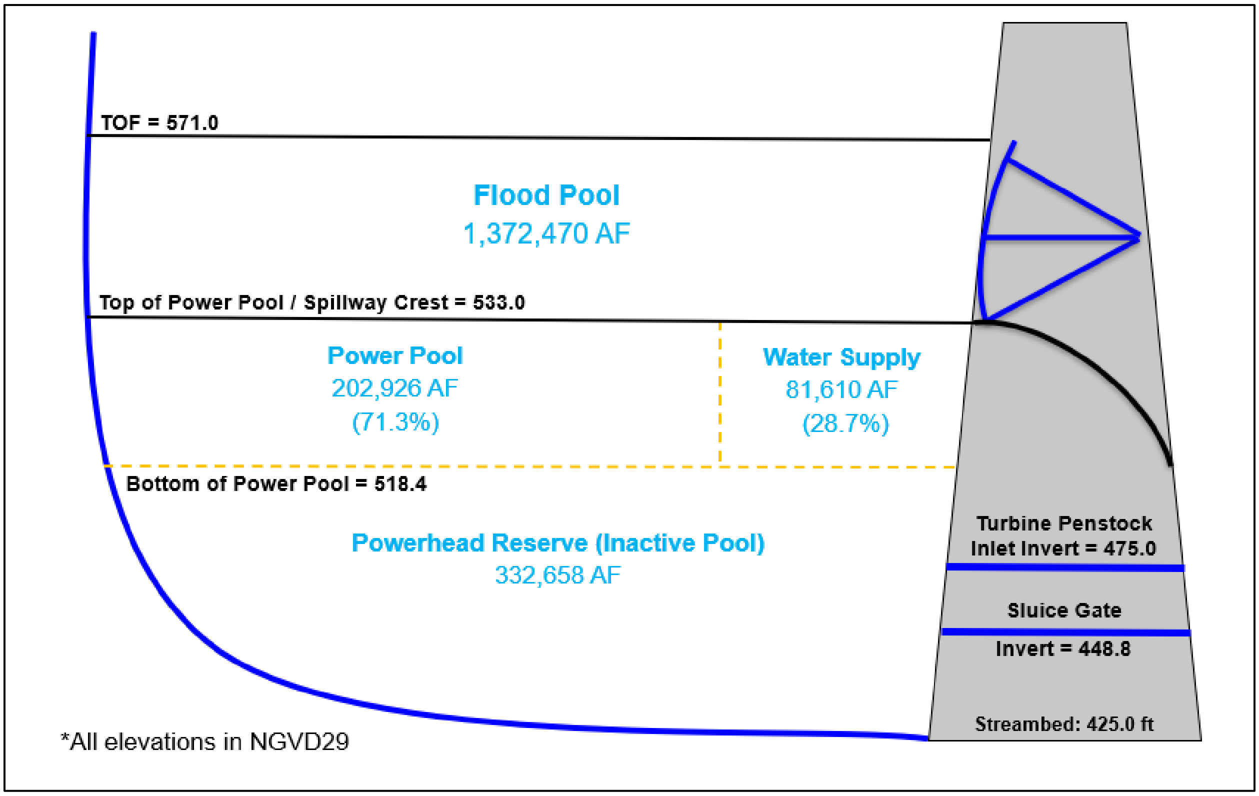

Figure 12. Alternative 4 – Decrease the upper conservation pool from 520 ft to 518.4 ft

3.5.7. Alternative 5 - Combination (Conservation Pool and Flood Pool)

Alternative 5 would equally divide the storage between elevation 520 ft and 533 ft between water supply and hydropower. The conservation pool would then be raised from 533 ft to 534.5 ft and the additional storage allocated to water supply. In total, water supply would be allocated 56% of the storage from elevation 520 – 534.5 ft and hydropower would be allocated 44%. Figure 13 provides a conceptual image of Alternative 5.

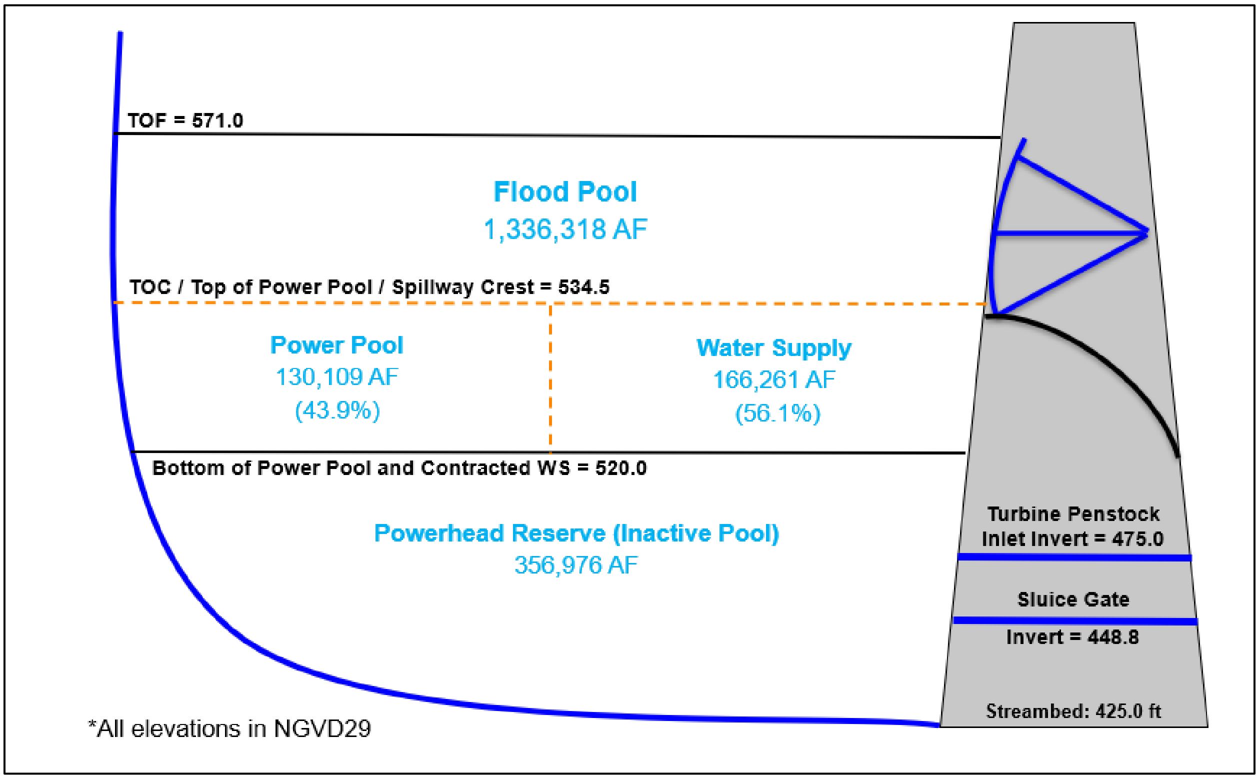

Figure 13. Alternative 5 - Conservation Pool and Flood Pool

3.5.8. Alternative 6 – Combination (Conservation Pool and Powerhead Reserve/Inactive Pool)

Alternative 6 would evenly split the storage (50/50) from elevation 520 ft to 533 ft between water supply and hydropower. In addition, the alternative would lower the conservation pool from an elevation of 520 ft to 512 ft. The additional storage would be allocated to water supply. Figure provides a conceptual image of Alternative 6.

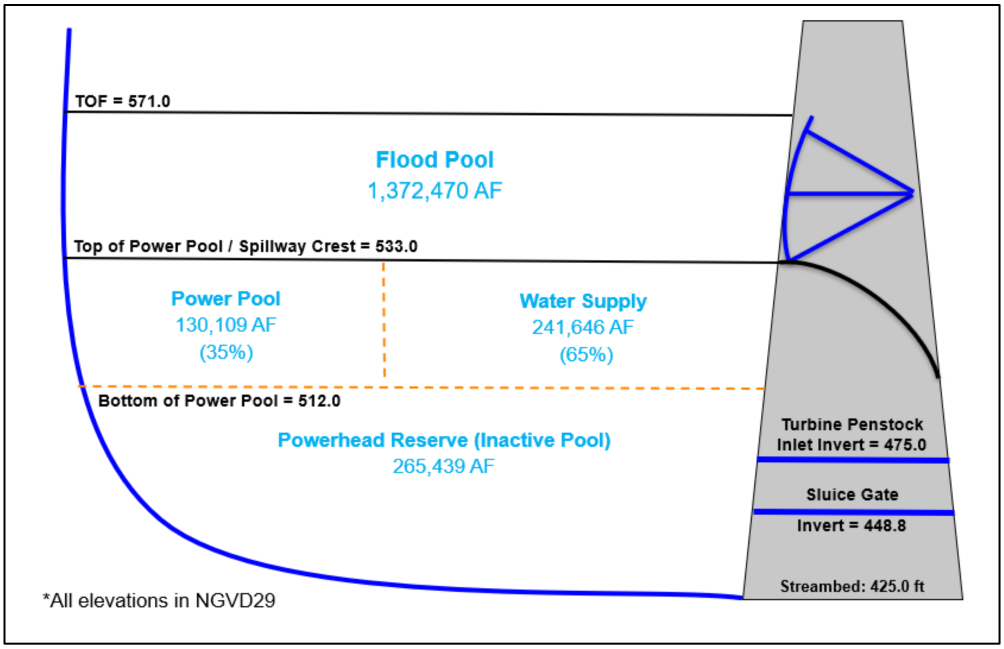

Figure 14. Alternative 6 - Conservation Pool and Powerhead Reserve/Inactive Pool

3.5.9. Next Least Cost Alternative

A test of financial feasibility must be performed to demonstrate that reallocation of storage is the most efficient water supply alternative. The test of financial feasibility would be for the non-Federal Action most likely to be taken in lieu of a federal action that produces a similar quantity and quality of water as the tentatively selected plan. For the purposes of the Whitney Lake Reallocation study, this would be Alternative 7 – construction of a new reservoir upstream of Whitney Lake and Dam. This alternative will be used for comparison purposes in the test of financial feasibility (Section 5.6) but is otherwise not further evaluated because of its high costs and environmental impacts.

Alternative 7 would be constructing South Bend Reservoir in Young and Stephens Counties, as proposed in the 2016 Brazos G Regional Water Plan (TWDB 2016). The proposed dam was depicted as being in Young County immediately downstream from the confluence of the main stem Brazos River and the Clear Fork of the Brazos River. The reservoir, as planned, would capture flow from both streams, with an estimated capacity of up to 771,604 acre-feet from the 13,168 square mile drainage area. The dam would be an earth fill embankment that would extend approximately 2.8 miles across the Brazos River at an elevation of 1,090 ft-msl and inundate approximately 29,900 surface acres.

4. Affected Environment and Environmental Consequences

This chapter discusses the existing conditions in the project area, referred to as the affected environment, and the probable environmental consequences or impacts of a water supply storage reallocation on Whitney Lake and Dam resources. The affected environment is the baseline against which potential impacts caused by the proposed alternatives are assessed. As described above in Section 3.5 Final Array of Alternatives, USACE is analyzing the following eight alternatives:

- Alternative 1 – No Action Alternative or Future Without Project
- Alternative 2 – Conservation Pool (67% water supply and 33% hydropower)
- Alternative 2a – Conservation Pool (50% water supply and 50% hydropower)
- Alternative 2c – Conservation Pool (energy focus)
- Alternative 3 – Flood Pool (Increase top of conservation pool 3ft)
- Alternative 4 - Powerhead Reserve/Inactive Pool (decrease the bottom of the conservation pool from 520 ft to 518.4 ft)
- Alternative 5 - Combination (conservation pool and flood pool)
- Alternative 6 – Combination (conservation pool and powerhead reserve/inactive pool)

The effects discussed can be either beneficial or adverse and were considered over a 50-year period of analysis (2027-2077). Future Without Project (FWOP) and Future With Project (FWP) conditions over the 50-year period of analysis are used to assess and compare the resource categories between No Action and proposed action alternatives.

The No Action Alternative is required under NEPA. The No Action Alternative is the most likely condition expected to occur in the future in the absence of a nonfederal action or any of the federal action alternatives. The No Action Alternative assumes no reallocation of water storage would occur from Whitney Lake and Dam and current operations would continue into the future, per the Water Control Manual. For each resource, the effects analysis area is defined depending upon that resource.

4.1. Hydrology and Hydraulics

The term hydrology and hydraulics (H&H) is commonly used in a general manner to discuss the quantity, movement, or behavior of water. The hydrologic and hydraulic characteristics discussed in this H&H Affected Environment and Environmental Consequences sections relate to the reservoir operations and surface water conditions: flow rates in river, and water levels in reservoir and river.

As mentioned above, releases from Whitney Lake and Dam are authorized to support flood risk management, hydropower generation, and water supply. Releases from Whitney Lake and Dam are made to ensure that the combined flow of the lake release and downstream runoff does not exceed the controlled discharges at gage locations. The USGS regularly reassesses stage-flow rating curves for significant changes due to changes in the channel and streambed. The goal of downstream regulation is to manage flooding and ensure that releases from the lake do not produce flows in excess of those that would have occurred without the dam.

Flood risk management releases from Whitney Lake and Dam are coordinated with releases from eight other USACE lakes within the Brazos River basin. Flood pool releases from the nine Flood Risk Management projects operated by the Fort Worth District Water Management Office in the Brazos River System are prioritized based on available flood pool storage in each lake and downstream channel capacity. The lake levels are lowered to their respective conservation pools at the earliest practical date in order to provide flood risk management capability against potential subsequent storms using a system balancing approach.

Releases from Whitney Lake and Dam are generally made at a rate, so that when combined with the runoff from downstream areas, the flows do not exceed the controlled discharges at downstream control point gages.

The Little River joins the Brazos River upstream from the Brazos River near Bryan Gage. The Brazos River above that point is regulated by Whitney, Aquilla, and Waco Lakes. The farthest downstream lake in the system is Somerville Lake on Yegua Creek, which joins the Brazos River upstream from the Brazos River near Hempstead Gage.

Surcharge water storage exists above the top of the flood control pool, and surcharge releases are made to protect the dam from overtopping during extreme flood events. These releases are sized and scheduled to prevent a flood event below the dam that is larger than what would have happened if the dam never existed.

The hydroelectric power plant at Whitney Lake and Dam has a capacity to generate power, with releases made through the turbines as coordinated with the SWPA. The minimum hydropower release during flood conditions is 500 day-second-feet (DSF), as stated in the Memorandum of Understanding between USACE and SWPA. During times when the lake elevation is between 533.0 and 533.5, the target daily flood control release is 2,200 DSF, made through the turbines as coordinated with SWPA. When the lake elevation is between 533.5 and 534.0, the target daily flood control release increases to 4,400 DSF. However, releases are limited to those required for firm power (500 DSF) per day if the target releases would cause the Brazos River flow to exceed 25,000 cfs between Whitney Dam and the confluence with the Bosque River, or to exceed 60,000 cfs at Waco, Hempstead, or Richmond gages.

Overall, the water management plan for Lake Whitney is designed to balance the needs of flood control hydropower generation, water supply, fish and wildlife, and recreation while ensuring the safe and effective operation of the dam.

Alternative 1- No Action Alternative

Under the No Action Alternative, no changes to existing water management operations including flood control operations and downstream releases as described in Section 4.1 would occur, resulting in no change to the plan of regulation under the No Action Alternative/FWOP condition.

Alternative #2 - Conservation Pool (67% water supply and 33% hydropower)

Under Alternative 2, little to no change in water management operations including downstream regulations are anticipated in comparison to the No Action/FWOP Alternative. Releases from Lake Whitney would still support all authorized uses. Releases from Whitney Lake would still be made to ensure that the combined flow of the lake release and downstream runoff does not exceed the controlled discharges at the gage locations. Reservoir water elevations would be similar as the No Action/FWOP Alternative.

During times when the lake elevation is between 533.0 and 533.5, the target daily flood control release is 2,200 DSF, made through the turbines as coordinated with SWPA. When the lake elevation is between 533.5 and 534.0, the target daily flood control release increases to 4,400 DSF. Under Alternative 2, it is projected that the lake be between 533.5 and 534.0 less often, which means it would likely be operating at a release in 2,200 DSF more often than not. Releases from Lake Whitney would still be made to ensure downstream water quality and flows, and to prevent flooding. Additionally, flood control releases from Whitney Lake would still be coordinated with releases from lakes within the Brazos River basin for maximum flood protection.

However, releases would be limited to those required for firm power (500 DSF) per day if the target releases would cause the Brazos River flow to exceed 25,000 cfs or flows at Waco, Hempstead, or Richmond gages to exceed 60,000 cfs.

Alternative #2a - Conservation Pool (50% water supply and 50% hydropower)

The effects listed above for Alternative 2 are applicable to Alternative 2a.

Alternative #2c – Conservation Pool (energy focus)

The effects listed above for Alternative 2 are applicable to Alternative 2c.

Alternative #3 - Flood Pool (increase top of conservation 3ft)

Under Alternative 3, on average, the lake elevation can be expected to get up to nearly 537 feet in some months under this alternative. Yet, releases are capped at 25,000 CFS for all elevations between 534 feet and 570 feet. At 25,000 CFS there are no impacts observed. This alternative may make it slightly more likely the lake elevation reaches the 570- or 572-foot lines, both of which require a different flood control schedule. This alternative would raise the top of the power pool by three feet and thus give dam operation three less feet to work with to manage extreme flood scenarios. Flood impacts are not extremely likely, but they're far more likely to occur under Alternative 3 than under the No Action/FWOP Alternative. This could cause slight disruptions to the plan of regulation in extreme flood scenarios, but no change to the plan of regulation from the FWOP on a day-to-day operations basis.

Under Alternative 3, there would be no impacts to downstream regulations. Under this Alternative, flows would still be capped at 25,000 cfs anytime the lake is under and not forecasted to rise above 570 feet. Under this alternative, releases would still be limited to those required for firm power if larger releases will cause the Brazos River flow to exceed 25,000 cfs between Whitney Dam and the confluence of the Bosque River, or to exceed 60,000 cfs at Waco, Hempstead, or Richmond gauges. At this higher elevation, it may be more likely the lake reaches extreme flood scenarios, but this would not change the downstream regulations.

Impacts within the reservoir are seen at the lower elevations between 523 and 545 ft-NAVD88. After elevation 545, the probability of occurrence starts to converge and becomes the same at elevation 571.1 at the surcharge pool. Substantial changes would be seen at the spillway crest and facilities between elevation 534,6 to 535.6. Alternative 3 has an increase where the pool elevation would be at or exceeding the spillway crest, elevation 533.1, from 23 % to 82% of the time when comparing it to the existing condition and the No Action Alternative. Modifications to the spillway may need to be implemented to reduce the time water touches the back of the tainter gates. Park facilities which include campgrounds, picnic sites, and boat ramps would see an increase in the pool elevation that equals or exceeds elevation 534.6 from 11% to 71% of the time (additional details can be found in Appendix B).

Alternative #4 - Powerhead Reserve/Inactive Pool (decrease the bottom of the conservation pool from 520 ft to 518.4 ft)

The effects listed above for Alternative 2 are applicable to Alternative 4.

Alternative #5 - Combination (conservation pool and flood pool)

Under Alternative 5, on a month-by-month average, the lake elevation can be expected to raise up to 535 feet in some months under this alternative. Yet, releases are capped at 25,000 CFS for all elevations between 534 feet and 570 feet. At 25,000 CFS there are no impacts observed.

This alternative may make it marginally more likely the lake elevation reaches the 570- or 572-foot lines, both of which require a different flood control schedule. This may cause slight disruptions to the plan of regulation in extreme flood scenarios, but no change to the plan of regulation from the FWOP on a day-to-day operations basis.

Impacts within the reservoir are seen at the lower elevations between 523 and 545 ft-NAVD88. After elevation 545, the probability of occurrence starts to converge and becomes the same at elevation 571.1 at the surcharge pool. Significant changes would be seen at the spillway crest and facilities between elevation 534,6 to 535.6. Alternative 5 has an increase where the pool elevation would be at or exceeding the spillway crest, elevation 533.1, from 23 % to 70% of the time when comparing it to the existing condition, Alterantive 1. Modifications to the spillway may need to be implemented to reduce the time water touches the back of the tainter gates. Park facilities which include campgrounds, picnic sites, and boat ramps would see an increase in the pool elevation that equals or exceeds elevation 534.6 from 11% to 22% of the time (additional details can be found in Appendix B).

Alternative #6 - Combination (conservation pool and powerhead reserve/inactive pool)

The effects listed above for Alternative 2 are applicable to Alternative 6.

Alternative Hydrologic and Hydraulic Result Summery

From the five-objective hydrologic and hydraulic analysis (Frequency, Historic 1957 Event, Elevation Duration, Monthly Average Pool Elevations), it was found that Alternatives 2, 2a, 2c, 4, and 6 were relatively the same with a slight variation due to operations. The changes between these alternatives were found to be nominal and did not have much variation from the existing conditions and the No Action Alternative, when it came to risk due to hydrologic and hydraulic conditions (probability of occurrence, downstream consequences, duration of pool exceedance, monthly pool averages, and capacity of the flood storage within the pool of Whitney Lake and Dam), these alternatives would be similar.

For the two alternatives that had a change in the top of the conservation pool elevation (Alternatives 3 and 5), there was a significant difference in the lower pool elevation that relate to inundation on the gates, boat ramps, and structures between elevation 534.6 and 535.6 (picnic areas and campgrounds). This range would be below the surcharge pool starting at elevation 571.1 ft NAVD88 all the way down to the conservation pool. Once the elevation reached the surcharge pool where the releases change from controlled flows based on downstream channel capacity to uncontrolled releases relating to inflows into the reservoir, the differences between the two converged and no longer had a significant change for the six hydrologic and hydraulic analysis performed for this study. Figure 15 shows the monthly average elevation for the final array of alternatives.

Detailed results for each study can be found in Appendix B

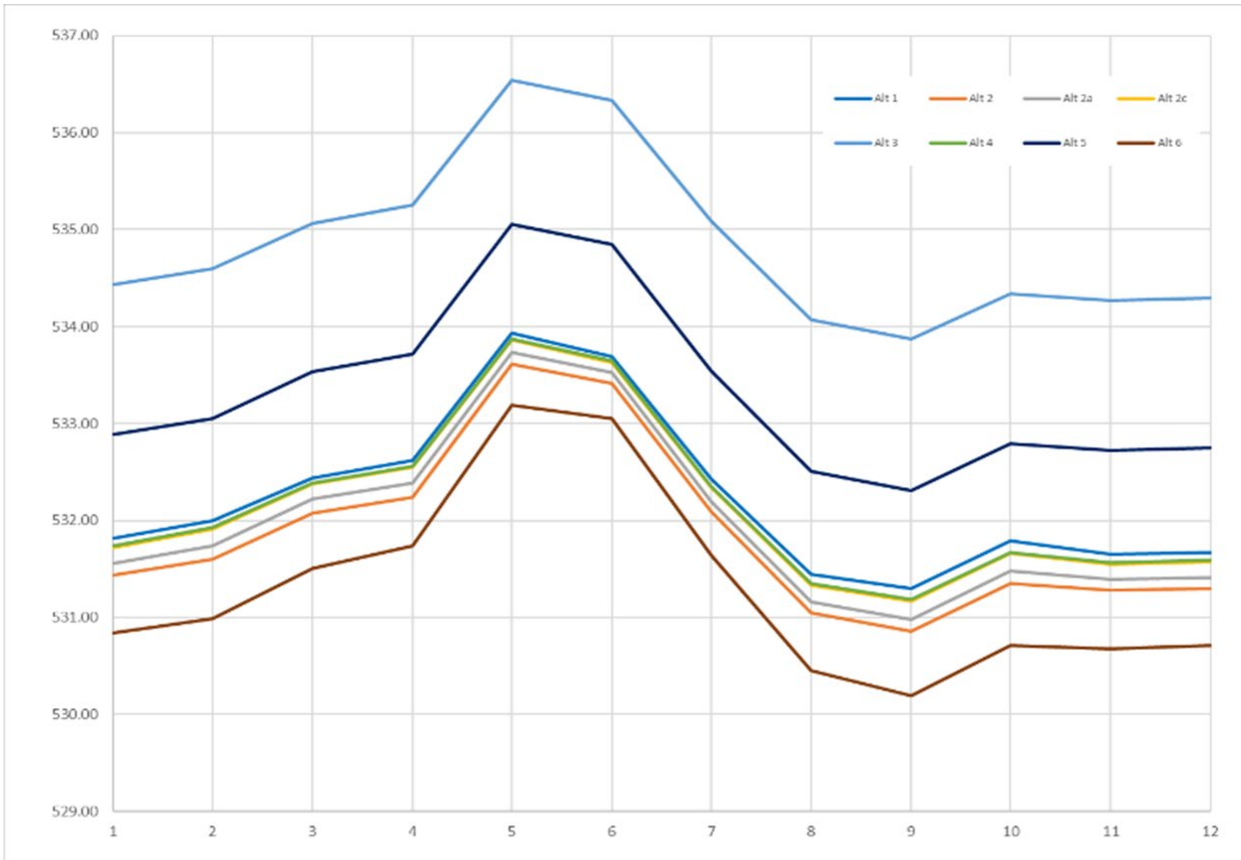

Figure 15. Monthly Average Reservoir Elevations for the Final Array of Alternatives

4.2. Topography, Geology, and Soils

Whitney Lake is situated within the Brazos River Basin, where the surrounding topography is largely controlled by the underlying and surface geology and soils. The dominant limestone subsurface geology (bedrock) gives rise to steep cliffs and bluffs, particularly where exposed, due to its resistance to erosion. Soils developed from thousands of years of slow erosion by major streams and tributaries cover most of the relatively flat areas of limestone surface, resulting in a rolling topography of hills bisected by steep bluffs where streams are located. Meandering stream beds and floodplains, cut into the limestone, are filled with relatively flat alluvial deposits in the stream valleys.

The underlying geology of the Whitney Lake area consists of Upper Cretaceous limestones, marls, and shales of the Fredericksburg Group. These bedrock formations are exposed in cliff outcrops along the shores of Whitney Lake and larger tributaries, where the Brazos River has cut through the landscape. Quaternary alluvium and Pleistocene fluvial deposits of clay, silt, and sandy loams are found in floodplains and on terraced hillsides. According to the U.S. Geological Survey (2014), the seismic hazard probability in the vicinity of Whitney Lake is very low, with a 2-4% probability of occurrence within a 50-year period.

The shoreline of Whitney Lake is characterized by a unique combination of gently sloping valleys and steep, rocky bluffs. This diverse topography creates a variety of habitats, including areas with submerged vegetation, rocky crevices, and sandy beaches. The lake's shoreline is also influenced by its geological history, with the underlying limestone and other rock formations shaping the lake's morphology and creating a complex environment that supports a wide range of aquatic life.

Whitney Lake is located at the junction of two major soil complexes. The eastern side, in Hill County, falls within the East Cross Timbers Land Resource Area, characterized by sandy soils and Brazos River terrace soils. Two primary soil associations are present: the Bastrop-Travis Association, comprising deep, sandy soils on level to gently sloping, old, and high terraces; and the Purves-Brackett-Bolar Association, consisting of moderately deep clayey soils on limestone slopes with gentle to steep grades.

The western side, in Bosque County, is situated within the Grand Prairie Land Resource Area, featuring three major soil associations: Bastrop-Travis fine sandy loams, Tarrant-Brackett clays, and Denton-Tarrant clays. Physically, the soils in Bosque County are similar to those in Hill County, except for the frequent presence of barren limestone outcroppings, characteristic of the Grand Prairie blacklands. The stony soils upstream of the project result in minimal sediment carried by the lake's inflow. Consequently, much of the shoreline of Whitney Lake consists of limestone cliffs with limited erosion.

Alternative 1- No Action Alternative

The current rate of soil erosion would likely continue at Whitney Lake because current reservoir operations would continue under the No Action Alternative. Future development would require soil disturbance, vegetation removal, and transformation of pervious surfaces into impervious areas. This promotes erosion during construction activities and increased surface water runoff after development is completed. In addition, remaining pervious surfaces around developed areas would likely become more impervious because of increased foot traffic from recreational activity. This type of potential future development would likely occur under all alternatives. Low-density public use activities, such as primitive camping, fishing, hunting, trails, and wildlife viewing, would continue with all alternatives. Additional shoreline use permits for docks, trails, and other similar amenities that could result in vegetation removal, topographic changes, increased impervious substrates, or soil disturbances would continue to be assessed and permitted on a case-by-case basis. Existing land and vegetation regulations would remain unchanged under all alternatives. There would be no impacts to topography, geology, and soils downstream as releases would remain similar to the No Action Alternative as described in Section 4.1.

Alternative #2 – Conservation Pool (67% water supply and 33% hydropower)

The shoreline may experience a slight increase in erosion due to the slight decrease in average lake elevations under Alternative 2. As small amounts of unexposed shoreline emerge, limited erosion could occur, though likely limited in scope and geologic setting of limestone cliffs. This decrease in lake elevations could be exacerbated in extreme drought conditions. There would be no impacts to topography, geology, and soils downstream as releases would remain similar to the current downstream flows as described in Section 4.1. Thus, negligible effects to topography, geology, and soils would occur.

Alternative #2a – Conservation Pool (50% water supply and 50% hydropower)

The effects listed above for Alternative 2 are applicable to Alternative 2a.

Alternative #2c – Conservation pool (energy focus)

The effects listed above for Alternative 2 are applicable to Alternative 2c.

Alternative #3 - Flood Pool (increase top of conservation 3ft)

Under Alternative 3, there would likely be minor limited impacts to the topography, geology, and soils along the shoreline, slightly higher than Alternatives 2, 2a, 2c, 4, and 6. Under this alternative, the lake level would rise which could lead to increased erosion of shoreline areas until aquatic and shoreline vegetation gets established, especially in areas with softer soils or where the limestone cliffs are not present.

Alternative #4 - Powerhead Reserve/Inactive Pool (decrease the bottom of the conservation pool from 520 ft to 518.4 ft)

The effects listed above for Alternative 2 are applicable to Alternative 4.

Alternative #5 – Combination (conservation pool and flood pool)

The effects listed above for Alternative 3 are applicable for Alternative 5, though likely at lower impact level than Alternative 3.

Alternative #6 – Combination (conservation pool and powerhead reserve/inactive pool)

The effects listed above for Alternative 2 are applicable to Alternative 6.

4.3. Water Quality

Whitney Lake and Dam is identified as segment 1203 within the Brazos River Basin. According to the Draft 2024 Texas Commission on Environmental Quality (TCEQ) 2024 Texas Integrated Report for Clean Water Act Section 305(b) and 303(d), no water quality parameters measured were considered impaired at Whitney Lake (TCEQ 2024). Depressed dissolved oxygen was identified as a concern for aquatic life use (CN) for the portion of the lake near the dam. Steele Creek, Nolan River, and Brazos River arms measurements were high enough for chlorophyll-a to cause concern for screening levels but not high enough to be considered impaired. All other parameters measured show Whitney Lake and Dam as fully supported for aquatic life, contact recreation, public water supply and general uses.

Deep reservoirs such as Whitney Lake and Dam can exhibit a slow response to climatic factors that induce in-reservoir circulation. Such variables as temperature and temperature-induced circulation ("turnovers") impact water quality including salinity, algal productivity, and overall reservoir ecology. One unique physical feature of Whitney Lake is that the linear nature of the reservoir lines up with the dominant wind direction for the region, both in the summer, from the southeast, and in the winter, from the northwest. Thus, wind driven circulation mechanics likely play a significant role in the circulation of the reservoir.

The main issue regarding utilization of Whitney Lake and Dam as a water supply resource is its salinity. Past work by the United States Geological Survey, USACE, and the State of Texas have pointed to the elevated salinity levels in Whitney Lake, which have been traced to specific geologic units within the watershed itself. Specifically, the geology of the Salt Fork of the Brazos River is partially made up of high-salinity sandstone, which results in increased salinity of return flow into main tributaries. These higher-salinity waters eventually find their way into the lake. Even though the drainage area of the watershed is nearly 35,000 square miles, the proximity of Whitney Lake and Dam to the high salinity inflow waters does not allow sufficient stream dilution distance to affect the elevated levels. Within the reservoir itself, initial data gathered by the Brazos River Authority shows concentrations of salinity during much of the year exceed the USEPA 300 part per million standards for drinking water by 20 to 30 percent. One additional issue that has been identified as a critical component of water quality in Whitney Lake and Dam is the presence of the toxin-producing golden algae (*Prymnesium parvum*). Whitney Lake and Dam has been subject to fish kills caused by large blooms of the algae.

TPWD, along with the TCEQ and the Baylor University Center for Reservoir and Aquatic Systems Research, monitors levels of golden algae and other microbial organisms in Whitney Lake and Dam. The last major algae-related kill on Whitney Lake occurred in early 2007 and killed off numerous individuals from species of fish such as threadfin *(Dorosoma petenense)* and gizzard shad *(D. cepedianum),* freshwater drum *(Aplodinotus grunniens),* crappie *(Pomoxis* spp.), and gar *(Lepisosteus* spp.) (Baylor University Center for Reservoir and Aquatic Systems Research 2009). While it is not believed that golden algae is harmful to humans or other wildlife, the cost associated with managing such fish kills can be extensive. Monitoring of Whitney Lake and Dam, along with several other aquatic systems in Texas, is ongoing.

Alternative 1- No Action Alternative

Whitney Lake and Dam pool fluctuations associated with precipitation events, tributary inflows, power production, water supply, and flood control procedures result in variable surface water elevations and shoreline inundation levels. Changes in water elevation along with prevailing winds, surface water runoff, and wave action result in variable shoreline erosional zones, which can increase sedimentation and turbidity at Whitney Lake. Turbidity and sedimentation can also increase at Whitney Lake for short periods from heavy upstream precipitation events. During these periods, surface water runoff and tributary inputs can also contribute additional phosphorous, nitrogen, and other constituents to the lake. Implementation of the No Action Alternative would not result in changes to the existing watershed drainage patterns or subsequent effects to existing lake water quality.

The potential for residential development around Whitney Lake and Dam under the FWOP condition would likely have short- and long-term negative impacts to Whitney Lake and Dam water quality because of the potential for increased erosion, localized increases in turbidity and sedimentation, and additional inputs of chemicals associated with residential and recreational-related properties.

It is likely that modifications and development would continue in the future, resulting in project-specific erosion during construction, increased impermeable surfaces, and increased surface water runoff. Low-density public use activities, such as primitive camping, fishing, hunting, trails, and wildlife viewing, would continue with all alternatives. Additional shoreline use permits for docks, trails, and other similar amenities that could result in vegetation removal, topographic changes, increased impervious substrates, or soil disturbances would continue to be assessed and permitted on a case-by-case basis. There would be no impacts to water quality downstream under any of the assessed alternatives as releases would remain unchanged as described in Section 4.1.

Alternative #2 - Conservation Pool (67% water supply and 33% hydropower)

Under Alternative 2, minimal effects to water quality are expected to occur. Any impacts are uncertain and would likely be short-term in duration. Salinity effects are complex and uncertain. While lower lake levels have the potential to result in higher lake salinity, since the receiving volume for a high salinity inflow event would be smaller, a difference of less than half a foot on average is negligible

This alternative could also have impacts on the golden algae blooms, though it's uncertain whether this change could lead to an increase or decrease in algae blooms. A slight decrease in average lake levels could also potentially lead to changes in the lake's circulation patterns and the water temperature. This could have impacts on dissolved oxygen levels and potentially exacerbate the existing concern for depressed dissolved oxygen near the dam. The changes under Alternative 2 could also potentially lead to changes in the lake's nutrient levels and phytoplankton growth, which could impact chlorophyll-a levels.

During extreme drought conditions, the decrease in lake elevations would worsened any water quality concerns.

With this alternative, reservoir outflows and water quality release are expected to be similar to existing outflows (Section 4.1), effects to downstream water quality would be the same as the existing conditions and No Action Alternative.

Alternative #2a - Conservation Pool (50% water supply and 50% hydropower)

The effects listed above for Alternative 2 are applicable to Alternative 2a.

Alternative #2c – Conservation Pool (energy focus)

The effects listed above for Alternative 2 are applicable to Alternative 2c.

Alternative #3 - Flood Pool (increase top of conservation 3ft)

Under Alternative 3, there are expected to be only negligible, uncertain impacts on dissolved oxygen levels as well as chlorophyll-a levels within the lake.

With this alternative, reservoir outflows and water quality release are expected to be similar to existing outflows (Section 4.1), effects to downstream water quality would be the same as the existing conditions and No Action Alternative.

Alternative #4 - Powerhead Reserve/Inactive Pool (decrease the bottom of the conservation pool from 520 ft to 518.4 ft)

The effects listed above for Alternative 2 are applicable to Alternative 4.

Alternative #5 - Combination (conservation pool and flood pool)

The effects listed above for Alternative 3 are applicable to Alternative 5.

Alternative #6 - Combination (conservation pool and powerhead reserve/inactive pool)

The effects listed above for Alternative 2 are applicable to Alternative 6.

4.4. Land Use and Protected Lands

The land use area of interest includes the federally owned property around the lake.

Table 14 highlights the different land classifications found at Whitney Lake and Dam as designated by the 2016 Whitney Lake Master Plan.

Table 14. Approximate Acres of the Land Classifications at Whitney Lake

LAND CLASSIFICATION	ACRES
Project Operations	460
High Density Recreation	3,608
Environmentally Sensitive Areas	2,268
Multiple Resource Managed Lands - Low Density Recreation	1,170
Multiple Resource Managed Lands - Wildlife Management	16,278
Multiple Resource Managed Lands - Vegetative Management	0
Multiple Resource Managed Lands - Future/ Inactive Recreation Areas	0

Water Surface: Restricted	23
Water Surface: Designated No-Wake	143
Water Surface: Fish and Wildlife Sanctuary	0
Water Surface: Open Recreation	21,536

Currently, Texas has 50 Wildlife Management Areas (WMA), encompassing some 748,768 acres of land and operated by Texas Parks and Wildlife Department. WMAs are established to represent habitats and wildlife populations typical of each ecological region of Texas. The are currently no WMAs within or surrounding Whitney Lake and therefore no impacts would occur to WMAs.

Alternative 1- No Action Alternative

No changes to existing lake operations are anticipated with this alternative. Any future land use changes at Whitney Lake would likely occur due to development of future recreational opportunities such as new marinas and campsites. Future residential development may also occur as existing land use agreements change under the FWOP condition. Due to the existing undeveloped nature of the study area, any future land use developments would result in less natural habitat at Whitney Lake. There would be no impacts to land uses downstream under any of the assessed alternatives as releases would remain unchanged as described in Section 4.1.

Alternative #2 - Conservation Pool (67% water supply and 33% hydropower)

The effects listed above for Alternative 1 are applicable to Alternative 2.

Alternative #2a - Conservation Pool (50% water supply and 50% hydropower)

The effects listed above for Alternative 1 are applicable to Alternative 2a.

Alternative #2c – Conservation Pool (energy focus)

The effects listed above for Alternative 1 are applicable to Alternative 2c.

Alternative #3 - Flood Pool (increase top of conservation 3ft)

The effects listed above for Alternative 1 are applicable to Alternative 3.

Alternative #4 - Powerhead Reserve/Inactive Pool (decrease the bottom of the conservation pool from 520 ft to 518.4 ft)

The effects listed above for Alternative 1 are applicable to Alternative 4.

Alternative #5 - Combination (conservation pool and flood pool)

The effects listed above for Alternative 1 are applicable to Alternative 5.

Alternative #6 - Combination (conservation pool and powerhead reserve/inactive pool)

The effects listed above for Alternative 1 are applicable to Alternative 6.

4.5. Wetlands

The area of interest for wetlands includes the federal fee boundary of Whitney Lake and Dam. Wetlands are vital components of the landscape, providing numerous benefits for both people and the environment. These benefits include improving water quality, supporting fish and wildlife habitats, regulating floodwaters, and maintaining surface water flow during dry periods.

Additionally, wetlands offer recreational opportunities, aesthetic values, and sites for research and education, as well as commercial fishery benefits.

The importance of wetlands is recognized under the Clean Water Act (CWA), which regulates these resources to protect their unique natural characteristics. Section 404 of the CWA is the primary federal statute governing the protection of wetlands and other waters of the United States. This section prohibits the discharge of material into "Waters of the U.S." unless exempted or authorized by USACE.

At Whitney Lake and Dam, the steep topography surrounding the lake limits the occurrence of wetlands to areas near the rivers and flatter regions on the eastern side of the lake. According to the U.S. Fish and Wildlife Service's (USFWS) National Wetland Inventory (NWI), approximately 4,659 acres of wetlands are present on federal property surrounding the lake. The two dominant wetland types found in this area are freshwater emergent and freshwater forested/shrub wetlands. These wetlands play a crucial role in maintaining the ecological balance of the lake and its surrounding environment.

Alternative 1- No Action Alternative

The USFWS NWI indicates there are approximately 4,659 acres of wetlands occurring throughout the adjacent federal property surrounding Whitney Lake and Dam. Only about 859 acres of wetland are inundated on a regular basis. Normal seasonal and yearly lake surface water elevation fluctuations would continue to influence the quality and quantity of existing wetlands around the lake. There would be no impacts to wetlands downstream under any of the assessed alternatives as releases would remain unchanged as described in Section 4.1.

Alternative #2 - Conservation Pool (67% water supply and 33% hydropower)

Under Alternative 2, minor effects to wetlands would occur. With the roughly half a foot change in water elevation levels, it could lead to a slight decrease in the amount of wetland area that is inundated with water. This could lead to changes in the types of vegetation that area able to grow in the wetland areas. There could also potentially be reduced water quality benefits, as wetlands are crucial to improving water quality by filtering out sediments and pollutants. However, it is likely these impacts to wetland areas lost would be offset by a number of new wetland areas created at this lower elevation. Furthermore, this alternative still lies within the current normal operating range of the lake. Therefore, we'd anticipate any impacts ultimately negligible at most.

Alternative #2a - Conservation Pool (50% water supply and 50% hydropower)

The effects listed above for Alternative 2 are applicable to Alternative 2a to a slightly lesser extent.

Alternative #2c – Conservation Pool (energy focus)

The effects listed above for Alternative 2 & 2a are applicable to Alternative 2c to a slightly lesser extent.

Alternative #3 - Flood Pool (increase top of conservation 3ft)

Under Alternative 3, effects to wetlands would occur due to the amount of wetlands inundated with the proposed rise of the conservation pool into the flood pool. Under this alternative, the number of acres of wetlands inundated would be approximately 2,008 acres, an increase of approximately 1,149 acres compared to the No Action Alternative. This increased inundation would likely lead to wetlands being permanently converted to open water. However, the potentially new wetlands would be created along the higher shoreline due the higher conservation pool elevation and could be beneficial. Thus, effects to wetlands would be moderate.

Under this Alternative, Freshwater Emergent Wetlands could see emergent vegetation take over in some areas with increases in water while other species struggle. Similar impacts are anticipated in Freshwater Forest/Shrub Wetlands, where instead trees and shrubs like willows and buttonbushes may thrive to the point of reducing overall biodiversity. These changes in vegetation could lead to impacts to the overall biodiversity of these ecosystems.

Alternative #4 - Powerhead Reserve/Inactive Pool (decrease the bottom of the conservation pool from 520 ft to 518.4 ft)

The effects listed above for Alternative 1 are applicable to Alternative 4.

Alternative #5 - Combination (conservation pool and flood pool)

Under Alternative 5, the effects to wetlands would be less to those described in Alternative 3. Under this alternative, the number of acres of wetlands inundated would increase to approximately 1,972 acres from 859 acres under the No Action Alternative. Similar to Alterative 3, this increased inundation would likely lead to an increase in the amount of wetlands permanently converted to open water, leading to impacts to the overall biodiversity of these ecosystems.

Alternative #6 – Combination (conservation pool and powerhead reserve/inactive pool)

The effects listed above for Alternative 1 are applicable to Alternative 6.

4.6. Aquatic Habitat

Whitney Lake and Dam provides a diverse and thriving aquatic habitat, supporting a wide range of fish. Since its impoundment in 1951, the lake has offered a quality fishery, with the submerged native forests creating a complex structure that provides habitat and forage for fish. The lake's aquatic ecosystem is characterized by three distinct biological zones: the littoral, limnetic, and profundal zones, each linked to the physical structure of the lake.

The littoral zone, which adjoins the shoreline, is where sunlight penetrates to the sediment, allowing aquatic plants to grow and thrive. This zone is critical for the lake's ecosystem, as it provides habitat and food for many aquatic species. In contrast, the limnetic zone is the open water area where light does not reach the bottom, and the profundal zone is the deepest area of the lake, beyond the reach of effective light penetration. For the purposes of this project, the littoral zone, or shoreline area, is of primary interest.

Whitney Lake and Dam provides fishing opportunities for the boater and for the bank angler. Common sport fish species present in Whitney Lake include striped bass *(Morone saxatilis)*, white bass *(Morone chrysops)*, largemouth bass *(Micropterus salmoides)*, smallmouth bass *(M. dolomieu)*, spotted bass *(M. punctulatus)*, white crappie *(Pomoxis annularis)*, black crappie *(P. nigromaculatus)*, channel catfish *(Ictalurus punctatus)*, blue catfish *(I. furcatus)*, and flathead catfish *(Pylodictis olivaris)*. Other species include a variety of sunfish *(Lepomis* spp.*)*, carp (*Cyprinus carpio)*, gar, drum, buffalo, and shad. Stocking of Whitney Lake is conducted by TPWD and varies annually but has included striped bass, largemouth bass, smallmouth bass, and bluegill. Golden algae blooms can occur in the reservoir and these blooms are at times toxic to fish and may affect the quality of fishing.

The invasive species area of interest includes the federally owned property around the lake. In accordance with Executive Order (EO) 13112, an invasive species means an alien species whose introduction causes or is likely to cause economic or environmental harm, or harm to human health. Invasive species can be microbes, plants, or animals that are nonnative to an ecosystem. Invasive species can be accidentally transported, or they can be deliberately introduced because they are thought to be helpful in some way. Invasive species cost local, state, and federal agencies billions of dollars every year. The most prevalent aquatic invasive species currently found at Whitney Lake and Dam is the Asian clam. A full list of occurring invasive species in the project area can be found in section 2.2.6 of the 2016 Whitney Lake Master Plan. USACE Whitney Lake and Dam personnel are also taking measures to prevent the spread of aquatic invasive species such as zebra mussels.

Alternative 1- No Action Alternative

The aquatic resources associated with Whitney Lake and Dam would continue as described in the existing condition under the No Action Alternative. No changes to the current operation of Whitney Lake and Dam would occur that could impact the existing quality and quantity of aquatic habitat within Whitney Lake and Dam, in associated upstream tributaries, and downstream of the lake. The quality and quantity of aquatic habitat within the study area would continue to vary over time with seasonal changes, watershed development, and habitat management objectives.

Whitney Lake and Dam and the area surrounding it are not protected from the spread of invasive species. Future residential and industrial growth adjacent to the shoreline would have the potential to introduce invasive species. Whitney Lake and Dam personnel would continue to manage and prevent invasive species under the No Action Alternative on a case-by-case basis.

Alternative #2 - Conservation Pool (67% water supply and 33% hydropower)

Under this alternative, the slight water elevation decrease may expose previously submerged aquatic plants, potentially alternating to composition of vegetation in the littoral zone. This impact is unlikely given the lake is already prone to regular elevation levels, and the species are likely well adapted to adjust to a 0.5-foot change in elevation.

This alternative may result in slight alteration to fish habitats. There may also be minimal impacts to benthic communities, as a decreased water level could expose these organisms to increased predation or other environmental stresses, which may impact the diversity of such communities especially in consecutive drought years.

Aquatic invasive species may experience a negligible impact under Alternative 2 as there would be a slight reduction in habitat availability for aquatic invasive species like Zebra Mussels and Hydrilla, which might make it more difficult for them to establish and spread. Though, this decreased water level may increase the risk of spreading these species as boats may be more likely to come into contact with infested regions of the like. It should be noted that these impacts, like many others, already often exist due to water elevation fluctuations.

There would be no impacts to aquatic habitat downstream as releases would remain similar to the current downstream flows as described in Section 4.1. Though aquatic habitats and associated species may experience localized minimal effects under Alternative 2, overall these potential impacts would not be beyond what the aquatic communities already experience due to normal fluctuations in lake elevation.

Alternative #2a - Conservation Pool (50% water supply and 50% hydropower)

The effects listed above for Alternative 2 are applicable to Alternative 2a, perhaps to a slightly more limited extent.

Alternative #2c – Conservation Pool (energy focus)

The effects listed above for Alternative 2 & 2a are applicable to Alternative 2c, though perhaps to a slightly more limited extent than Alternative 2a.

Alternative #3 - Flood Pool (increase top of conservation 3ft)

Under Alternative 3, there are anticipated to be minimal beneficial impacts to aquatic habitat. The increased water level experienced under this alternative could increase habitat for aquatic plants as there's a slight expansion of the littoral zone, allowing plants to develop in areas previously too shallow.

For the aquatic invasives, there may be an increase in habitat availability, making it easier for zebra mussels and hydrilla to establish and spread within the lake. The overall management effort strategies of invasive species may also need to be adjusted with this significant of a change in power pool level, which may cause a temporary decrease in success in these efforts until new management plans can be established and well-implemented among staff.

Alternative #4 - Powerhead Reserve/Inactive Pool (decrease the bottom of the conservation pool from 520 ft to 518.4 ft)

The effects listed above for Alternative 1 are applicable to Alternative 4.

Alternative #5 - Combination (conservation pool and flood pool)

The effects listed above for Alternative 3 are applicable to Alternative 5, though perhaps to a more limited extent than under Alternative 3.

The effects listed under Alternative 3 are applicable to Alternative 5, though the effects seen under Alternative 5 will likely be to a much lesser degree than under Alternative 3, both in a positive and negative sense.

Alternative #6 - Combination (conservation pool and powerhead reserve/inactive pool)

Under this alternative, the slight water elevation decrease may expose previously submerged aquatic plants, potentially alternating to composition of vegetation in the littoral zone. This impact is unlikely given the lake is already prone to regular elevation levels, and the species are likely well adapted to adjust to a 1-foot change in elevation.

This alternative may result in slight alteration to fish habitats. There may also be minimal impacts to benthic communities, as a decreased water level could expose these organisms to increased predation or other environmental stresses, which may impact the diversity of such communities especially in consecutive drought years.

Aquatic invasive species may experience a negligible impact under Alternative 6 as there would be a slight reduction in habitat availability for aquatic invasive species like Zebra Mussels and Hydrilla, which might make it more difficult for them to establish and spread. Though, this decreased water level may increase the risk of spreading these species as boats may be more likely to come into contact with infested regions of the like. It should be noted that these impacts, like many others, already often exist due to water elevation fluctuations.

There would be no impacts to aquatic habitat downstream as releases would remain similar to the current downstream flows as described in Section 4.1. Though aquatic habitats and associated species may experience localized minimal effects under Alternative 6, overall these potential impacts would not be beyond what the aquatic communities already experience due to normal fluctuations in lake elevation.

4.7. Terrestrial Habitat

The terrestrial habitat area of interest includes the federally owned property around the lake. Whitney Lake and Dam is located within the Cross Timbers ecological region in north-central Texas. This region is a transitional area between tall grass prairies and oak savannas and is characterized by areas with high densities of trees and irregular plains and prairies. In addition to the wetlands described above in Section 4.5, this draft FR/EA analyzed four habitat types around Whitney Lake in the federally owned property: savannah, bottomland hardwood, woodland, and swamp. Bottomland Hardwoods around Whitney Lake typically form immediately adjacent to the lake and are characterized by their regular flooding events. Around Whitney Lake, these are typically areas with large amounts of river oak species and some flooded timber. Savannahs around Lake Whitney are typically Post Oak Savannahs and often have hardy, drought resistant oaks, shrubs, and lots of bunchgrasses. Woodlands around Whitney Lake are largely post oak and juniper woodlands or mixed hardwood woodlands often scattered with juniper, various oaks, hickories, and a diverse understory of grasses, shrubs, and wildflowers. Swamps near Whitney Lake are very similar to bottomland hardwood forests and have standing water for extended periods of time with similar vegetation including cypress, water oak, willows, and other aquatic plants. Table 15 present the acres of each habitat type at low and high reservoir elevations.

Table 15. Acres of Existing Habitat Types at Whitney Lake and Dam

Habitat Type	Low Elevation in acres (531 feet)	High Elevation in acres (534 feet)
Savannah	75	95
Bottomland Hardwood	582	918
Woodland	18	26
Swamp	3	3

The dominate tree species include live oak (*Quercus virginiana*), post oak *(Quercus stellata)*, American elm *(Ulmus americana)*, cedar elm *(Ulmus crassifolia)*, eastern cottonwood *(Populus deltoides)*, black willow *(Salix nigra)*, pecan *(Carya illinoinensis)*, Ashe juniper *(Juniperus ashei)*, hackberry *(Celtis occidentialis)*, and honey mesquite *(Prosopis glandulosa)*. Various species of native grasses and forbs are found around the lake as well.

Alternative 1- No Action Alternative

Under the No Action Alternative, the existing habitats at Whitney Lake and Dam would continue to occur. Table 16 shows the approximate change in acres to the existing habitat types of savannah, bottomland hardwood, woodland, and swamp due to potential changes in reservoir elevations due to the alternatives. In addition, the fish and wildlife that found in those habitats would continue to utilize those habitats. There would be no impacts to terrestrial habitat downstream under any of the assessed alternatives as releases would remain unchanged as described in Section 4.1. Natural variability by season, with lake operations and future watershed development, are anticipated for fish and wildlife species and their habitats under the FWOP condition above, below, and within Whitney Lake and Dam. This variability would occur under all alternatives.

Table 16. Change in Habitat Acres for Each Habitat Type for Reservoir Elevations (Low and High)

Habitat Type	Savannah	Bottomland Hardwood	Woodland	Swamp
-	Change in Elevation (Low / High) in acres	Change in Elevation (Low / High) in acres	Change in Elevation (Low / High) in acres	Change in Elevation (Low / High) in acres
Alternative 1	No Change (High/Low)	No Change (High/Low)	No Change (High/Low)	No Change (High/Low)
Alternative 2	Similar to FWOP	Similar to FWOP	Similar to FWOP	Similar to FWOP
Alternative 2a	Similar to FWOP	Similar to FWOP	Similar to FWOP	Similar to FWOP
Alternative 2c	Similar to FWOP	Similar to FWOP	Similar to FWOP	Similar to FWOP
Alternative 3	19 / 9	336 / 497	9 / 46	0 / 8
Alternative 4	Similar to FWOP	Similar to FWOP	Similar to FWOP	Similar to FWOP
Alternative 5	19 / 8	326 / 480	7 / 40	0 / 7
Alternative 6	Similar to FWOP	Similar to FWOP	Similar to FWOP	Similar to FWOP

Alternative #2 - Conservation Pool (67% water supply and 33% hydropower)

Terrestrial habitat would likely experience minimal impacts under Alternative 2. A decrease in reservoir elevation under this alternative could potentially lead to an increase in the amount of terrestrial area around the lake, potentially providing more habitat for terrestrial species. It may also lead to an increase in stress on vegetation species which are adapted to growing in areas with frequent inundation such as willows. This could result in slight changes in the composition of vegetation in some area. Alternatively, it’s possible that a decrease in water level could lead to improved soil quality in certain areas, which has potential benefits to plant growth and biodiversity.

The slight decrease in water level under Alternative 2 may expose new areas of land, which may provide marginally more habitat for invasive species such as feral hogs, Ashe Juniper, and Johnson grass to colonize and spread. This decreased water level would also likely favor the growth of other invasive species including Cheatgrass, Chinese Tallow, and King Ranch Bluestem. The slight decrease in water level by monthly average could alter the habitat availability for terrestrial species such as white-tailed deer, turkey, and feral hogs, which may impact population levels. This change in water level could negatively affects the habitat and food availability for waterfowl and shorebirds as well. Overall, these potential impacts would not be beyond what the terrestrial habitats already experience due to normal fluctuations in lake elevation. It is however possible that this decrease in lake elevations could be exacerbated in extreme drought conditions.

Alternative #2a - Conservation Pool (50% water supply and 50% hydropower)

The effects listed above for Alternative 2 are applicable to Alternative 2a.

Alternative #2c – Conservation Pool (energy focus)

The effects listed above for Alternative 2 are applicable to Alternative 2c.

Alternative #3 - Flood Pool (increase top of conservation 3ft)

Terrestrial habitat would likely see minor to moderate impacts under Alternative 3. An increase in water elevation associated with this alternative would lead to a decrease in the amount of terrestrial area around the lake, which could reduce the habitat availability as areas previously terrestrial get flooded out. This increase in water would also lead to an increased stress on trees and plants that are not adapted to growing in areas with frequent flooding.

Under Alternative 3, there would likely be minor impacts to invasive species. For terrestrial species, an increase in water level would likely reduce the available habitat for species such as feral hogs, Ashe Junipers, and Johnson Grasses. The higher elevation may make it harder for invasive plants to survive and spread, while the invasive animals could see increased mortality as they may be more susceptible to drownings or displacement. This increased water level could also result in an alteration of vegetation in the area, which may favor the growth and spread of more native species over the invasives like Cheatgrass, Chinese Tallow, and King Ranch Bluestem.

More terrestrial wildlife may see more minor negative impacts. This rise in water level could result in loss of terrestrial habitat, especially for those that rely on woodland vegetation such as white-tailed deer and turkey. This raised water mark could also result in changes to food availability and loss of habitat to species including the mourning dove and fox squirrel.

Meanwhile, waterfowl and shorebirds could flourish with higher water elevations. These water levels may provide more suitable conditions for these species to nest and breed which could in turn lead to increases in population.

Alternative #4 - Powerhead Reserve/Inactive Pool (decrease the bottom of the conservation pool from 520 ft to 518.4 ft)

The effects listed above for Alternative 1 are applicable to Alternative 4.

Alternative #5 - Combination (conservation pool and flood pool)

The effects listed above for Alternative 3 are applicable to Alternative 5, though likely to a more limited extent.

The effects listed under Alternative 3 are applicable to Alternative 5, though the effects seen under Alternative 5 would likely be to a much lesser degree than under Alternative 3, both in a positive and negative sense.

Alternative #6 - Combination (conservation pool and powerhead reserve/inactive pool)

The effects listed above for Alternative 2 are applicable to Alternative 6.

4.8. Protected Species

4.8.1. Threatened and Endangered Species

The threatened and endangered species area of interest includes the federally owned property around the lake. The Endangered Species Act (ESA) of 1973, as amended, was enacted to provide a program for the preservation of endangered and threatened species and to provide protection for the ecosystems upon which these species depend for their survival. All federal agencies are required to implement protection programs for designated species and to use their authorities to further the purposes of the act. Responsibility for the identification of a threatened or endangered species and development of any potential recovery plans lies with the Secretary of the Interior and the Secretary of Commerce.

An endangered species is a species in danger of extinction throughout all or a significant portion of its range. A threatened species is a species likely to become endangered within the foreseeable future throughout all or a significant portion of its range. Proposed species are those that have been formally submitted to Congress for official listing as threatened or endangered. Species may be considered endangered or threatened when any of the five following criteria occurs: (1) the current/imminent destruction, modification, or curtailment of their habitat or range; (2) overuse of the species for commercial, recreational, scientific, or educational purposes; (3) disease or predation; (4) the inadequacy of existing regulatory mechanisms; and (5) other natural or human-induced factors affecting continued existence. In addition, USFWS has identified species that are candidates for listing as a result of identified threats to their continued existence. The candidate designation includes those species for which USFWS has sufficient information to support listing the species as endangered or threatened under ESA.

As identified by USFWS IPaC in Table 17, there are 7 endangered species and no critical habitats within the project area.

Table 17. Endangered Species Act List

Species	Status	Effect Determination
Tricolored Bat (*Perimyotis subflavus*)	Proposed Endangered	No effect
Golden-cheeked Warbler (*Setophaga chrysoparia*)	Endangered	No effect
Piping Plover (*Charadrius melodus*)	Threatened	No effect
Rufa Red Knot (*Calidris canutus rufa*)	Threatened	No effect
Whooping Crane (*Grus americana*)	Endangered	No effect
Texas Fawnsfoot (*Truncilla macrodon*)	Threatened	No effect
Monarch Butterfly (*Danaus plexippus*)	Proposed Threatened	No effect

Alternative 1- No Action Alternative

Under the No Action Alternative, the existing habitat and ecosystem services around Whitney Lake and Dam would continue to support the listed species populations, barring any potential disruptions or impacts from new development or activities.

This project was evaluated for potential impacts to federally listed endangered and threatened species. The Tricolored Bat is known to roost and reside within the project area, but all proposed alternatives avoid tree removal or modification, resulting in a determination of “no effect.” The Piping Plover and Rufa Red Knot are only relevant considerations in the context of wind energy development, which is not included in this project; therefore, no effect is determined for these species. While the Golden-cheeked Warbler is present, this alternative does not anticipate impacts to its preferred habitat which is upland, supporting a “no effect” determination. Whooping Cranes occasionally utilize the project area during migration, but modifications to lake elevation under any alternative are not expected to alter critical stopover habitat. The Monarch Butterfly would not be impacted, as the project would not affect milkweed resources. Finally, the Texas Fawnsfoot, which occurs downstream, would not be affected as project operations would not alter downstream conditions. Project releases will remain consistent with current operations (see Section 4.1), further confirming no impacts to downstream endangered and threatened species.

Alternative #2 - Conservation Pool (67% water supply and 33% hydropower)

The effects listed above for Alternative 1 are applicable to Alternative 2.

Alternative #2a - Conservation Pool (50% water supply and 50% hydropower)

The effects listed above for Alternative 1 are applicable to Alternative 2a.

Alternative #2c – Conservation Pool (energy focus)

The effects listed above for Alternative 1 are applicable to Alternative 2c.

Alternative #3 - Flood Pool (increase top of conservation 3ft)

The effects listed above for Alternative 1 are applicable to Alternative 4.

Alternative #4 - Powerhead Reserve/Inactive Pool (decrease the bottom of the conservation pool from 520 ft to 518.4 ft)

The effects listed above for Alternative 1 are applicable to Alternative 4.

Alternative #5 - Combination (conservation pool and flood pool)

The effects listed above for Alternative 1 are applicable to Alternative 5.

Alternative #6 - Combination (conservation pool and powerhead reserve/inactive pool)

The effects listed above for Alternative 1 are applicable to Alternative 6.

4.8.2. Migratory Birds

The migratory birds area of interest includes the federally owned property around the lake. While not protected under ESA, certain birds are protected under the Migratory Bird Treaty Act of 1918 and the Bald and Golden Eagle Protection Act of 1940. There are nine birds of conservation concern (BCC) in the area surrounding Lake Whitney. Two species are BCCs that are of concern only in particular Bird Conservation Regions (BCRs) in the continental United States, and the remaining seven are of are of concern throughout their range anywhere within the United States.

The bald eagle is not a BCC within the area of interest but warrants attention because of the Bald and Golden Eagle Protection Act or for potential susceptibilities in offshore areas from certain types of development or activities.

Species	Level of Concern
American Golden Plover *(Pluvialis dominica)*	BCC Rangewide (CON)
Chimney Swift *(Chaetura pelagica)*	BCC Rangewide (CON)
Least Tern *(Sternula antillarum antillarum)*	BCC Rangewide (CON)
Lesser Yellowlegs *(Tringa flavipes)*	BCC Rangewide (CON)
Little Blue Heron *(Egretta caerulea)*	BCC-BCR
Pectoral Sandpiper *(Calidris melanotos)*	BCC Rangewide (CON)
Prairie Loggerhead Shrike *(Lanius ludovicianus excubitorides)*	BCC-BCR
Red-Headed Woodpecker *(Melanerpes erythrocephalus)*	BCC Rangewide (CON)
Sprague's Pipit *(Anthus spragueii)*	BCC Rangewide (CON)

Alternative 1- No Action Alternative

The No Action Alternative would mean that the existing habitat and ecosystem services provided by the area around Whitney Lake and Dam would continue to support the migratory bird populations, barring any potential disruptions or impacts from new development or activities. The seven species that are BCCs throughout their range in the United States, would continue to utilize the area as a critical stopover point or breeding ground. The two species that are BCC-BCR would also continue to benefit from the existing habitat and ecosystem services provided by the area.

The No Action Alternative is consistent with the principles of conservation and management of migratory bird populations, as it avoids any potential harm or disruption to the existing habitat and ecosystem services provided by the area around Whitney Lake and Dam. The area would continue to provide a safe and healthy environment for the migratory birds to rest, feed, and breed, without any potential impacts from human activities or development. There would be no migratory birds downstream under any of the assessed alternatives as releases would remain unchanged as described in Section 4.1.

Alternative #2 - Conservation Pool (67% water supply and 33% hydropower)

Under Alternative 2, there would likely be no impacts to migratory birds. Under this alternative, there may be a slight exposure of new shoreline areas, which could produce more habitat for many species including the American Golden Plover, the Lesser Yellow legs, and the Pectoral Sandpiper, which prefer shallow water and mudflats. This small decrease in water level could potentially impact the vegetation in the areas, which may lead the impacts of availability of food and shelter for species like the Chimney Swift, Red-Headed Woodpecker, and Sprague's Pipit. Other species such as the Least Tern, Little Blue Heron, and Prairie Loggerhead Shrike rely on the lake's shoreline and vegetation for foraging and breeding, which may see minor impacts under this alternative.

Alternative #2a - Conservation Pool (50% water supply and 50% hydropower)

The effects listed above for Alternative 2 are applicable to Alternative 2a to perhaps a slightly lesser extent.

Alternative #2c – Conservation Pool (energy focus)

The effects listed above for Alternative 2 & 2a are applicable to Alternative 2c to perhaps a slightly lesser extent than 2a.

Alternative #3 - Flood Pool (increase top of conservation 3ft)

Under Alternative 3, there will likely be minor to moderate impacts to migratory birds. A pronounced increase in inundation of shoreline areas could reduce the habitat for species like the American Golden Plover, Lesser Yellowlegs, and Pectoral Sandpiper, which prefer shallow water and mudflats. This increase in water elevation may also affect vegetation composition in the area which could affect the availability of food and shelter for the Chimney Swift, Red-Headed Woodpecker, and Sprague's Pipit. Yet, this water level increase will increase aquatic habitat which could benefit birds which rely on the lake's shoreline for foraging and breeding including the Least Tern, Little Blue Heron, and Prairie Loggerhead Shrike.

This raised water level also has the possibility of inundating nesting sites, which would negatively impact bird species like the Least Tern and the Little Blue Heron. Even if these sites are not inundated, they would likely at least be displaced which may force birds to nest in less suitable areas, which often leads to less reproductive success.

Alternative #4 - Powerhead Reserve/Inactive Pool (decrease the bottom of the conservation pool from 520 ft to 518.4 ft)

The effects listed above for Alternative 1 are applicable to Alternative 4.

Alternative #5 - Combination (conservation pool and flood pool)

The effects listed above for Alternative 3 are applicable to Alternative 5, though to a far less extreme extent. Expect more minor impacts of what was described under Alternative 3.

Alternative #6 - Combination (conservation pool and powerhead reserve/inactive pool)

Under Alternative 6, there would likely be no impacts to migratory birds. Under this alternative, there may be a slight exposure of new shoreline areas, which could produce more habitat for many species including the American Golden Plover, the Lesser Yellow legs, and the Pectoral Sandpiper, which prefer shallow water and mudflats. This small decrease in water level could potentially impact the vegetation in the areas, which may lead the impacts of availability of food and shelter for species like the Chimney Swift, Red-Headed Woodpecker, and Sprague's Pipit. Other species such as the Least Tern, Little Blue Heron, and Prairie Loggerhead Shrike rely on the lake's shoreline and vegetation for foraging and breeding, which may see minor impacts under this alternative.

4.9. Cultural Resources

This section discusses the existing condition of cultural resources using an integrated approach, that is, accomplishing analyses to comply with relevant cultural resource legislation in one document, including:

- National Environmental Policy Act (NEPA)
- National Historic Preservation Act (NHPA), specifically Section 106, overseen by the Advisory Council on Historic Preservation (ACHP)
- Historic Sites Act
- Antiquities Act
- Archeological Resources Protection Act (ARPA)
- Archeological & Historic Preservation Act (AHPA)
- American Indian Religious Freedom Act (AIRFA)
- Native American Graves Protection and Repatriation Act (NAGPRA)
- Religious Freedom Restoration Act (RFRA)

The NHPA of 1966, as amended, directs federal agencies to assume responsibility for all cultural resources under their jurisdiction. Section 106 of NHPA (and its implementing regulations) requires agencies to consider potential effects of their actions on historic properties, which are those properties that are listed or are eligible for listing on the National Register of Historic Places (NRHP). NHPA requires that federal agencies consult with the State Historic Preservation Officers (SHPOs), appropriate Tribal Historic Preservation Officers, federally recognized Native American tribes, and interested parties to ensure that all historic properties, including historic properties of religious or cultural significance to tribes, are adequately identified, evaluated, and considered in planning for proposed undertakings. Information regarding coordination is located in Section 7, Public Involvement, Review, and Consultation, and in Appendix H, National Historic Preservation Act Documentation and Correspondence.

The NHPA considers a “historic property” as any prehistoric or historic district, site, building, structure, or object included in or eligible for inclusion in the NRHP maintained by the Secretary of the Interior (National Park Service [NPS]). NRHP eligibility criteria require a historic property to demonstrate a quality of significance in American history, architecture, archaeology, and culture. They must possess aspects of integrity of location, design, setting, materials, workmanship, feeling, and association. Section 101(d)(6)(A) of NHPA, as amended, provides for properties of traditional religious and cultural importance to Native American tribes (traditional cultural properties) to be evaluated for potential inclusion in the NRHP. In addition, cultural resources must be at least 50 years old, except in exceptional circumstances. Sites that have not been evaluated to be either “eligible” or “not eligible” for the NRHP remain “unevaluated.”

An adverse effect under NHPA is found when an undertaking may alter, directly or indirectly, any of the characteristics of a historic property that qualify the property for inclusion in the NRHP in a manner that would diminish the property’s integrity. Adverse effects may include reasonably foreseeable effects caused by the undertaking that may occur later, be farther removed in distance, or be cumulative.

NEPA considers “cultural resources,” which has a broader definition and includes sacred sites, archaeological sites not eligible for the NRHP, and archaeological collections. Cultural resources include both tangible and intangible cultural materials including artifacts, archeological sites, buildings, ships, cemeteries, bridges and dams, paintings, sculptures, and landscapes. Significance is determined based on context and intensity. Impacts are analyzed in several contexts such as society, the affected region, the affected interests, and the locality. Intensity refers to the severity of effect, which includes factors such as the magnitude, geographic extent, duration, and frequency of the effect.

Previous Cultural Resource Investigations at Whitney Lake and Dam

The preliminary project footprint, the lake footprint and the USACE fee boundary (focused study area) were examined for previous cultural resource surveys that took place using the Texas Historical Commissions Archaeological Sites (Atlas) database. This review found 15 previous cultural resource surveys/archaeological testing efforts that took place within (or partially within) fee boundary. An extensive review of the "Digital Archaeological Record" website (https://core.tdar.org) also revealed an additional 21 cultural resource surveys/reconnaissance surveys/and excavation efforts that took place at Whitney Lake not represented on the Atlas.

The initial archeological investigations at Whitney Lake were conducted between 1947 and 1951 by the Smithsonian River Basin Surveys. During that period, 61 sites were recorded, five of which were excavated. Plans to enlarge the lake in the 1970s led to additional investigations by Southern Methodist University (SMU), during which 29 new sites were recorded. This was followed by excavations at the Bear Creek Shelter by SMU and the Fort Graham site by Wake Forest University. Limited survey work since then has added to the number of known archeological sites (USACE 2016). Since the 70's there have been intermittent cultural resource surveys conducted (in the 1980's, 90's and 2000's) within fee resulting in archaeological sites recorded.

A review of the Texas Historical Commissions Historic Sites Atlas (a databased focused on buildings, structures, objects, historic districts, etc.) didn't reveal any historic resource surveys that have taken place at Whitney Lake.

Recorded Cultural Resources at Whitney Lake and Dam

After reviewing the Texas Historical Commissions Archaeological Sites (Atlas) database, currently there are 110 archeological sites that have been recorded at Whitney Lake and Dam within the USACE fee boundary for the lake. Only 20 of these sites have been evaluated to determine their eligibility for the National Register of Historic Places (NRHP) (two listed, 7 eligible and 11 not eligible). The remaining 90 archeological sites have not yet been evaluated for NRHP eligibility. The two archaeological sites formally nominated to the NRHP within fee consist of a site called Bear Creek Shelter (41HI17) and another called Pictograph Cave (41HI22).

According to the Whitney Lake and Dam master plan and the Texas Historical Commissions office, currently there are two historic structures determined eligible to the NRHP at Whitney Lake: first the Whitney Dam and Powerhouse and second SH 174-Bridge over the Brazos River.

Although the review identified previous surveys, it is important to note that the majority of the preliminary project footprint has not been culturally surveyed to identify historic properties. There is a potential for encountering newly identified historic properties within the final developed Area of Potential Effect (APE) for this study.

The primary considerations concerning cultural resources with this study are threats from direct impacts to intact terrestrial archeological sites and direct and indirect impacts to historic structures from water inundation or exposure by water recession.

Alternative 1- No Action Alternative

Under the No Action Alternative, there would be no foreseeable horizontal or vertical impact to known cultural resources within the study area, aside from natural formation processes that occur over time due to the continuation of the existing condition.

Alternatives 2, 2A, 2C and 4

The effects described above for the No Action Alternative would be the same for Alternatives 2, 2A, 2C and 4.

Alternatives 3 and 5

Adverse impacts would occur horizontally and vertically to cultural resources within the shoreline region of the reservoir raising the conservation pool by 3 feet (for Alternative 3) or raising the conservation pool by 1.5 feet (Alternative 5). Both alternatives would result in moderate adverse direct effects on cultural resources from the new shoreline area being inundated (either permanently or temporarily) and experiencing wave action.

Alternative 6 - Combination (conservation pool and powerhead reserve/inactive pool)

Reservoir simulation modeling of this alternative shows that the lake elevation, on average, will be lower than any of the other alternatives in the focused array as well as the baseline water elevation of the reservoir. The mean elevation for the baseline water elevation of the reservoir is 532.2 ft and the mean elevation for this alternative is 531.3 ft. When plotting the average elevation for every day in the year, the recession most notable from the period of July to December. This alternative, which lowers the bottom of the power pool to 512.0 ft and increases contracted water supply, would result in a one-foot drop/recession on average with most elevation reduction occurring the second half of the calendar year as shown in Figure 16. This alternative would not be changing the authorized elevation for the reservoir (i.e., Top of Conservation Pool: 533.0 ft), but reservoir modeling shows it would be altering the mean baseline elevation of the reservoir. This alternative would have a direct effect on cultural resources from lake recession exposing known/new archaeological sites to potential looting/vandalism as well as exposing known/new archaeological sites to wet/dry cycles that would lead to loss of archaeological site data. Activities associated with the Alternative 6 that impact cultural resources consist of lowering the conservation pool throughout a calendar year to 531.3 ft. The preliminary APE includes the horizontal footprint of all areas of direct impacts from the conservation pool being lowered from 532.2 ft to 531.3 ft on average (Figure 16).

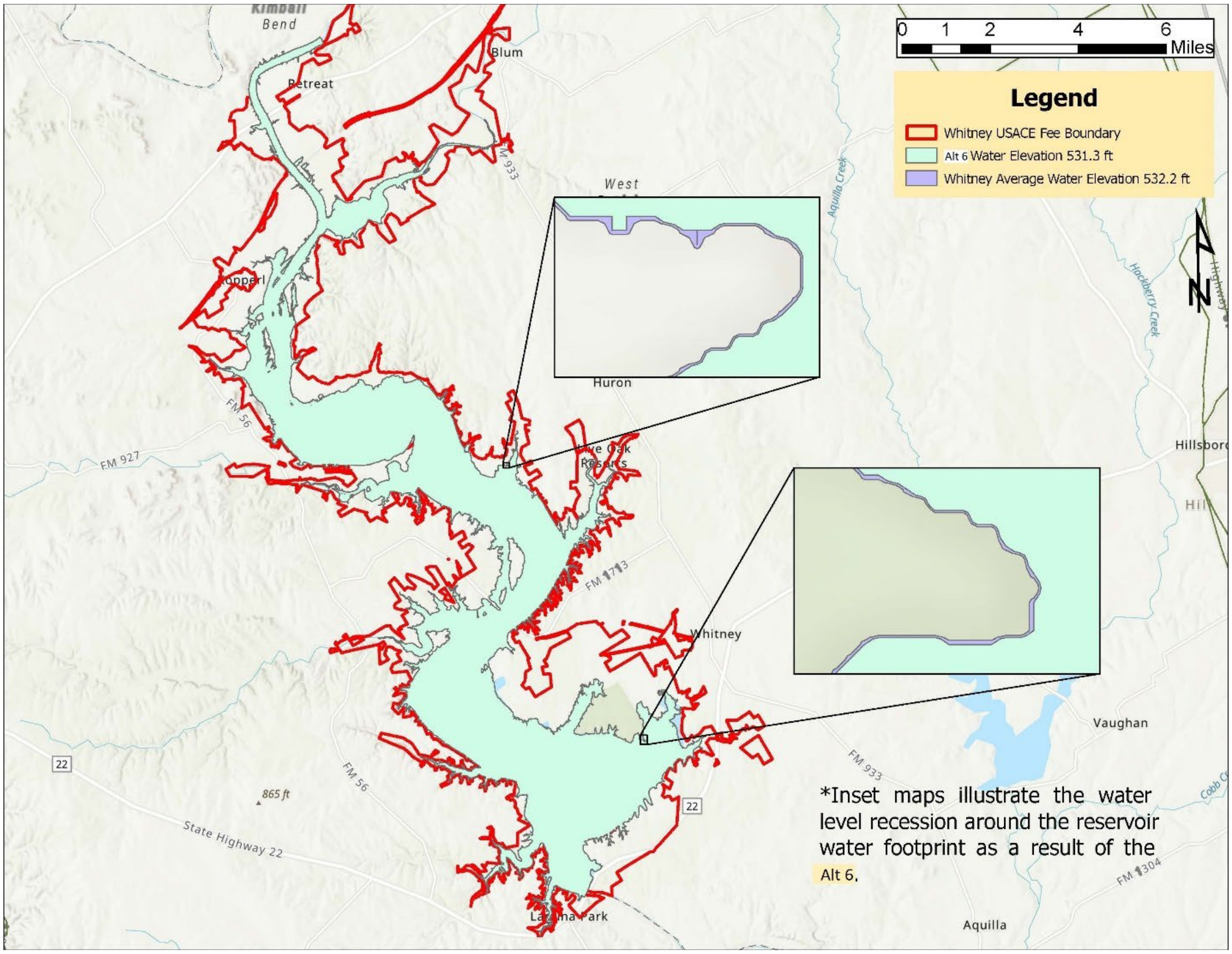

Figure 16. Preliminary Area of Potential Effects

Alternative 6 does impact known historic properties based on background research. With the Alternative 6 not being previously culturally surveyed to identify historic properties, pursuant to 36 CFR 800.4; the potential to encounter newly identified historic properties is high.

USACE would ensure that prior to the execution on a new water supply contract or amendment that intensive Section 106 cultural resource investigations to identify and evaluate any identified historic properties within the APE are performed, with the results being consulted on with the Texas SHPO and appropriate Tribal Nations. Further, any building, structure and/or object encountered during the proposed cultural resource investigations will be evaluated for potential inclusion in the NRHP, to include assessing its overall significance in the historic Whitney Lake complex.

Known terrestrial archaeological resources previously identified and recorded within the focused study area are primarily prehistoric in nature; however, some historic archaeological sites were previously identified and recorded. It is unknown what types of terrestrial archaeological resources will be encountered when the final developed APE is culturally surveyed to identify historic properties, but there is a potential to encounter both prehistoric and historic terrestrial archaeological resources based on background research.

USACE recommends intensive Section 106 cultural resource investigations to identify and evaluate any historic properties within the likely exposed areas of the reservoir. The scope of these investigations will be determined in consultation with the Texas State Historic

Preservation Officer and appropriate Native American Tribal Nations in accordance with the Programmatic Agreement developed for cultural resources for this study. Section 106 (16 U.S.C. 470f) of the National Historic Preservation Act of 1966, as amended, (NHPA) requires that Federal agencies consider their undertakings, or projects and the potential of those undertakings to impact significant cultural resources through the procedures found in 36 Code of Federal Regulations (CFR) Part 800 (Protection of Historic Properties). To fully consider the effects of a proposed project on cultural resources, USACE must consult with the Texas State Historic Preservation Office (SHPO) and federally recognized Native American tribes who have traditionally or historically used the area affect by the proposed action. USACE initiated consultation with the SHPO and appropriate Native American tribal nations in 2023.

Texas SHPO and Native American Tribal Nation consultation has been occurring throughout the planning process for this study, with all comments received addressed appropriately. The scope of these cultural resource investigations would be determined in consultation with the Texas SHPO and appropriate Native American Tribal Nations in accordance with the Programmatic Agreement developed for this study.

4.10. Air Quality

The U.S. Environmental Protection Agency (EPA) is primarily responsible for regulating air quality nationwide. The Clean Air Act (CAA) (42 U.S.C. 7401 et seq.), as amended, requires EPA to set National Ambient Air Quality Standards (NAAQS) for wide-spread pollutants from numerous and diverse sources considered harmful to public health and the environment. The CAA established two types of national air quality standards classified as either “primary” or “secondary.” Primary standards set limits to protect public health, including the health of at-risk populations such as people with preexisting heart or lung diseases (such as asthma), children, and older adults. Secondary standards set limits to protect public welfare, including protection against visibility impairment, damage to animals, crops, vegetation, and buildings.

EPA has set NAAQS for six principal pollutants known as “criteria” pollutants. Criteria pollutants include carbon monoxide (CO), nitrogen dioxide (NO2), ozone (O3), particulate matter less than 10 microns (PM10), particulate matter less than 2.5 microns (PM2.5), sulfur dioxide (SO2) and lead (Pb). If the concentration of one or more criteria pollutant in a geographic area is found to exceed the regulated “threshold” level for one or more of the NAAQS, the area may be classified as a non-attainment area. Areas with concentrations of criteria pollutants that are below the levels established by the NAAQS are considered either attainment or unclassifiable areas.

The air quality area of interest is the three-county area of Bosque, Hill, and Johnson Counties. Currently Bosque and Hill counties are in attainment for all criteria pollutants. However, Johnson County is in serious non-attainment for ozone air pollution.

Alternative 1- No Action Alternative

Under the No Action alternative, air quality around the lake would remain relatively the same. This alternative does not add new air emission sources or changes to the existing emission sources, which are likely as development continues over the next 50 years. No violations of the National Ambient Air Quality Standards (NAAQS) as established by EPA are expected as a result of the implementation of this alternative. Any new or increased emissions in the future would be permitted and regulated based on current and future NAAQS criteria and thresholds.

Alternative #2 - Conservation Pool (67% water supply and 33% hydropower)

Impacts to air quality under Alternative 2 would be only extremely minor in scale, especially in comparison to the primary factors causing air quality concerns in the area including industrial emissions, vehicular emissions, and agricultural operation. It’s possible, though unlikely, that this slightly lower water elevation observed under Alternative 2 could lead to increased dust as more shoreline and lakebed areas are exposed, which could contribute to higher levels of PM levels, especially on windier days. The slight decrease in water level may increase dry vegetation, which could lead to a marginal increase in wildfire risk, which is a major threat to air quality.

Alternative #2a - Conservation Pool (50% water supply and 50% hydropower)

The effects listed above for Alternative 2 are applicable to Alternative 2a to perhaps a slightly lesser extent.

Alternative #2c – Conservation Pool (energy focus)

The effects listed above for Alternative 2 & 2a are applicable to Alternative 2c to perhaps a slightly lesser extent than 2a.

Alternative #3 - Flood Pool (increase top of conservation 3ft)

The effects listed above for Alternative 1 are applicable to Alternative 3.

Alternative #4 - Powerhead Reserve/Inactive Pool (decrease the bottom of the conservation pool from 520 ft to 518.4 ft)

The effects listed above for Alternative 1 are applicable to Alternative 4.

Alternative #5 - Combination (conservation pool and flood pool)

The effects listed above for Alternative 1 are applicable to Alternative 5.

Alternative #6 – Combination (conservation pool and powerhead reserve/inactive pool)

The effects listed above for Alternative 2 are applicable to Alternative 6 to perhaps a slightly greater extent.

4.11. Socioeconomics and Other Social Effects

The zone of interest for this socioeconomic analysis includes Bosque, Hill, Johnson, and McLennan counties with additional economic influence extending up to a 100-mile radius of Whitney Lake. This four-county region and the nearby town of Whitney, where the most impacts would be expected, has been utilized as the basis in summarizing the population characteristics of Whitney Lake.

Table 18 shows the population data in most areas in the past decade. Whitney, TX was the only area to experience a decline in population, with a decrease of 4.55% from 2,087 to 1,992 residents. In contrast, the surrounding counties of Hill, Johnson, McLennan, and Bosque all saw population increases, ranging from 2.00% in Bosque County to 16.09% in Johnson County. At the state level, Texas experienced a significant population growth of 15.94%, with the population rising from 25,145,561 to 29,154,505. This trend is also reflected at the national level, with the United States as a whole seeing a population increase of 7.35% from 308,745,538 to 331,449,281.

Table 18. Local Population Growth

Geographic Area	2010	2020	Percent Change
Whitney, TX	2,087	1,992	-4.55%
Hill County	34,854	36,109	+3.60%
Johnson County	147,611	171,359	+16.09%
McLennan County	229,587	254,045	+10.65%
Bosque County	18,067	18,428	+2.00%
Texas	25,145,561	29,154,505	+15.94%
United States	308,745,538	331,449,281	+7.35%

Population projections for the specific study area are not available; however, it is likely that population levels will increase in the future based on historical trends, and the clear population expansion taking place within the adjacent metropolitan region. There is anticipated to be a rapid increase in demand in these areas, which coincides with population growth.

The population distribution across various age groups in the AOI in Table 19 provides insight into the socioeconomic characteristics of these regions. The data shows that areas such as Johnson County and McLennan County have a higher percentage of younger populations, with 13.5% and 18.1% of their populations falling within the 15-24 age group, respectively. This could indicate a stronger workforce and potential for economic growth in these areas. In contrast, areas like Bosque County have a higher percentage of older populations, with 15.1% and 14.3% of their populations falling within the 55-64 and 65-74 age groups, respectively. This may suggest a need for more age-related services and support in these regions. At the state and national levels, Texas and the United States have similar population distributions, with a relatively high percentage of working-age individuals.

Table 19. Population Distribution

Geographic Area	9 or Less	10 to 14	15 to 24	25 to 34	35 to 44	45 to 54	55 to 64	65 to 74	75 or more
Whitney, TX	10.7%	11.7%	15.9%	9.1%	9.8%	11.2%	9.9%	9.1%	12.4%
Hill County	11.7%	7.5%	12.5%	11.0%	11.5%	11.7%	14.0%	12.0%	8.3%
Johnson County	14.5%	6.4%	13.5%	12.6%	14.8%	12.5%	11.7%	8.5%	5.6%
McLennan County	13.0%	6.7%	18.1%	13.1%	12.3%	10.6%	10.7%	9.3%	6.3%
Bosque County	11.1%	5.5%	10.9%	9.6%	11.4%	11.1%	15.1%	14.3%	10.9%
Texas	13.1%	7.2%	13.1%	14.3%	14.2%	12.3%	11.0%	8.4%	5.4%

United States	12.1%	6.5%	13.2%	13.9%	12.6%	12.7%	12.9%	9.4%	6.7%

Table 20 shows the median household income and poverty rate for the AOI. This data indicates a range of median household incomes and poverty rates. The area has a mix of higher and lower income communities, with Johnson County having the highest median household income at 83,787 and Whitney, TX having the lowest at 42,024. Poverty rates also vary, with Bosque County having the lowest rate at 9.1% and Whitney, TX having the highest rate at 21.8%. This socioeconomic diversity suggests that the project's potential environmental and economic impacts may affect different communities within the project area in varying ways.

Table 20. Median household income and poverty rate by geographic area

Geographic Area	Median Household Income	Poverty Rate
Whitney, TX	$42,024	21.8%
Hill County	$63,147	14.2%
Johnson County	$83,787	10.2%
McLennan County	$63,553	17.1%
Bosque County	$69,339	9.1%
Texas	$75,780	13.7%
United States	$74,755	12.6%

The demographic data for the AOI, as seen in Table 21, indicates a diverse population with varying racial and ethnic compositions. The majority of the population in the project area identifies as White Alone, with percentages ranging from 57.1% in McLennan County to 79.4% in Bosque County. The Hispanic/Latino population is also significant, with percentages ranging from 18.8% in Bosque County to 27.2% in McLennan County. The project area also has smaller but still notable populations of Black, Asian, and Native American/Alaskan individuals.

Table 21. Demographic Data by race/ethnicity

Geographic Area	White Alone	Black	Asian	Native American/Alaskan	Other	2 or More Races	Hispanic /Latino
Whitney, TX	77.3%	6.6%	1.9%	0.3%	6.5%	7.5%	20.5%
Hill County	75.1%	6.1%	0.6%	0.2%	9.1%	8.8%	23.5%
Johnson County	68.7%	5.9%	1.3%	0.7%	5.1%	18.1%	25.9%
McLennan County	57.1%	14.4%	1.7%	0.6%	4.0%	22.3%	27.2%
Bosque County	79.4%	1.4%	0.5%	0.1%	4.8%	13.8%	18.8%

Texas	47.7%	12.3%	5.7%	0.9%	9.9%	23.3%	39.8%
United States	57.8%	12.1%	0.7%	5.9%	0.2%	4.1%	18.7%

Other Social Effects

The area of interest for this project encompasses seven census tracts in Bosque and Hill counties, which will be assessed for potential social effects that may be exacerbated by the project. The tracts in Bosque County, including Census Tracts 9501, 9503, and 9506, share similar concerns related to climate hazards, low income, and negative health outcomes.

Census Tract 9501 in Bosque County, with a population of 4,326 and has multiple risks which are of concern. This census tract has concerns with the expected building loss rate in the area, as assessed by the Natural Hazards Risk Index. In this index, this community falls within the 82nd percentile, which leaves them particularly vulnerable to destruction from natural hazards, including flooding. Also assessed by the Natural Hazards Risk Interest is the expected population loss rate, in which tract 9501 falls in the 89th percentile, which assesses risk to life from these same natural hazards. This community is also considered particularly vulnerable for projected wildfire risk as well, landing in the 93rd percentile. Furthermore, income is a concern for this tract, where the mean income for a household is $83,306, landing in the 72nd percentile for low-income metrics among all tracts nationwide. Despite this, energy cost is known to be relatively high in the area, landing in the 87th percentile with an energy burden of 5%. This tract also struggles with negative health outside with recent estimates showing 1470 adults diagnosed with diabetes (87th percentile), and 900 adults with a coronary heart disease (91st percentile). As assessed by the Department of Transportation, this tract also lands in the 98th percentile for the DOT Travel Barriers Score, which assesses the average of relative cost and time spent on transportation. Finally, this tract includes a population in which 15% of its population has not attained a high school diploma.

In contrast, Census Tract 9503, with a population of 1,353, has an expected building loss rate in the 91st percentile and a projected wildfire risk in the 92nd percentile. The energy burden is also high, ranking in the 87th percentile, with a burden of 5%. Health outcomes are concerning, with diabetes rates ranking in the 88th percentile and coronary heart disease affecting 930 adults, ranking in the 93rd percentile. The tract also faces transportation barriers, ranking in the 88th percentile for the DOT Travel Barriers Score, and has a population with 10% lacking a high school diploma.

Census Tract 9506, with a population of 1,789, has an expected population loss rate in the 91st percentile and a projected wildfire risk in the 94th percentile. The median household income is $70,250, ranking in the 84th percentile for low income. The energy burden is high, ranking in the 88th percentile, with a burden around 5%. Health outcomes are concerning, with diabetes rates ranking in the 92nd percentile and coronary heart disease affecting 1100 adults, ranking in the 98th percentile. The tract also struggles with transportation barriers, ranking in the 99th percentile for the DOT Travel Barriers Score.

In Hill County, Census Tract 9602, with a population of 4,498, faces significant climate hazards, with an expected population loss rate in the 93rd percentile and a projected wildfire risk in the 90th percentile. Coronary heart disease is a concern, with 780 individuals affected, ranking in the 80th percentile. The tract also faces transportation barriers, ranking in the 96th percentile for the DOT Travel Barriers Score, and has a population with 11% lacking a high school diploma.

Census Tract 9604, with a population of 2,105, has an expected population loss rate in the 91st percentile and a projected wildfire risk in the 94th percentile. The median household income is $63,103, ranking in the 83rd percentile for low income. The energy burden is high, ranking in the 93rd percentile, with a burden around 5%. Health outcomes are concerning, with diabetes rates ranking in the 89th percentile, coronary heart disease affecting 930 adults, ranking in the 96th percentile, and low life expectancy, with an average life expectancy of 71.7 years, ranking in the 94th percentile. Additionally, 5% of homes lack indoor plumbing or a kitchen, ranking in the 97th percentile, and 17% of the population lacks a high school diploma.

Census Tract 9605, with a population of 5,778, faces significant climate hazards, with an expected population loss rate in the 92nd percentile and a projected wildfire risk in the 93rd percentile. The life expectancy is low, ranking in the 81st percentile, with an average life expectancy of 74.9 years. The tract also faces transportation barriers, ranking in the 92nd percentile for the DOT Travel Barriers Score, and has a population with 10% lacking a high school diploma.

Finally, Census Tract 9606, with a population of 1,420, faces high climate hazards, with an expected population loss rate in the 94th percentile and a projected wildfire risk in the 96th percentile. The median household income is $52,216, ranking in the 85th percentile for low income. The energy burden is high, ranking in the 90th percentile, with a burden around 5%. Health outcomes are concerning, with diabetes rates ranking in the 93rd percentile and coronary heart disease affecting 930 adults, ranking in the 98th percentile. The tract also faces transportation barriers, ranking in the 88th percentile for the DOT Travel Barriers Score, and has a significant portion of the population (25%) lacking a high school diploma.

Overall, the census tracts in the areas closest to the lake, and thus are most likely to incur impacts, face significant social and environmental challenges, including climate hazards, low income, negative health outcomes, and transportation barriers. These concerns will be taken into account in the assessment of potential social effects of the project alternatives.

Alternative 1- No Action Alternative

In the absence of the proposed project, the socioeconomic conditions and social effects in the Whitney Lake area are expected to continue along current trends. The population in the four-county region of Bosque, Hill, Johnson, and McLennan counties is likely to increase, with Johnson County and McLennan County expected to experience the most significant growth. The age distribution in the area is anticipated to remain relatively stable, with a mix of younger and older populations, although areas like Bosque County may continue to have a higher percentage of older residents. The median household income and poverty rates in the area are expected to remain diverse, with some communities, such as Johnson County, having higher incomes and lower poverty rates, while others, like Whitney, TX, may continue to struggle with lower incomes and higher poverty rates.

The demographic characteristics of the population in the area, including racial and ethnic composition, are likely to remain relatively stable, with the majority of the population identifying as White Alone, followed by significant Hispanic/Latino populations. The social effects in the area, including climate hazards, low income, negative health outcomes, and transportation barriers, are expected to persist, particularly in the census tracts closest to the lake. These tracts, including Census Tracts 9501, 9503, 9506, 9602, 9604, 9605, and 9606, are anticipated to continue facing significant challenges, including high expected building loss rates, projected wildfire risks, energy burdens, and poor health outcomes.

Without the proposed project, the existing social and environmental challenges in the area are likely to continue, and may even worsen, due to the lack of investment and attention to these issues. The population in the area may continue to experience negative health outcomes, including high rates of diabetes and coronary heart disease, and may face increased risks from climate hazards, such as flooding and wildfires. Current diminishing water resources may also become an issue under the No Action Alternative, though this is not as prominent of a concern in this region in comparison to much of the Western US. The transportation barriers and lack of access to education and economic opportunities may also persist, exacerbating the existing social and economic disparities in the area. There would be no impacts to communities downstream under any of the assessed alternatives as releases would remain unchanged as described in Section 4.1. Overall, the no-action alternative is expected to result in a continuation of the current socioeconomic conditions and social effects in the Whitney Lake and Dam area, with potentially negative consequences for the population and the environment; though these effects are not singularly attributable to the choice of this alternative and are likely to continue under most alternatives considered.

Alternative #2 - Conservation Pool (67% water supply and 33% hydropower)

Under Alternative 2, there are anticipated to be some impacts to socioeconomics and other social effects. Lowering the water elevation, even slightly, opens up the possibility for economic impacts. At a lower elevation level, there is the potential for harms in industries like tourism, fishing, and recreation. Should these impacts be seen, this may disproportionately impact low-income communities in the area, like the Whitney, TX, which already have a disproportionately high poverty rate (21.8%) and relatively lower median household income compared to other communities within the region.

There is also the possibility for increased inequity under this alternative. A lot of the communities closest to the lake already face significant social and environmental challenges, including climate hazards, low incomes, and negative health outcomes. A slight decrease in water elevation could exacerbate some of these preexisting issues.

However, the negligible impacts possible under this alternative would very likely be offset by the net benefit of providing water to these growing populations and ultimately avoiding other environmental and economic impacts associated with the construction of new infrastructure to otherwise address water resource needs.

Alternative #2a - Conservation Pool (50% water supply and 50% hydropower)

The effects listed above for Alternative 2 are applicable to Alternative 2a to perhaps a slightly lesser extent.

Alternative #2c – Conservation Pool (energy focus)

The effects listed above for Alternative 2 & 2a are applicable to Alternative 2c to perhaps a slightly lesser extent than 2a.

Alternative #3 - Flood Pool (increase top of conservation 3ft)

There are anticipated to be moderate impacts to socioeconomics and other social effects under Alternative 3. Under the rise in elevation associated with this alternative, it makes it more likely that low lying areas around the reservoir would be flooded out in the case of an extreme flood event. This could disproportionately impact properties, infrastructure, and agricultural lands in lower income communities in the area with more limited access to resources. These extreme flood case could also lead to the displacement and relocation of residents, especially in those areas with inadequate flood protection.

The effects that come partially as a result of this elevation increase could also be inequitably distributed, placing communities with higher risk factors in greater danger than those in more affluent areas.

There is also the potential that some communities experience benefits in socioeconomics in other social effects as a result of this alternative. This alternative would increase water storage and theoretically enhance recreational opportunities. However, it should be noted that it's unlikely these benefits would be evenly distributed, and many communities may not have the resources of infrastructure to take advantage of these stated "benefits".

Alternative #4 - Powerhead Reserve/Inactive Pool (decrease the bottom of the conservation pool from 520 ft to 518.4 ft)

The effects listed above for Alternative 1 are applicable to Alternative 4.

Alternative #5 - Combination (conservation pool and flood pool)

The effects listed above for Alternative 3 are applicable to Alternative 5 to perhaps a slightly lesser extent.

Alternative #6 - Combination (conservation pool and powerhead reserve/inactive pool)

The effects listed above for Alternative 2 are applicable to Alternative 6.

4.12. Recreation

Whitney Lake and Dam is a popular place for public recreation including a total of 4,478 acres of total recreation. Of the classified recreation areas, USACE operated areas include, 11 parks, 449 campsites, 14 boat ramps, 4 marinas, 3 swim beaches. Four parks are not operated by USACE and are leased by surrounding counties.

The peak visitation months on Whitney Lake and Dam are April through September when 82 percent of visits occur. June is the highest visitation month and accounts for 17 to 21 percent of the annual total. Approximately 95 percent of visits to recreation areas occur in USACE-managed recreation areas. The remaining visitation takes place on USACE lands that have been leased to marina operators and to TPWD, Johnson County, Hill County, and the City of Whitney for recreational purposes.

Recreational use at Whitney Lake and Dam continues to evolve. While visitation in USACE managed recreational areas remains strong, there is demand for recreational opportunities not offered in these parks that would likely continue to be addressed throughout the future.

Alternative 1- No Action Alternative

Under the No Action Alternative, increased climate instability may present challenges to recreation at Lake Whitney. Increased frequency of extreme weather events could lead to temporary closures of recreational areas and potential damage to facilities. Natural fluctuations due to altered precipitation patterns could impact boat ramp accessibility, shoreline recreation, and overall lake usability. Extended periods of drought, even without reallocation, could reduce the lake's appeal for water-based recreation. Warmer water temperatures could also increase the risk of harmful algal blooms, leading to beach closures where present. The 4 parks leased to surrounding counties would continue to provide recreational opportunities under this alternative, with their management and maintenance remaining the responsibility of those entities, and any changes in their funding or priorities could affect recreational access.

Under the No Action Alternative, recreational access would be periodically affected by high water levels. Specifically, at a reservoir elevation of 534 feet, three primitive campsites located between Lofers Bend East and Plowman Creek Park would become inaccessible. Additionally, the boat ramp and dock at Steele Creek Park, along with a second dock and two picnic areas within other fee-owned lands, would be unavailable for use.

Continued implementation of the No Action Alternative would also result in temporary closures of outgranted recreational facilities, particularly at Whitney Ridge Marina. At 534 feet elevation, six docks and one boat ramp would be closed. Three additional boat ramps at other facilities would also be impacted at this water level. Furthermore, approximately 0.25 miles of trails within Whitney Lake State Park would be submerged and temporarily unusable.

Overall, the No Action Alternative is anticipated to result in moderate, but gradual, changes to recreation at Lake Whitney. While the lake would likely remain a popular recreational destination, the evolving nature of recreational demand, potential infrastructure degradation, and the impacts of climate instability could affect the quality and diversity of recreational experiences under this alternative. There would be no impacts to recreation downstream under any of the assessed alternatives as releases would remain unchanged as described in Section 4.1. These impacts under Alternative 1, are not unique to this alternative, and would likely remain relevant under any alternative selected.

Alternative #2 - Conservation Pool (67% water supply and 33% hydropower)

The effects listed above for Alternative 1 are applicable to Alternative 2.

Alternative #2a - Conservation Pool (50% water supply and 50% hydropower)

The effects listed above for Alternative 1 are applicable to Alternative 2a.

Alternative #2c – Conservation Pool (energy focus)

The effects listed above for Alternative 1 are applicable to Alternative 2c.

Alternative #3 - Flood Pool (increase top of conservation 3ft)

There would likely be substantial impacts to recreation under Alternative 3. Under this alternative there would be a direct expansion of the lake's surface area at typical conservation pool levels. This expansion could improve access for boating, fishing, and other lake activities. However, implementation of Alternative 3 would result in temporary, yet recurring, impacts to recreational facilities at USACE-owned and operated facilities due to inundation during periods of high reservoir elevation. These impacts include the temporary loss of access to 10 boat ramps and 7 dock facilities. Recreational access would also be diminished by the loss of 26 picnic sites, 2 beaches, 11 electric campsites, and 19 primitive campsites. Approximately 200,000 square feet of roadway and 50,000 square feet of parking areas would be inundated, impacting vehicular access. The alternative would also result in the loss of access to approximately four acres of parkland situated between Cedron Creek Park and Plowman Creek Park, reducing available recreational space.

In addition to impacts on USACE-managed lands, Alternative 3 would also affect recreational opportunities at outgranted areas in close proximity to the reservoir. During periods of highest reservoir elevation, 13 boat ramps and 36 dock facilities at these locations would be subject to closure. Further impacts include the closure of eight picnic areas, one fuel dock, and one fish house, as well as 0.6 miles of trails. Approximately 18,400 square feet of parking areas at these facilities would be damaged due to inundation. These impacts would further reduce recreational opportunities for users of both USACE and outgranted facilities.

While the 3-foot increase could mitigate some impacts of drought conditions by maintaining more water volume for recreation, prolonged drought could still lead to reduced recreational opportunities. Furthermore, the construction activities associated with facility modifications could cause temporary disruptions to recreational access for members of the public.

To offset these impacts to recreational facilities, specifically to boat ramp accessibility, raising or extending existing boat ramps, or constructing new ramps, would be necessary to maintain functionality at higher lake levels. Similarly, docks would require adjustments to prevent submersion. Roads and parking areas adjacent to the lake would be vulnerable to increased erosion and flooding, necessitating upgrades and protective measures. The potential for increased erosion along the shoreline also presents a challenge, potentially impacting picnic areas, campsites, and natural shoreline aesthetics in recreation areas.

Alternative #4 - Powerhead Reserve/Inactive Pool (decrease the bottom of the conservation pool from 520 ft to 518.4 ft)

The effects listed above for Alternative 1 are applicable to Alternative 4.

Alternative #5 - Combination (conservation pool and flood pool)

There would likely be extensive impacts to recreation under Alternative 5, though less severe than those observed under Alternative 3. This increase in the conservation pool would likely enhance the consistency of water-based recreational opportunities, such as boating and fishing, by reducing the frequency and duration of low-water conditions. However, realizing these benefits requires addressing potential impacts to existing recreational infrastructure and managing associated costs.

Implementation of Alternative 5 would result in temporary, but recurring, impacts to recreational facilities at USACE-owned and operated facilities due to inundation during periods of high reservoir elevation. These impacts include the temporary loss of access to 7 boat ramps and 5 dock facilities. Recreational access would also be diminished by the closure of 19 primitive campsites, 10 electric campsites, and 16 picnic sites. Both beaches at McCown Valley Park and Lofers Bend Day Use Park would be closed during high-water events. Approximately 200,000 square feet of roadway and 16,000 square feet of parking areas would be inundated, impacting vehicular access. The alternative would also result in the loss of access to approximately four acres of parkland, consistent with impacts identified under Alternative 3, reducing available recreational space

In addition to impacts on USACE-managed lands, Alternative 5 would also affect recreational opportunities at privately operated facilities in close proximity to the reservoir. During periods of highest reservoir elevation, 12 boat ramps and 24 dock facilities at these locations would be subject to closure, along with one fuel dock. Inundation would also affect eight picnic areas and 0.6 miles of trails. Approximately 18,400 square feet of parking areas at these facilities would be completely inundated. These impacts would further reduce recreational opportunities for users of both USACE and privately operated facilities.

The same type of mitigation proposed for Alternative 3 would be needed for Alternative 5 to offset recreational impacts.

Alternative #6 - Combination (conservation pool and powerhead reserve/inactive pool)

The effects listed above for Alternative 2 are applicable to Alternative 6.

4.13. Hazardous, Toxic, and Radioactive Waste

In order to complete a feasibility level Hazardous, Toxic, Radiological Waste (HTRW) evaluation for the Whitney Reallocation Study, a records review was conducted following the guidance of ER 1165-2-132: *HTRW Guidance for Civil Works Projects*, and portions of ASTM E1527- 13: *Standard Practice for Environmental Site Assessment: Phase 1 Environmental Site Assessment Process*. The proposed project involves the reallocation of storage to authorized purposes. For the purposes of this records search, the lake and immediate vicinity out to one mile were considered the footprint of the project. This review does not constitute a Phase I ESA.

The areas directly surrounding Whitney Lake and Dam and out to one mile are majority natural, commercial, and residential. These properties are primarily used for recreation with little to no HTRW concerns within the project footprint. Additional modeling should be conducted to determine downstream effects and flooding hazards associated with the reallocation of water within Lake Whitney.

In the records review, files, maps and other documents that provide environmental information about the project area are obtained and reviewed. To complete the records review, USACE reviewed publicly available databases and sources, using the proposed footprint of the project described above. Once the database searches were complete, USACE analyzed the results for recognized environmental conditions (RECs) that could affect the proposed project or need further investigation, given the proposed project measures. The results of that analysis, specifics of the REC (where applicable), and justification for dismissal from further evaluation (where applicable) are discussed below in Section 3.0.

Due to the extensive area of the search, environmental databases had to be searched manually. These databases included the following sources:

- Environmental Protection Agency (EPA) Cleanups in my Community (CIMC) database
- Texas and Tribal Voluntary Cleanup Sites
- EPA Envirofacts database

Alternative 1- No Action Alternative

EPA conducts and supervises investigation and cleanup actions at sites where oil or hazardous chemicals have been or may be released into the environment. Cleanup activities take place at active and abandoned waste sites, federal facilities and properties, and where any storage tanks have leaked. EPA, other federal agencies, states or municipalities, or the company or party responsible for the contamination may perform cleanups. This multisystem viewer compiles data from multiple databases to include RCRA generators, brownfields, and other environmental conditions. No sites of concern were found after a search for this site.

The Voluntary Cleanup Program is administered by the Texas Commission on Environmental Quality and consists of a database. A review of the regulated search results list did not yield any significant RECs within the potential area.

Alternative #2 - Conservation Pool (67% water supply and 33% hydropower)

The effects listed above for Alternative 1 are applicable to Alternative 2.

Alternative #2a - Conservation Pool (50% water supply and 50% hydropower)

The effects listed above for Alternative 1 are applicable to Alternative 2a.

Alternative #2c – Conservation Pool (energy focus)

The effects listed above for Alternative 1 are applicable to Alternative 2c.

Alternative #3 - Flood Pool (increase top of conservation 3ft)

The effects listed above for Alternative 1 are applicable to Alternative 3.

Alternative #4 - Powerhead Reserve/Inactive Pool (decrease the bottom of the conservation pool from 520 ft to 518.4 ft)

The effects listed above for Alternative 1 are applicable to Alternative 4.

Alternative #5 - Combination (conservation pool and flood pool)

The effects listed above for Alternative 1 are applicable to Alternative 5.

Alternative #6 - Combination (conservation pool and powerhead reserve/inactive pool

The effects listed above for Alternative 1 are applicable to Alternative 6.

4.14. Aesthetics

Whitney Lake and Dam is a scenic lake that offers a blend of natural beauty. It is characterized by its beautiful limestone cliffs, surrounding rolling hills, and wooded areas. The shoreline is dotted with numerous coves, inlets, and peninsulas which creates a diverse and interesting landscape.

The lake's aesthetic value is further enhanced by diverse wildlife, including bald eagles, osprey, and white pelicans, which offers unique wildlife watching opportunities. The shoreline is also home to a variety of plant species including wildflowers, trees, and shrubs which add to the lake's natural beauty.

This all makes it a popular destination for boating and camping. While Whitney Lake does not have a Visitor Center, the Lofers Bend Park Walking Trail can be used for interpretation, including nature walks and plant identification.

Alternative 1- No Action Alternative

Lands around Whitney Lake and Dam generally provide a natural setting that are aesthetically pleasing to recreational users. Fluctuations in lake levels are one of the main contributors to changes in lake aesthetics. Increases in lake elevation could submerge vegetation and trees surrounding the lake, causing aesthetic changes including deteriorating and dead trees and vegetation. Decreases in elevation could expose rocky shorelines to a greater extent. These potential changes in the shoreline of Whitney Lake and Dam are typically short-term in nature but could be considered aesthetically unappealing and may discourage boaters and other recreational users from visiting the lake. Over the long-term, changes in vegetation type and extent could occur based on the dynamics of long-term changes in surface water elevation. There would be no impacts to aesthetics downstream under any of the assessed alternatives as releases would remain unchanged as described in Section 4.1. The aesthetics would not undergo increased changes from the existing conditions due to implementation of the No Action Alternative.

Alternative #2 - Conservation Pool (67% water supply and 33% hydropower)

There are likely to be minor impacts to aesthetics under Alternative 2. A slight lowering of water elevation may expose more unique shoreline features, such as small unique geological formations and an increase in the visibility of coves and inlets which may create a more dramatic and intricate shoreline. The lower water level could concentrate certain wildlife in specific areas, making it slightly easier for visitors to be able to spot Bald Eagles, Osprey, White Pelicans, and other majestic wildlife species.

Meanwhile, this lowering of water elevation may introduce a number of negative impacts on aesthetic value. This lowering could potentially expose more shoreline debris, such as stumps and branch which could detract what would traditionally be considered the beauty of the lake. This adjustment in water level could change plant species distribution as well which may change the lake's aesthetic character. Additionally, a lower water level may mean marginally warmer water temperatures which could in turn increase algal growth and take away from the natural beauty.

Alternative #2a - Conservation Pool (50% water supply and 50% hydropower)

The effects listed above for Alternative 2 are applicable to Alternative 2a to perhaps a slightly lesser extent.

Alternative #2c – Conservation Pool (energy focus)

The effects listed above for Alternative 2 & 2a are applicable to Alternative 2c to perhaps a slightly lesser extent than 2a.

Alternative #3 - Flood Pool (increase top of conservation 3ft)

There are likely to be minor impacts to aesthetic resources under Alternative 3. An increased water elevation could create a more dramatic and scenic landscape and create a more intricate shoreline. The increased water level could bring more waterfowl and other wildlife closer to the shoreline, which would provide better wildlife watching experiences for visitors. The increased elevation may also lead to more moisture in the soil which could cause vegetation along the shorelines to become more lush, colorful, and vibrant which may enhance the lake's overall aesthetic value.

This water level increase could also inundate some of the most valued shoreline features, such as some small rocky outcroppings or other unique geological formations. This higher water level could also lead to increased erosion of the shoreline, potentially causing the loss of valuable vegetation that contributes to the lake's natural beauty.

Alternative #4 - Powerhead Reserve/Inactive Pool (decrease the bottom of the conservation pool from 520 ft to 518.4 ft)

The effects listed above for Alternative 1 are applicable to Alternative 4.

Alternative #5 - Combination (conservation pool and flood pool)

The effects listed above for Alternative 3 are applicable to Alternative 5, though likely more limited in severity of impacts.

Alternative #6 - Combination (conservation pool and powerhead reserve/inactive pool)

The effects listed above for Alternative 2 are applicable to Alternative 6.

4.15. Noise

The noise environment at Whitney Lake and Dam is characterized by a mix of natural and human induced sounds. The lake is in a rural location with a surrounding landscape of rolling hills and wooded areas which contribute to a relatively quiet and tranquil atmosphere.

Natural sounds heard at the lake include birdsongs and calls from birds such as bald eagles and waterfowl; insect sounds; sounds of lapping waves against the shoreline; and the rustling of leaves in the breeze.

Human sounds at the lake meanwhile persist among recreation activities, such as boating and fishing which generate sound from equipment or voices. There's also limited traffic noise from nearby roads and highways depending on your position on the lake as well as occasional aircraft noise. Noise may occasionally originate from nearby residential and commercial properties as well from activities such as lawn maintenance and other day-to-day activities.

Overall, noise levels at the lake are generally no higher than 40 to 60 dBA which is equivalent to a quiet conversation or a breeze.

Alternative 1- No Action Alternative

The noise levels in and around Whitney Lake are typical of those normally found in areas where water recreation takes place (i.e., noise from boats, jet skis, and other recreational vehicles and equipment). Recreational use and associated noise levels at Whitney Lake are not considered excessive but may increase gradually under the No Action Alternative as population numbers increase in the surrounding areas. There would be minor adverse effects associated with noise levels at Whitney Lake due to increased long-term recreational use with implementation of the No Action Alternative. This assumption would be the same for all alternatives. There would be no impacts to noise downstream under any of the assessed alternatives as releases would remain unchanged as described in Section 4.1.

Alternative #2 - Conservation Pool (67% water supply and 33% hydropower)

There is not likely to be demonstrative impacts to noise under Alternative 2. A slightly lower water level could result in marginally reduced wave action against the shoreline, which may decrease some noise from waves. It's also possible that a more exposed shoreline associated with this alternative could lead to increased vegetation and thus more birds which would add more birdsongs and calls to the area. Shoreline and boating activities are still fairly likely to continue as currently exists under Alternative 2 or perhaps increase gradually over time as discussed under Alternative 1.

Alternative #2a - Conservation Pool (50% water supply and 50% hydropower)

The effects listed above for Alternative 2 are applicable to Alternative 2a to perhaps a slightly lesser extent.

Alternative #2c – Conservation Pool (energy focus)

The effects listed above for Alternative 2 & 2a are applicable to Alternative 2c to perhaps a slightly lesser extent than 2a.

Alternative #3 - Flood Pool (increase top of conservation 3ft)

There is not likely to be impacts to noise under Alternative 3. The higher water elevations experienced under this alternative could potentially increase wave action noise. There's also the chance that this rise in water also results in a growth of aquatic vegetation which could also increase birdsongs and other sounds in nature. This higher lake level could also result in an increase in boat traffic and the associated noise if it is easier for boats to access for areas within the lake.

Alternative #4 - Powerhead Reserve/Inactive Pool (decrease the bottom of the conservation pool from 520 ft to 518.4 ft)

The effects listed above for Alternative 1 are applicable to Alternative 4.

Alternative #5 - Combination (conservation pool and flood pool)

The effects listed above for Alternative 3 are applicable to Alternative 5, though likely more limited in severity of impacts.

Alternative #6 - Combination (conservation pool and powerhead reserve/inactive pool)

The effects listed above for Alternative 2 are applicable to Alternative 6.

4.16. Climate Instability

The Whitney Lake and Dam area has already experienced the impacts of climate instability. Over the past century, the average temperature in the region has risen by approximately 1.5°F (0.8°C), with an average annual temperature of 64.4°F (18°C) (NOAA, 2020). This trend is consistent with the overall trend in Texas, where temperatures have been increasing at a rate of about 0.5°F (0.3°C) per decade since 1970 (Karl et al., 2017). The increased temperatures have likely contributed to changes in the lake's water quality and ecosystems, including shifts in the distribution and behavior of aquatic species (IPCC, 2019).

Changes in precipitation patterns have also been observed in the Whitney Lake area. The region has experienced an increase in extreme precipitation events, including heavy rainfall and flash flooding, over the past few decades (USGS, 2020). According to data from the National Oceanic and Atmospheric Administration (NOAA), the area has seen an increase in the number of days with precipitation exceeding 2 inches (50 mm) per day, which can lead to increased stormwater runoff and nutrient loading into the lake (NOAA, 2020). Conversely, the region has also experienced periods of drought, including the severe drought of 2011, which can impact the lake's water levels and water quality (TPWD, 2012).

The impacts of changing conditions on Whitney Lake's water quality and ecosystems are likely forthcoming. The BRA 2022 Basin Summary Report, had not yet identified changing trends in water quality at Lake Whitney. However, at pace with warming planetary conditions, warmer water temperatures are likely to soon follow which are known to lead to an increase in algal blooms and aquatic plant growth and can affect the lake's trophic state and aquatic ecosystems (EPA, 2020). Changes in precipitation patterns have lead to more frequent and severe droughts leading to increasingly fluctuating water levels (USGS, 2020). These changes can have cascading effects on the lake's ecosystems, including impacts on fish populations and other aquatic species (TPWD, 2020).

In terms of human health and safety, the Whitney Lake and Dam area has already experienced the impacts of changing conditions. The increased frequency and severity of heatwaves, for example, can exacerbate existing health conditions, such as heat stress and respiratory problems, particularly for vulnerable populations like the elderly and young children (CDC, 2020). Additionally, the increased risk of extreme weather events, such as flash flooding and tornadoes, can pose a threat to human safety and property (NWS, 2020). While the full extent of these impacts is still being studied, it is clear that changing conditions has already had considerable effects on the Whitney Lake area, and these effects would likely continue to evolve in the coming years.

Alternative 1- No Action Alternative

Under the No Action Alternative, the Whitney Lake and Dam area is expected to continue experiencing the impacts of climate instability, with potentially severe consequences for the environment, ecosystems, and human health. Without any intervention, the average temperature in the region is likely to continue rising, potentially exceeding the current rate of 0.5°F (0.3°C) per decade, leading to further changes in the lake's water quality and ecosystems. The increased frequency and severity of extreme precipitation events, including heavy rainfall and flash flooding, will likely persist, resulting in increased stormwater runoff and nutrient loading into the lake. Conversely, the region will also continue to experience periods of drought, which can impact the lake's water levels and water quality. As a result, the lake's ecosystems will likely continue to shift, with potential increases in algal blooms and aquatic plant growth, affecting the lake's trophic state and aquatic ecosystems. The impacts on human health and safety will also persist, with the increased frequency and severity of heatwaves, extreme weather events, and other climate-related stressors posing a threat to vulnerable populations, such as the elderly and young children. Though the No Action Alternative features likely decline of resources and ecosystem services in the area, it is unlikely any of the alternatives would provide more favorable conditions regarding climate instability concerns.

Alternative #2 - Conservation Pool (67% water supply and 33% hydropower)

There is unlikely to be much impact to climate instability under Alternative 2. Under this alternative, we are unlikely to see demonstrable changes in greenhouse gas emissions, global temperature trends, or participation patterns. A lower water level could lead to a marginal increase in evaporation from the lake's surface, which could potentially contribute to local climate instability by increasing the amount of water vapor in the air. However, evaporation patterns remain complex and these evaporation increases seen as a result of a decrease in depth could be partially or fully offset by the decrease in surface area experienced under this alternative. Beyond that, all other impacts to climate instability under Alternative 1 would remain relevant under Alternative 2.

Alternative #2a - Conservation Pool (50% water supply and 50% hydropower)

The effects listed above for Alternative 2 are applicable to Alternative 2a.

Alternative #2c – Conservation Pool (energy focus)

The effects listed above for Alternative 2 are applicable to Alternative 2c.

Alternative #3 - Flood Pool (increase top of conservation 3ft)

The effects listed above for Alternative 2 are applicable to Alternative 3.

Alternative #4 - Powerhead Reserve/Inactive Pool (decrease the bottom of the conservation pool from 520 ft to 518.4 ft)

The effects listed above for Alternative 1 are applicable to Alternative 4.

Alternative #5 - Combination (conservation pool and flood pool)

The effects listed above for Alternative 2 are applicable to Alternative 5.

Alternative #6 - Combination (conservation pool and powerhead reserve/inactive pool)

The effects listed above for Alternative 2 are applicable to Alternative 6.

4.17. Reasonably Foreseeable Future

The impact analysis for each resource above presents the direct and indirect effects of the final array of alternatives on each resource's affected environment. The resource conditions described account for the effects to resources related to past and present actions. This Section further considers the effects of each alternative combined with reasonably foreseeable future actions and conditions for all resources.

Reasonably foreseeable future actions would include future development i.e. residential in the area surrounding the lake and future water supply actions such as water conservation efforts, etc. identified in the 2021 Brazos G Regional Water Plan. Future development would typically require soil disturbance, vegetation removal, and transformation of pervious surfaces into impervious areas. This could lead to erosion during construction activities and increased surface water runoff which would lead to habitat loss and water quality impacts resulting in impacts to wildlife including ESA listed species. An increase in development and population could put a strain on nearby recreation facilities such as those at Whitney Lake and Dam. The final array of alternatives would not cumulatively contribute to impacts from future development because the potential impacts from these alternatives are anticipated to be similar the existing condition with the exception of recreation impacts. Recreational impacts from Alternatives 3 and 5 could put an additional strain on recreational facilities at Whitney Lake and Dam when combined with impacts from an increase in development.

In assessing reasonably foreseeable future effects on known historic properties (or properties that are treated as eligible until formal evaluation by SHPO/appropriate Tribal Nations) within the focused study area there is a high potential for reasonably foreseeable future effects from implementation of all the action alternatives due to the unpredictable nature of water movement horizontally and vertically. The PA for this study was written to make a reasonable and good faith effort to account for adverse effects that are reasonably foreseeable, may occur later in time, be farther removed in distance, or cumulative and appropriately avoid or mitigate them.

5. Plan Comparison and Selection

5.1. Plan Comparison

The final array of alternatives went through technical analysis through several modeling efforts including Riverware, HEC-RAS, and modeling efforts related to hydropower analysis. Results are presented in this section along with a summary of comprehensive benefits for all final alternatives.

5.2. Derivation of User Cost

USACE's ER 1105-2-100 specifies the four pricing methods used to calculate the value of storage considered for reallocation (i.e. the price to be charged for the capital investment for reallocated storage). The value placed on the storage is the highest of the four methods. In addition to determining user cost, USACE must ensure that the reallocation of Federal storage to water supply is the most economical alternative compared to other sources of water (including the Next Least Costly Alternative), which is discussed in Section 5.5. Reallocated storage to water supply can be repaid over a period not to exceed 30 years.

5.2.1. Hydropower

The USACE Hydropower Analysis Center (HAC) estimated impacts to the hydropower project at Whitney Lake and Dam that could manifest if the USACE reallocates water storage. The primary results of this analysis are estimates of the impacts to the economic benefits associated with hydropower operations at the project and estimates of the revenue impacts to SWPA, the Power Marketing Agency (PMA) responsible for the sale and delivery of the project's power. HAC worked extensively with USACE staff at Fort Worth District, Water Management and the Water Management and Reallocation Studies Planning Center of Expertise, as well as representatives from SWPA and the study sponsor, to ensure analytical rigor and accuracy.

5.2.1.1. National Economic Development Impacts to Hydropower

Monetary figures are expressed at fiscal year 2025 price levels. Some prices, such as annual wholesale generation prices in the Energy Information Agency Annual Energy Outlook forecasts, are based on a calendar year price level rather than fiscal year. Because the fiscal year overlaps three-quarters of the calendar year, these prices are used as fiscal year prices, without adjustment. Costs and benefits occurring at different points in time are converted to an average annual equivalent basis over a 50-year period of analysis using the federal discount rate prescribed for water resources projects (at the time of analysis 3.00 percent).

Appendix D contains the complete HAC report, and details important considerations regarding hydropower economic analysis, and material presented here summarizes key metrics applied in plan formulation and analysis. One unique characteristic of Whitney Lake and Dam hydropower operations is that SWPA's customers primarily use the project's capacity to provide spinning reserves capacity to the regional power market operated by The Electric Reliability Corporation of Texas (ERCOT).

In general, most energy produced at Whitney Lake and Dam is the result of water supply and flood control related releases through the powerhouse, and releases for power production itself are relatively infrequent - occurring on fewer than 20 days per year. In turn, ERCOT is noteworthy as a "energy-only" organized wholesale electricity market in this region, generators are compensated through energy and ancillary services provision only, without a separate capacity market, unlike other deregulated U.S. markets.

HAC's analysis centers on the National Economic Development (NED) benefits arising from hydropower operations at Whitney Lake and Dam. These benefits stem from multiple related but distinct power products and services marketed from hydropower plants. The USACE guidance related to the computation of hydropower benefits is outlined in EM 1101-2-1701 *Hydropower*, and ER 1105-2-100, *Planning Guidance Notebook*. The guidelines require that the reallocation cost charged to the water supply customer be the highest of hydropower benefits foregone (lost to reallocation) PMA revenues foregone, or the updated cost of water storage.

Electricity systems are unique among economic markets in that supply must meet demand at all times. Any imbalance, even if momentary, can cause equipment failures, damage, and grid blackouts. As a result, the output exchanged in wholesale electricity markets takes the form of several different goods and services, rather than a single commodity, that together ensure continuous system operation and reliability. Broadly speaking, these products are typically bought and sold as "energy", "capacity", and a group of reliability tools collectively called "ancillary services" that includes reserve capacity.

Energy generation refers to the electrical energy supplied by a combination of current and electrical potential, delivered by wires from generator to consumer. Typically measured in kilowatt-hours (kWh) or megawatt-hours (MWh), energy can be thought of as roughly analogous to the commodity delivered in a more conventional market.

Capacity in this context refers to the ability of a generating resource or system to deliver energy, usually measured in megawatts (MW). Market participants and system operators typically focus on "firm" or "dependable" capacity, which is the maximum ability of a generator to contribute to system needs under adverse demand (load) and supply conditions. In some regions, capacity is bought and sold separately from energy; in others, capacity is effectively bundled with energy and ancillary services via spot market prices or embedded with energy in long-term bilateral contracts.

Ancillary Services are grid reliability tools that ensure continuous operation at often small time scales (i.e., milliseconds to minutes). Ancillary service relevant to this study is called "spinning reserve" capacity, which system operators require over and above the capacity needed to meet expected loads to cover unforeseen disruptions such as power plant outages or transmission failures.

Energy systems consist of highly regulated and interlinked markets overseen by federal, regional, and local government entities. Market participants such as utilities that are responsible for serving electric customers are required by law to obtain each of these products in sufficient amounts to ensure safe and reliable service. Specifically, the Federal Energy Regulatory Commission (FERC), the North American Electric Reliability Corporation (NERC), and the State of Texas all require the production or procurement of energy, firm capacity, and ancillary services by system operators.

Because ERCOT is an "energy-only" market region, the monetary value of capacity – in other words, the fixed costs associated with constructing, operating, and maintaining a power plant – is in principle embedded within wholesale energy and ancillary services prices, rather than in an additional and separable value. Dependable capacity impacts are consequently presented in this study in terms of megawatts but not in monetary terms distinct from energy and reserves benefits.

Hydropower benefits are based on the cost of the most likely alternative source of power. When conservation storage is reallocated for water supply, the usual assumption is that the lost hydropower will be replaced with power generated from thermal sources. Power benefits forgone can be divided into two components, energy benefits forgone and capacity benefits forgone. Energy benefits forgone are based on the loss in generation (both at-site and downstream) as a result of water being diverted from the reservoir for water supply rather than passing through the hydropower plant. In addition, there could be a loss of capacity benefits as a result of a loss in dependable capacity at the project.

Energy benefits forgone are computed by multiplying expected annual losses in megawatt-hours (MWh) of super-peak, peak and off-peak generation by the average annual prices of super-peak, peak and off-peak energy in dollars per megawatt-hour over the period of analysis. Energy prices are based on the marginal cost of energy from a combination of thermal generating plants that would replace the energy lost from hydropower generation. Table 22 summarizes previously presented results. Monetary values are based on the replacement costs of power as represented by market prices.

Table 22. Changes in Hydropower Benefits for Lake Whitney due to Potential Storage Reallocation (monetary figures in $1000s)

Alternative	Energy	Reserves (RRS)	Total NED Benefits	Benefits Change from Baseline	Benefits % Change from Baseline	Dependable Capacity (85th percentile; MW)	Dependable Capacity % Change from Baseline
Alt 1	$2,051.99	$4,686.17	$6,738.16	na	n/a	36.9	n/a
Alt 2	$2,200.54	$4,532.77	$6,733.31	($4.85)	-0.1%	36.6	-1.0%
Alt 2a	$2,142.91	$4,590.50	$6,733.40	($4.76)	-0.1%	36.8	-0.4%
Alt 2c	$2,088.83	$4,647.67	$6,736.51	($1.65)	0.0%	36.9	-0.1%
Alt 3	$2,188.15	$4,834.51	$7,022.66	$284.50	4.2%	37.8	2.2%
Alt 4	$2,081.63	$4,654.97	$6,736.60	($1.56)	0.0%	36.9	-0.1%
Alt 5	$2,214.03	$4,670.04	$6,884.07	$145.91	2.2%	37.1	0.3%
Alt 6	$2,371.26	$4,358.26	$6,729.52	($8.64)	-0.1%	36.6	-0.9%

5.2.1.2. Power Marketing Administration Impacts

HAC's hydropower analyses for water storage reallocation studies calculate both the impacts to NED benefits and (separately) the financial impact to the PMA's revenues. This is because the PMAs are responsible for repayment of projects' hydropower-specific costs and a portion of joint costs; if a water storage reallocation reduces the ability of the project to produce power, the PMA's revenue and thus its ability to repay its obligations will likewise decrease. HAC's calculation of PMA revenues foregone thus provides an estimate of the credit due to the PMA against its obligations. USACE guidance on estimating the revenue impacts of water storage reallocations is reflected in the following from EM 1110-2-1701:

> *"Revenues foregone to hydropower are the reduction in revenues accruing to the U.S. Treasury as a result of the reduction in hydropower outputs based on the existing rates charged by the power marketing agency."*

> *"The Corps does not market the power it produces; marketing is done by the Federal power marketing agencies (Southeastern Power Administration, Southwestern Power Administration, Western Area Power Administration, Bonneville Power Administration, Alaska Power Administration) through the Secretary of Energy. The rates are set by the marketing agency to: (a) recover costs (producing and transmitting) over a reasonable period of years (50 years*

usually); and (b) encourage widespread use at the lowest possible rates to consumers, consistent with sound business principles."

Financial value to the power marketing agency is usually materially different from NED benefits for two primary reasons. The first is that NED benefits are based on economic value – replacement cost, society's willingness to pay, and other related concepts. Foregone power from USACE hydroelectric dams must be replaced by system participants, and the market prices of energy and capacity represent the marginal cost to do so. The economic value of energy and capacity can be thought of as the avoided cost of having to purchase replacements at market prices. Conversely, the federal government does not charge power customers a market-determined price. Rather, federal power rates are based on the government's cost of production and are often substantially lower than market prices. Because PMAs sell power at cost-based rates, rather than market prices, the revenue value of hydropower and the economic value of hydropower are different concepts.

The second reason that NED benefits can differ from PMA revenue is that the way in which PMA's sell power reflects a bilateral agreement between specific parties and does not necessarily reflect its value to the entire energy system. A PMA's contract with a power customer may be structured in a way that suits the PMA's operating strategy and a specific customer's purposes and may rely on contract terms and definitions that diverge from those used in the Corps hydropower analyses. This can be particularly true with matters of firm or dependable capacity, where minor differences in assumptions or definitions can drive significant discrepancies in calculated revenue and economic value.

Whereas the accounting of megawatt-hours of energy is reliably independent of individual entity's perspectives, the accounting of capacity is not. Therefore, the capacity revenue estimates below should be interpreted as rough approximations of the actual financial impact to the Power Marketing Administration based on changes to dependable capacity. Actual impacts to the PMA will be driven by changes to the amount of capacity actually marketed to its customers.

Revenues foregone estimates (Table 23) for each of the study alternatives are based on rates expected to take effect under SWPA's Rate Schedule P-23 April 2025:

- Capacity: $5.30/kW-month of peaking billing demand
- Energy: $12.80/MWh

SWPA does not charge a volumetric rate associated with the Responsive Reserve Service provided by the project to its customers. Impacts to RRS provision are thus excluded from these revenue calculations.

Table 23. Changes in Hydropower Revenues for Lake Whitney due to Potential Storage Reallocation

Alternative	Energy (MWh)	Energy Revenue	Dependable Capacity (MW)	Capacity Revenue	Total Revenue	Revenue Change from Baseline	Revenue % Change from Baseline
Alt 1	48,098	$615.66	36.94	$2,349.38	$2,965.04	$0	0.0%
Alt 2	50,082	$641.05	36.58	$2,326.49	$2,967.53	$2.49	0.1%
Alt 2a	49,279	$630.77	36.80	$2,340.48	$2,971.25	$6.21	0.2%
Alt 2c	48,465	$620.36	36.89	$2,346.20	$2,966.56	$1.52	0.1%
Alt 3	50,106	$641.35	37.76	$2,401.54	$3,042.89	$77.85	2.6%

Alt 4	48,404	$619.57	36.90	$2,346.84	$2,966.41	$1.37	0.0%
Alt 5	50,347	$644,439	37.06	$2,357,016	$3,001,455	$36,414	1.2%
Alt 6	52,409	$670,833	36.61	$2,328,396	$2,999,229	$34,188	1.2%

A final caution regarding the revenue estimates above requires discussion. As the rightmost column illustrates, changes to revenue as a result of the proposed reallocation would be positive, because under these alternatives generation increases due to water supply releases through the powerhouse. However, as noted, SWPA and its customers use this project primarily for reserves capacity rather than energy. Thus, these changes may not be viewed as positive by these parties regardless of the minor increases in energy produced and revenues collected. Longer-term impact to SWPA and hydropower at the project may be impacted in ways that are neither marginal nor captured by these estimates.

5.2.2. Real Estate and Cultural Mitigation

Surface water elevations could change due to reallocation and may require actions such as federal purchase of flowage easements on parcels surrounding the lake. For alternative 3 and 5 (which reallocate from the flood pool) SWF Real Estate estimated costs of purchasing easements and properties, and these are included in the alternative evaluation (Table 24). Staff identified 122 affected parcels, 58 of which are privately owned USACE “fee” lands, 64 that would require flowage easements acquisition. Total costs range from about $9.0 million to $12.2 million depending on whether a flowage easement would be required. For the alternative evaluation, costs are annualized at the midpoint of these two figures, and cost apply to both alternatives 3 and 5 equally. In addition to real estate costs, Alternative 6 would lower lake elevation and would require a relatively minor expense associated with cultural site surveys. The PDT archeologist provided a cost estimate of approximately $500,000.

Table 24. Real Estate Mitigation Costs for Increased Lake Elevation from Flood Pool Reallocation Alternatives (Alternative 3 and 5)

Activity	USACE owned parcels	Parcels not federally owned
Environmental Assessment	$100,000	$100,000
Mapping	$40,000	$40,000
Landowner meeting	$1,500	$1,500
Obtain ROEs	$32,000	$61,000
Obtain Title Contract	$5,000	$5,000
Obtain Title Commitment	$732,000	$732,000
Obtain Survey Contract	$10,000	$10,000
Conduct Boundary Survey	$1,830,000	$1,830,000
USACE Survey Review	$122,000	$122,000
Obtain Appraisal Contract	$10,000	$10,000
Conduct Appraisals	$320,000	$610,000
USACE Appraisal Review/Corrections	$115,200	$219,600
Land Value*	$2,757,000	$3,600,000
Conduct Negotiations	$128,000	$244,000
Perform Amicable Closing	$0	$183,000

Condemnations	$960,000	$1,830,000
Obtain Title Contract	$5,000	$5,000
Title Policy	$80,000	$152,500
Subtotal	$7,247,700	$9,755,600
Contingency	$1,811,925	$2,438,900
Total	**$9,059,625**	**$12,194,500**

5.2.3. Flood Risk Management

The PDT evaluated effects and estimated the economic impacts as they relate to flood risk management (FRM) and a flood pool reallocation. Section 3.5.3 discusses potential increases in risks of flood damages to downstream communities. Reallocation from the flood pool could increase downstream flood impacts. To estimate the extent, the team used USACE's Hydrologic Engineering Center LifeSim software (HEC-LifeSim) to estimate potential damages to structures, contents, and vehicles, and determine populations at risk of increased flood risks.

Of the array of alternatives only 3 and 5 lower the amount of flood water that Whitney Lake and Dam can hold. Alternative 3 reduces flood pool elevation by about 3 feet and alternative 5 reduces the elevation by 1.5 feet. Based on Riverware modeling, for both flood pool reallocation alternatives, flood risk relative to Alternative 1 (no federal action) did not increase until the 500-year event (AEP 0.002), which makes sense given that pool elevations typically only produce large surcharge releases under the most adverse conditions (i.e., during low frequency events). In addition, to standard AEP events (0.5 through the 0.002 frequencies), the PDT also modeled the "storm of record" for Whitney Lake and Dam referred to herein as the "1957" event.

The Hydraulic Engineer provided depth grids corresponding to the 500-year and 1957 storm event for each alternative. Simulations for structure damage and population at risk were run in LifeSim 2.1.3. This modeling used a structure inventory created and validated for the consequences chapter of the 2024 Whitney Dam Periodic Assessment.

The following tables and figures summarize potential consequences for each alternative. Flood releases from dams downstream of Lake Whitney contributes to damages, particularly in the case of the 1957 storm. The marginal $1 billion of additional damages between Alternative at the 500-year event and the 1957 storm is due to both surcharge releases from Whitney Dam, and releases and or failures of dams and levees elsewhere in the system.

Table 25. Estimated structures inundated, population at risk, and total damages (500-year recurrence interval, 0.002 AEP and 1957 event)

Hydrologic Loading Condition	Structures Inundated	Daytime Population at Risk	Nighttime Population at Risk	Total Damages
Alternative 1 (500-year event)	7,546	22,986	21,880	$759,077,000
Alternative 3 (500-year event)	8,004	23,893	23,246	$823,007,000
Alternative 5 (500-year event)	7,894	23,692	22,925	$808,560,000
Alternative 1 (1957 event)	15,643	44,827	43,532	$1,736,972,000
Alternative 3 (1957 event)	17,732	48,233	48,999	$1,962,154,000
Alternative 5 (1957 event)	16,651	46,342	46,008	$1,841,344,000

Table 26. Estimated downstream impacts by county for Alternative 1 (500-year recurrence interval 0.002 AEP)

Downstream Counties	Flood Depth Range (feet)	Number of Structures	Daytime Population at Risk	Nighttime Population at Risk	Total Damages
Hill County	3 - 5	8	10	17	$1,585,000
McLennan County	0 - 5	612	1,872	2,117	$111,435,000
Fort Bend County	0 - 0	0	0	0	$0
Brazoria County	0 - 3	6,390	20,324	19,070	$606,987,000

Table 27. Estimated downstream impacts by county for Alternative 1 (1957 event)

Downstream Counties	Flood Depth Range (feet)	Number of Structures	Daytime Population at Risk	Nighttime Population at Risk	Total Damages
Hill County	0 - 9	25	26	39	$3,541,000
McLennan County	1 - 7	1,035	6,601	3,819	$232,078,000
Fort Bend County	0-3	4,104	6,970	9,204	$298,596,204
Brazoria County	0 - 3	10,336	30,894	30,273	$1,178,289,000

Table 28. Estimated downstream impacts by county for Alternative 3 (500-year recurrence interval 0.002 AEP)

Downstream Counties	Flood Depth Range (feet)	Number of Structures	Daytime Population at Risk	Nighttime Population at Risk	Total Damages
Hill County	4 - 7	8	10	17	$2,027,000
McLennan County	0 - 5	618	1,876	2,120	$114,554,000
Fort Bend County	0 - 0	0	0	0	$0
Brazoria County	0 - 3	6,778	21,127	20,276	$662,380,000

Table 29. Estimated downstream impacts by county for Alternative 3 (1957 event)

Downstream Counties	Flood Depth Range (feet)	Number of Structures	Daytime Population at Risk	Nighttime Population at Risk	Total Damages
Hill County	0 - 10	26	27	40	$3,602,000
McLennan County	1 - 7	1,083	6,716	3,988	$239,542,000

Fort Bend County	0 - 3	5,714	9,307	13,212	$434,731,100
Brazoria County	0 - 3	10,757	31,839	31,558	$1,258,920,000

Table 30. Estimated downstream impacts by county for Alternative 5 (500-year recurrence interval 0.002 AEP)

Downstream Counties	Flood Depth Range (feet)	Number of Structures	Daytime Population at Risk	Nighttime Population at Risk	Total Damages
Hill County	4 - 6	8	10	17	$1,792,000
McLennan County	0 - 5	663	1,955	2,244	$122,891,000
Fort Bend County	0 - 0	0	0	0	$0
Brazoria County	0 - 3	6,636	20,849	19,853	$641,375,000

Table 31. Estimated Downstream Impacts by County for Alternative 5 (1957 event)

Downstream Counties	Flood Depth Range (feet)	Number of Structures	Daytime Population at Risk	Nighttime Population at Risk	Total Damages
Hill County	0 - 10	25	26	39	$1,792,000
McLennan County	1 - 7	1,051	6,655	3,895	$122,891,000
Fort Bend County	0 - 2	3,782	5,747	7,959	$0
Brazoria County	0 - 3	10,546	31,354	30,908	$641,375,000

Compliance with WRDA Section 308 was considered. Section 308 limits structures built or substantially improved after July 1, 1991, in designated floodplains not elevated to the 0.01 AEP (100-year recurrence interval) flood elevation from being included in the benefit base of economic analysis for flood risk management projects. This essentially means that structures built after that date in undesignated areas are not considered when determining economic benefits. Simulation results above show existing consequence conditions unaltered for Section 308. To comply with Section 308, PDT economists removed structures constructed after 1990 in current FEMA designated 100-year AEP or lower floodplains (Table 32).

Table 32. Estimated Structures Inundated, Population at Risk, and Total Damages Removed for WRDA Section 308 Compliance

Hydrologic Loading Condition	Structures Inundated	Daytime Population at Risk	Nighttime Population at Risk	Total Damages
Alternative 1 500-year AEP	286	400	614	$20,434,000
Alternative 3 500-year AEP	316	498	740	$22,685,000
Alternative 5 500-year AEP	309	480	726	$21,801,000
Alternative 1 1957 event	998	1,602	2,245	$97,241,000

Alternative 3 1957 event	1,092	1,767	2,459	$109,454,000
Alternative 5 1957 event	1,036	1,656	2,320	$102,973,000

Unlike the USACE's Flood Damage Analysis software (HEC-FDA), LifeSim FIA is event driven and does not perform probabilistic calculations and does not implicitly annualize damage estimates, which is necessary when comparing alternatives in most cases. Tables 33 through 35 show incremental and probabilistic estimates for the standard ranges of recurrence intervals or AEPs used in USACE FRM economic evaluations. In this case, we only see damages at the 500-year event or longer recurrence periods (5,000 year for the storm of record). Typically, the range of events includes increments between the 2 year and 500-year intervals. Annual damages or forgone benefits for each action alternative is expected annual damages (EAD) less EAD of Alternative 1 (No Federal Action). EAD for Alternative 3 is $309,000 and for Alternative 5 it is $180,000 assuming damages from both the 500-year and 1957 event are included. EAD capped at the 500-year event is $62,000 (Alternative 3) and $48,000 (Alternative 5).

Table 33. Expected Annual Damages for Alternative 1 (No Federal Action)

Recurrence Interval (year)	Frequency	Single Event Damages	Recurrence Interval	Damage Interval	Expected Annual Damages (EAD)
0	0	0	-	-	-
2	0.5	$0.0	0.5	0	$0.0
5	0.2	$0.0	0.3	0	$0.0
10	0.1	$0.0	0.1	0	$0.0
25	0.04	$0.0	0.06	0	$0.0
50	0.02	$0.0	0.02	0	$0.0
100	0.01	$0.0	0.01	0	$0.0
250	0.004	$0.0	0.006	0	$0.0
500	0.002	$738,643,000	0.002	$369,322,000	$739,000
5,000	0.0002	$1,639,732,000	0.0018	$1,189,187,000	$2,141,000
				Total EAD	**$2,879,000**

Table 34. Expected Annual Damages for Alternative 3 (flood pool reallocation)

Recurrence Interval (year)	Frequency	Single Event Damages	Recurrence Interval	Damage Interval	Expected Annual Damages (EAD)
0	0	0	-	-	-
2	0.5	$0.0	0.5	0	$0.0
5	0.2	$0.0	0.3	0	$0.0
10	0.1	$0.0	0.1	0	$0.0
25	0.04	$0.0	0.06	0	$0.0
50	0.02	$0.0	0.02	0	$0.0
100	0.01	$0.0	0.01	0	$0.0
250	0.004	$0.0	0.006	0	$0.0
500	0.002	$800,323,000	0.002	$400,162,000	$801,000
5,000	0.0002	$1,852,701,000	0.0018	$1,326,512,000	$2,388,000
				Total EAD	$3,188,000

Table 35. Expected Annual Damages for Alternative 5 (flood pool reallocation)

Recurrence Interval (year)	Frequency	Single Event Damages	Recurrence Interval	Damage Interval	Expected Annual Damages (EAD)
0	0	0	-	-	-
2	0.5	$0.0	0.5	0	$0.0
5	0.2	$0.0	0.3	0	$0.0
10	0.1	$0.0	0.1	0	$0.0
25	0.04	$0.0	0.06	0	$0.0
50	0.02	$0.0	0.02	0	$0.0
100	0.01	$0.0	0.01	0	$0.0
250	0.004	$0.0	0.006	0	$0.0
500	0.002	$786,760,000	0.002	$393,380,000	$787,000
5,000	0.0002	$1,738,371,000	0.0018	$1,262,566,000	$2,273,000
				Total EAD	$3,059,000

5.2.4. Recreation

Several alternatives would pool elevation resulting in closures of boat ramps and other recreation facilities (see Section 4.0). Table 36 displays mitigation costs to modify recreation facilities for relevant alternatives.

Table 36. Recreation Mitigation Construction Costs for Alternatives 3, 5 and 6

USACE Facilities (pool impacts)	Alternative 3	Alternative 5	Alternative 6
Elevation (feet)	**534.5**	**536.0**	**TSP**
Boat Ramps	$560,000	$800,000	$800,000
Docks	$280,000	$360,000	$520,000
Bathrooms	$0	$100,000	$0
Playgrounds	$0	$0	$0
Swim Beach	$60,000	$60,000	$60,000
Picnic Sites	$320,000	$520,000	$0
Primitive Camp Sites	$665,000	$665,000	$0
Electric Camp Sites	$500,000	$550,000	$0
Parking Lots	$352,000	$1,210,000	$0
Roads	$4,314,200	$4,501,200	$0
Erodable Shoreline	$590,250	$590,250	$0
Total Construction Costs	$7,641,450	$9,356,450	$1,380,000

5.2.5. Updated Cost of Storage

The PDT updated original costs of reservoir construction as presented in the: “Whitney Project: Revised Cost Allocation Report” published in December November of 1955 shortly after project construction. To index project costs to current dollars, original first costs were inflated to construction midpoint in 1959 using the Engineering News Record (ENR) construction cost indices, and from FY1967 to current FY2025 price levels using the USACE Civil Works

Construction Cost Index System (CWCCIS). Land and damages were updated using the composite weighted CWCCIS index while other relevant indices including:

- 08 Roads, Railroads & Bridges
- 04 Dams
- 07 Power Plant

Updated FY25 costs were adjusted using the CWCCIS state level index adjustment weight of 0.88 for the State of Texas. Table 37 displays total updated cost of storage for the Whitney Lake and Dam project as a whole, and Tables 38 through 44 show updated cost of storage for the portion of project storage under consideration for reallocation for the final array of alternatives. Updated cost of storage for alternatives use current joint cost of storage for the entire project ($609,078,800), multiplied by the percentage of storage reallocated to water supply as a percent of total usable storage for the project (1,988,413 acre-feet of usable storage).

Table 37**. Updated Cost of Storage for Whitney Lake**

Item	Initial Project Cost 1955	Midpoint of Construction	ENR Index at Time of Const. [1]	Jul 67 ENR Index	Jul 67 CWCCIS Index [2]	FY25 CWCCIS Index	FY25 Project Cost	FY25 Project Cost (adjusted by state factor) [3]
Land and Land Rights	$14.25	1959	660	1,078	100	1187	$276.18	$243.04
Structures and Improvements	$1.95	1959	660	1,078	100	1209	$38.60	$33.97
Dam and Spillway	$20.84	1959	660	1,078	100	1164	$396.12	$348.59
Turbine and Generators	$1.87	1959	660	1,078	100	1164	$35.49	$31.23
Accessory Eclectic Generating	$0.65	1959	660	1,078	100	1164	$12.33	$10.85
Miscellaneous Power Plants	$0.38	1959	660	1,078	100	1097	$6.74	$5.93
Roads Railroads Bridges	$0.33	1959	660	1,078	100	1176	$6.43	$5.66
Electric Transmission Plants	$0.42	1959	660	1,078	100	1097	$7.50	$6.60
Total	$40.68	1959	660	1,078	100	1187	$779.39	$685.86
Specific Costs								
Structures and Improvements (power)	$5.94							
Flood Control	$0.89						$41.92	$36.89
Recreation-Development Incremental	$0.01						$38.60	$33.97
							$6.74	$5.93
Subtotal	$6.84						$87.26	$76.79
Joint-Use Cost	$33.84						$692.14	$609.08
Total Project Cost first cost)	$40.68						$779.39	$685.86

[1] ENR refers to Engineering New Record
[2] CWCCIS factors are taken from EM1110-2-1304, dated 31 March 2024, (3Q-24-Apr-Jun) revised 30 Sep 07.
[3] CWCCIS cost adjustment multiplier for State of Texas is 0.88.

Table 38. Annual Cost of Storage for Alternatives NED Analysis for Alternative 2 (67% Water Supply and 33% Hydropower)

Parameter	Amounts ($FY25)
Total storage required (acre-feet)	173,479
Water supply yield (millions of gallons per day)	55,708
Interest rate	3.00%
Repayment period	50
Flood control storage	1,372,470
Conservation Storage	615,943
Inactive storage	1,216
Usable Storage	1,988,413
Storage required as percent of useable storage	8.7%
Joint use project cost	$609,078,800
Annual OM	$9,136,182
Share of total storage costs (capital)	$53,139,052
Share cost of storage costs (OM)	$797,086
Annual cost of storage (capital)	$2,065,276
Total annual cost	**$2,862,361**

Table 39. Annual Cost of Storage for Alternatives NED Analysis for Alternative 2a (50% Water Supply and 50% Hydropower)

Parameter	Amounts ($FY25)
Total storage required (acre-feet)	130,109
Water supply yield (millions of gallons per day)	55,708
Interest rate	3.000%
Repayment period	50
Flood control storage	1,372,470
Conservation Storage	615,943
Inactive storage	1,216
Usable Storage	1,988,413
Storage required as percent of useable storage	0.0654
Joint use project cost	$609,078,800
Annual OM	$9,136,182
Share of total storage costs (capital)	$39,854,212
Share cost of storage costs (OM)	$597,813
Annual cost of storage (capital)	$1,548,954
Total annual cost	$2,146,767

Table 40. Annual Cost of Storage for Alternatives NED Analysis for Alternative 2c (Energy Focus)

Parameter	Amounts ($FY25)
Total storage required (acre-feet)	88,474
Water supply yield (millions of gallons per day)	41,573
Interest rate	3.000%
Repayment period	50
Flood control storage	1,372,470
Conservation Storage	615,943
Inactive storage	1,216
Usable Storage	1,988,413
Storage required as percent of useable storage	0.0445
Joint use project cost	$609,078,800
Annual OM	$9,136,182
Share of total storage costs (capital)	$27,100,828
Share cost of storage costs (OM)	$406,512
Annual cost of storage (capital)	$1,053,287
Total annual cost	$1,459,799

Table 41. Annual Cost of Storage for Alternatives NED Analysis for Alternative 3

Parameter	Amounts ($FY25)
Total storage required (acre-feet)	130,857
Water supply yield (millions of gallons per day)	46,152
Interest rate	3.000%
Repayment period	50
Flood control storage	1,372,470
Conservation Storage	615,943
Inactive storage	1,216
Usable Storage	1,988,413
Storage required as percent of useable storage	0.0658
Joint use project cost	$692,135,000
Annual OM	$10,382,025
Share of total storage costs (capital)	$45,549,244
Share cost of storage costs (OM)	$683,239
Annual cost of storage (capital)	$1,770,294
Total annual cost	$2,453,533

Table 42. Annual Cost of Storage for Alternatives NED Analysis for Alternative 4 (Decrease the upper conservation pool from 520 to 518.4 feet)

Parameter	Amounts ($FY25)
Total storage required (acre-feet)	81,610
Water supply yield (millions of gallons per day)	46,152
Interest rate	3.000%
Repayment period	50
Flood control storage	1,372,470
Conservation Storage	615,943
Inactive storage	1,216
Usable Storage	1,988,413
Storage required as percent of useable storage	0.0410
Joint use project cost	$692,135,000
Annual OM	$10,382,025
Share of total storage costs (capital)	$28,407,145
Share cost of storage costs (OM)	$426,107
Annual cost of storage (capital)	$1,104,058
Total annual cost	$1,530,165

Table 43. Annual Cost of Storage for Alternatives NED Analysis for Alternative 5 (Combination)

Parameter	Amounts ($FY25)
Total storage required (acre-feet)	166,261
Water supply yield (millions of gallons per day)	52,173
Interest rate	3.000%
Repayment period	50
Flood control storage	1,372,470
Conservation Storage	615,943
Inactive storage	1,216
Usable Storage	1,988,413
Storage required as percent of useable storage	0.0836
Joint use project cost	$692,135,000
Annual OM	$10,382,025
Share of total storage costs (capital)	$57,872,815
Share cost of storage costs (OM)	$868,092
Annual cost of storage (capital)	$2,249,256
Total annual cost	$3,117,348

Table 44. Annual Cost of storage for Alternatives NED Analysis for Alternative 6.

Parameter	Amounts ($FY25)
Total storage required (acre-feet)	241,646
Water supply yield (millions of gallons per day)	84,734
Interest rate	3.000%
Repayment period	50
Flood control storage	1,372,470
Conservation Storage	615,943
Inactive storage	1,216
Usable Storage	1,988,413
Storage required as percent of useable storage	0.1215
Joint use project cost	$692,135,000
Annual OM	$10,382,025
Share of total storage costs (capital)	$84,113,137
Share cost of storage costs (OM)	$1,261,697
Annual cost of storage (capital)	$3,269,099
Total annual cost	$4,530,796

5.2.6. Other Costs

Reallocating storage from the flood pool (alternatives 3 and 5) would require additional bulkheads for Tainter gates on the dam that allow for controlled water releases; however, adding bulkhead slots at piers between Tainter gates is not feasible due to the location of low flow bulkheads. The other more feasible option would be steel-Fab floating bulkheads consisting of sealed caissons with integral ballast chambers that fill with water or pressurized air. Caissons assemble on the impoundment and then the appropriate ballast chambers are filled with water to vertically orientate bulkheads and move them into position in front of spillway gates. Bulkheads are seated to the dam or piers once a differential head exists and can move to adjacent spillway bays once a balanced head condition is achieved. To remove floating bulkheads, chambers are vacated with air allowing bulkheads to return to a horizontal orientation. The cost to fabricate floating bulkheads for a 40-foot-wide Tainter gate opening can vary significantly depending on several key factors including height, but as a rough order of magnitude costs, SWF operations estimate that one bulkhead costs $345,000 and lake managers would need about 10 for a total gate cost of roughly $3.5 million, and an additional $518,000 for other materials and labor for installation. Total capital costs are approximately $4.0 million.

5.3. Comprehensive Benefits

A system of accounts was used to compare the alternatives and identify a Comprehensive Benefits Plan per the 5 January 2021 policy directive from the Assistant Secretary of the Army for Civil Works. The four accounts used in this analysis are defined by the Principles and Guidelines as the following:

- National Economic Development (NED) Account – NED calculations include both financial costs to implement, maintain, and operate each alternative, and forgone economic benefits of implementing an alternative.

- Regional Economic Development (RED) Account – RED addresses economic benefits important at the regional level: State, counties, communities in the broad study area.

- Environmental Quality (EQ) account – EQ is an assessment of favorable or unfavorable changes in the ecological, aesthetic and cultural or natural resources. This review is being conducted with the participation of agencies, local governments, and stakeholders an on-going and engaging series of agency and stakeholder meetings, and scoping meetings.

- Other Social Effects (OSE) accounts – OSE considers the effects of alternative plans in areas that are not already contained in the NED and RED accounts. The categories of effects contained within the OSE account include Health and Safety (population at risk), community impacts, and leisure and recreation.

The comprehensive benefits analysis centered on relevant economic, environmental, and social factors in the region that may be impacted by the implementation of the project. These factors were identified by the USACE, the NFS, and government resource agencies. These factors were then organized into one of the above accounts and evaluated quantitatively or qualitatively for the accounts. Table presents the results of the NED evaluation and Table presents the results of the RED, EQ, and OSE evaluation.

National Economic Development

National Economic Development (NED) costs include both financial costs to implement, maintain, and operate each alternative, and forgone economic benefits of implementing an alternative. Water supply is the amount of water an alternative can provide expressed as yield from the lake in millions of gallons per day (MGD), and water supply benefits are the cost savings achieved when compared to the No Federal action alternative (new reservoir) measured by differences in unit cost per yield generated. Other costs and benefits (or disbenefits) in addition to physical water supply generated consist of:

- Hydropower reserve benefits,
- Hydropower energy benefits,
- Hydropower revenues,
- Real estate costs,
- Cultural compliance costs,
- Recreation mitigation costs,
- Flood gate costs; and,
- Flood risk management benefits (expected annual damages).[10]

For example, as shown in Table 38 Alternative 3 (Flood pool increase of 3 feet) generates positive non-water supply benefits in terms of hydropower generation ($181,000 in reserve benefits and $86,000 in energy benefits). In contrast, the plan would raise pool elevation

[10] For the final array comparison, we did not include the 1957 storm event given that the standard modeling exercise is to consider eight AEP events (0.5 through 0.002). Including the 1957 storm would increase non-water supply costs or disbenefits significantly and would only reinforce the TSP decision.

resulting in real estate costs (flowage easements etc.), costs to modify recreation facilities such as relocating shoreline recreation areas, and expenses for new bulkheads for Tainter gates on the dam. A higher flood pool could also increase downstream flood damages ($62,000 in EAD). In total, “non water supply benefits” for Alternative 3 are a negative $0.95 million. In terms of “water supply”, the annual financial costs of reallocating storage based on updated reservoir costs for Alternative 3 is $2.5 million at a unit cost of $6.68 per MGD resulting in water supply benefits of $35.3 million when compared to the No-action alternative with unit cost of $348 per MGD.[11]

Annualized NED metrics used to compare final alternatives assume FY 2025 price levels and interest rate (3.00 percent) and monetary costs include project capital and operating (if applicable) costs. As shown in Table 45, the alternative that minimizes forgone NED costs and disbenefits and maximizes net water supply benefits is Alternative 6 (2a and 4 combined).

Regional Economic Development

RED was assessed qualitatively for all alternatives based on best professional judgements. Impacts to the local economies are expected to be minimal for all alternatives.

Environmental Quality

The alternatives were assessed for contributing to habitat change, risk to T&E species, impacts to cultural resource sites, and potential impacts to HTRW sites. The No Action Alternative, along with Alternatives 2, 2a, 2c, 4 and 6 were all found to be similar to the future without project condition for habitat, T&E species, and HTRW. All of these alternatives would be considered the Least Environmental Damaging Practicable Alternative. For Alternatives 3 and 5, habitat changes ranged from 352 acres to 535 acres. These are acres which would become inundated with the raising of the conservation pool from elevation 533 ft to 536 ft or 534.5 ft. In addition, Alternatives 6 would result in adverse impacts to cultural resources. Under Alternatives 3 and 5, there would not effects to T&E species.

Other Social Effects

All alternatives were assessed for impacts to health and safety (population at risk), community impacts, and leisure and recreation impacts. Alternative 2, 2a, 2c, and Alternative 4 were found to have similar impacts as the No Action Alternative. There would be no change in health and safety of the local population with the implementation of these alternatives and there would be minimal impacts to recreation. Implementation of these alternatives may have positive local and regional benefits due to additional water availability for municipalities and industry by avoiding impacts from construction of other water infrastructure.

Alternatives 3 and 5 would see a slight increase in the population at risk and may experience negative impacts due to increased needs for Operations and Maintenance activities especially if the state highway needs to be shutdown to conduct inspections. The consistently higher elevation of the conservation pool would also impact roads, recreation facilities, and boat docks. The combination of Alternative 2a and 4 would likely impact boat docks by consistently lowering the lake elevation by 12 inches from the baseline.

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[11] When evaluating the final array, the storage volume for Alternative 7 (BRA reservoir) was held constant at 65,000 acre-feet given that the metric is a scalar increasing it to match each alternative for the calculation would not change the *ordinal* ranking of all alternatives in terms of net water supply benefits. For the test of financial feasibility, reservoir costs were scaled to match the storage volume of the TSP.

Table 45. National Economic Development Criteria for Plan Selection (metrics annualized using FY25 discount rate of 3.00 percent over 50 years)

Annual Cost and Benefits[1]	Alt 1 – NAA	Alt 2 - Cons pool: 2/3 water supply and 1/3 hydropower	Alt 2A - cons pool: 50/50	Alt 2C – Energy focus	Alt 3 - Flood pool increase 3.0 ft	Alt 4 - cons pool decrease 1.6 ft	Alt 5 combo - cons (50/50) and flood increase 1.5 ft	Alt 6 - combo cons (50/50) and lower cons pool 8ft	Alt 7 – Next Least Cost Alternative (new Reservoir)
Non water supply benefits									
Hydropower reserves	-	($96,000)	($62,000)	($19,000)	181,000	(49,000)	36,000	(78,000)	
Hydropower energy	-	$72,000	$47,000	$6,000	$86,000	$38,000	$87,000	$58,000	
Hydropower revenues	-	$3,000	$7,000	$2,000	$78,000	$2,000	$37,000	$35,000	
Real estate impacts[3]	-	$0	$0	$0	($414,000)	$0	($414,000)	$0	
Recreation mitigation	-	$0	$0	$0	($588,000)	$0	($489,000)	($119,000)	
Flood gate costs	-	$0	$0	$0	($276,000)	$0	($276,000)	$0	
Flood damages[4]	-	$0	$0	$0	($62,000)	$0	($49,000)	$0	
Cultural compliance[3]	-	$0	$0	$0	$0	$0	$0	($20,000)	
Sub total	-	($21,000)	($8,000)	($11,000)	($995,000)	($9,000)	($1,068,000)	($124,000)	
Water supply storage and benefits									
Storage (acre-feet)		173,479	130,109	88,474	130,857	81,610	166,261	241,646	65,000
Yield provided (acre-feet per year)		83,146	83,146	83,147	103,309	93,905	93,000	130,360	
Cost of storage (capital)		$2,070,000	$1,550,000	$1,060,000	$1,780,000	$1,110,000	$2,250,000	$1,270,000	83,428
Cost of storage (OMRR&R)[4]		$800,000	$600,000	$410,000	$690,000	$430,000	$870,000	$3,270,000	$25,356,000
Unit cost of storage (per acre-foot)		$16.54	$4.61	$4.63	$5.27	$5.27	$5.23	$13.53	$3,680,000
Unit cost of yield (per acre-foot)		$34.52	$7.22	$4.93	$6.68	$4.58	$9.35	$25.08	$447
Financial cost of storage		$2,870,000	$2,150,000	$1,470,000	$2,470,000	$1,540,000	$3,120,000	$4,540,000	$348
Water supply benefits [5`]		$26,068,000	$28,338,000	$28,529,000	$35,266,000	$32,253,000	$31,498,000	$42,101,000	$29,036,000
Net water supply benefits[6]	**-**	**$26,047,000**	**$28,330,000**	**$28,518,000**	**$34,271,000**	**$32,244,000**	**$30,430,000**	**$41,977,000**	

1) Annualized over 50 years at FY25 discount rate of 3.0 percent for NED comparison (parameters for repayment figure will be based on 30 years at applicable water supply interest rate)
2) Cost estimate provided by BRA for a single purpose reservoir from Region G 2022 Regional Water Plan indexed to FY25 dollars.
3) Included in capital cost estimate provided by BRA
4) Expected annual damages for recurrence intervals of 2, 5, 10, 25, 50, 100, 250 and 500 years). Damages only occur at 500-year interval.
5) Assumed to be 1.5 percent of capital costs.
6) Water supply benefits = [(Unit cost no action yield-unit cost alternative yield) * (alternative yield)] * [adjustment factor described below].
7) Net water supply benefits = [(Unit cost no action yield-unit cost alternative yield) * (alternative yield)] - (Total NED evaluation criteria)]

Table 46. EQ, RED, and OSE Criteria

Criteria	Alt 1 - No Federal Action[2]	Alt 2 - Conservation pool: 67% water supply and 33% hydropower	Alt 2A – Conservation pool: 50% water supply/50% hydropower	Alt 2C – conservation pool: energy focus	Alt 3 - Flood pool increase 3.0 ft	Alt 4 - Conservation pool decrease 1.6 ft	Alt 5 combo – conservation and flood pool	Alt 6 – Combination: powerhead reserve/inactive and conservation pool
National Economic Development (See Table X)								
Regional Economic Development (RED)								
Regional economic impacts (jobs, sales, income, tax revenues, etc.)	None	Minimal	Minimal	Minimal	Minimal	Minimal	Minimal	Minimal
Environmental Quality (EQ)								
High Elevation Habitat Change	0 acres	Similar to FWOP	Similar to FWOP	Similar to FWOP	-558 Acres	Similar to FWOP	-535 Acres	Similar to FWOP
Low Elevation Habitat Change	0 acres	Similar to FWOP	Similar to FWOP	Similar to FWOP	-365 Acres	Similar to FWOP	-352 Acres	Similar to FWOP
T&E Species Risk	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect
Cultural Resources Sites	No effect aside from the natural formation process over time	No effect aside from the natural formation process over time	No effect aside from the natural formation process over time	No effect aside from the natural formation process over time	Adverse effect	No effect aside from the natural formation process over time	Adverse Effect	Impacts to cultural resources site
HTRW sites/impact	no effect	no effect	no effect	no effect	increase risk	no effect	increase risk	increase risk
Other Social Effects (OSE)								
Health and Safety (Population at Risk)	22,986	Same as FWOP			23,893	Same as FWOP	23,692	Same as FWOP
Community Impacts	No change	Positive local and regional benefits due to additional water availability for municipalities and industry. Avoid impacts from construction of other water infrastructure.			Potential negative impacts if increased OM requires shutdown of state highway	Positive local and regional benefits due to additional water availability for municipalities and industry. Avoid impacts from construction of other water infrastructure.	Potential negative impacts if increased OM requires shutdown of state highway	Positive local and regional benefits due to additional water availability for municipalities and industry. Avoid impacts from construction of other water infrastructure.
Leisure and Recreation	Minimal impacts	Minimal impacts			Impacts to roads, recreation facilities, and boat docks due to higher water elevation	Minimal impacts	Impacts to roads, recreation facilities, and boat docks due to higher water elevation	Impacts to boat docks

5.4. Plan Selection

Based on the economic and environmental evaluations, the PDT, including the proposed water user, Brazos River Authority, have selected Alternative 6 as the Tentatively Selected Plan. The combination alternative would divide the storage between 520 ft and 533 ft equally between water supply and hydropower and lower the elevation of the conservation pool to 512 ft to allow for water supply withdrawals at that elevation. Approximately, 130,109 acre-feet of storage would be available for hydropower and 241,646 acre-feet of storage would be available for water supply. The Tentatively Selected Plan meets the study objective and provides the greatest net water supply benefits, which maximizes benefits consistent with the study purpose. Furthermore, Alternative 6 reasonably maximizes total net benefits across all benefit categories and is the Total Net Benefits Plan.

5.5. Test of Financial Feasibility

As a test of financial feasibility, annual financial cost of storage is compared to the cost of the most likely and least costly alternative that a sponsor would undertake in the absence of a storage reallocation. Such an alternative should be one that generates an equivalent amount of water in terms of both quality and quantity. In this case, the most likely and least cost alternative is a single purpose reservoir. Given the amount of water availability required by BRA customers, the most likely feasible option would be a new impoundment. Other water supply options including groundwater, aquifer storage and retrieval, reuse etc. are potential approaches but better suited to a target specific community or large water user as opposed to providing water at a system level, which is a significant advantage (in addition to financial cost) of reallocating storage on one of BRA's mainstem reservoirs. BRA provided estimated costs of a comparable reservoir from the 2022 Brazos G Regional Water Plan, and for the test of financial feasibility costs were scaled unit costs per yield to match the yield generated by the TSP. As shown in Table , reallocation of storage is significantly less expensive than the non-Federal Action most likely to be taken in lieu of a federal action (Alternative 7) and passes the test.

Table 47. Costs of non-federal action most likely to be taken in lieu of federal action (FY25 discount rate annualized at 3.00 percent over 50 years)

Item	Value
Estimated First Cost	$623,882,000
Annual Interest Rate	3.0%
Project life (Years)	50
Construction Period (Months)	36
Compound Interest Factor	37.62056031
Capital Recovery Factor	0.0388655
Interest During Construction	$28,497,745
Investment Cost	$652,379,745

Interest	$19,571,392
Amortization	$5,783,673
Annualized Capital Costs	$25,355,065
Annual OMRR&R	$3,679,000
Annual Costs	$29,034,065

* Included in capital costs

Table 48. Test of Financial Feasibility (FY25 discount rate annualized at 3.00 percent over 50 years)

Metric	No Federal Action	Alt 6
Hydropower reserves	$0	($78,000)
Hydropower energy	$0	$58,000
Hydropower revenues	$0	$35,000
Real estate costs*	$0	$0
Recreation mitigation costs	$0	($119,000)
Flood gate capital and OMMRRR costs (FP alternatives)	$0	$0
Flood damages (expected annual)	$0	$0
Cultural compliance costs*	$0	($20,000)
Financial costs	$29,036,000	$4,540,000
Total	**$29,036,000**	**$4,416,000**

* Included in capital costs

6. Tentatively Selected Plan

6.1. Plan Components

The Tentatively Selected Plan is a combination of changing the proportion of storage between elevation 520 ft – 533 ft and lowering the elevation of the conservation pool from 520 ft to 512 ft. Figure 17 provides a graphical representation of the tentatively selected plan.

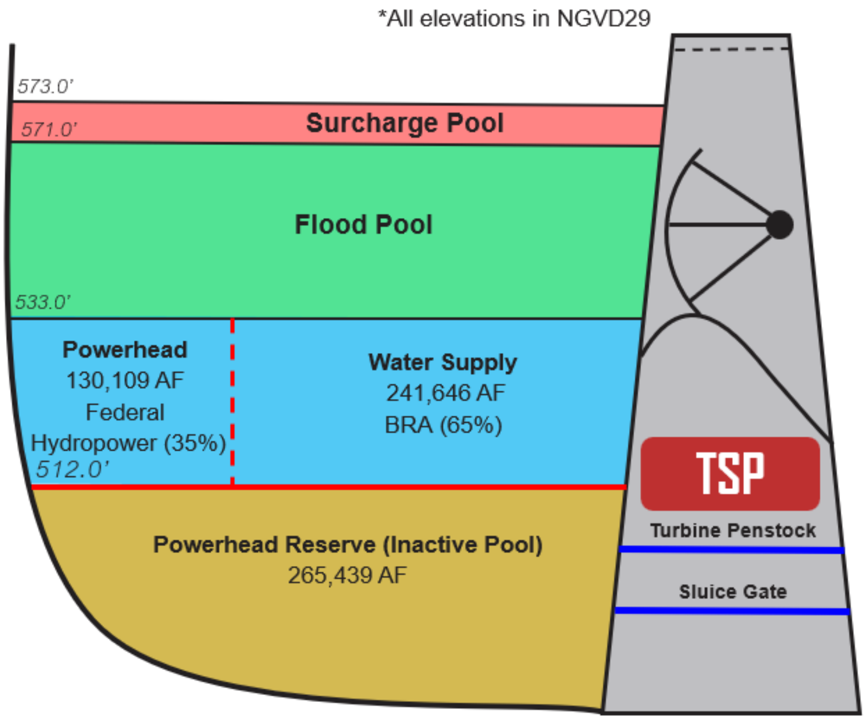

Figure 17. Tentatively Selected Plan

Approximately, 130,109 acre-feet of storage would be available for hydropower and 241,646 acre-feet of storage would be available for water supply.

6.2. Serious Effects Determination

USACE is currently studying a water supply storage reallocation study for Whitney Lake and Dam in accordance with a request for municipal and industrial (M&I) storage from the non-federal sponsor and the authority provided in the Water Supply Act of 1958, 43 U.S.C. § 390b. Section 301(b) of the Act, 43 U.S.C. § 390b(b), provides the Secretary of the Army with authority to develop water supplies "in connection with the construction, maintenance, and operation of Federal…multiple purpose projects," such that the USACE may include water supply storage in any USACE reservoir for "present or anticipated future demand or need for municipal or industrial water." While the Act provides the Secretary with the authority to modify projects in ways that affect their authorized purposes to some extent, section 301(d), 43 U.S.C. § 390b(e), provides a limit, requiring new Congressional authorization be obtained if the proposed modifications would "seriously affect the purposes for which the project was authorized, surveyed, planned, or constructed, or which would involve major structural or operational changes."

The USACE Policy for Conducting Civil Works Planning Studies (ER 1105-2-103, Section 9-3 (b)) states:

> *"The Water Supply Act of 1958 authorizes the ASA(CW) to reallocate storage in planned or existing reservoirs for domestic and M&I water supply use, provided that the reallocation would not seriously affect other authorized purposes or involve major structural or operational changes. A reallocation of storage for a water supply purpose may have effects on other authorized purposes of the reservoir; for each alternative formulated the impacts to other purposes must be calculated. The USACE Chief Counsel opinion of June 25, 2012, entitled "Authority to Provide for Municipal and Industrial Water Supply from the Buford Dam/Lake Lanier Project, Georgia," interprets major structural or operational changes or serious effects to authorized purposes as actions that would fundamentally depart from Congressional intent for the project; the amount or percent of storage involved is not determinative. Whether impacts have a serious effect on other project purposes or involve major structural or operational changes should be coordinated with Office of Counsel and will be determined on a project-by-project basis."*

The Tentatively Selected Plan (TSP) would reduce hydropower storage from 202,926 acre-feet to 130,109 acre-feet. Impacts to hydropower, while present, appear minimal. Generation impacts are relatively small to modest, and generally positive since reallocation away from hydropower storage increases total hydropower generation for the TSP. This is due to the unique hydropower operating regime at Whitney Lake and Dam as water supply releases are typically released through the turbines. The TSP is the most impactful alternative to hydropower energy production with an average annual increase in energy output of 9% over the baseline (see Appendix D for additional information). However, it is important to note that because hydropower storage is utilized primarily to provide spinning reserves rather than typical energy production, an increase in generation does not necessarily reflect the preference of SWPA or its customers. Ready reserves provisions would be reduced by approximately 3.5% from the baseline with implementation of the TSP. From a National Economic Development perspective, these impacts are minimal.

Thus, these changes may not be viewed as positive by these parties regardless of the minor increases in energy produced and revenues collected. However, the study has evaluated the impacts based on the law that states that an evaluation should be conducted to determine if the changes proposed (in this case, the TSP) seriously affect the purposes for which the project was authorized, surveyed, planned, or constructed, or if those changes would involve major structural or operational changes. In this case, it does not appear to seriously affect the hydropower purpose, and it does not involve major structural or operational changes. The fact that the hydropower purpose at Whitney Lake and Dam is primarily for spinning reserves meaning generation only in extreme condition(s) beseeches the question if that can be a serious affect because it is not an immediate need. All purposes at the reservoir will have affects during extreme conditions and therefore, it is not prudent to use this standard for determining serious effects.

The TSP would have no impact on flood risk management (Appendix B) since downstream flows would not change from the base conditions.

The outcome of the serious effects determination will determine if approval of the Whitney Lake Reallocation Study will reside within the USACE Chief's discretionary authority or if the report will require congressional approval.

6.3. Water Supply Agreement

An amendment to the current water supply agreement between USACE and BRA at Whitney Lake and Dam would be completed once the final report is approved. This would likely occur in FY27.

6.4. Lands, Easements, Rights of Way, Relocations, and Disposal

USACE acquired 53,233 acres of land (REDM 1966) in fee and flowage easements for Whitney Lake and Dam. Available land and resources are detailed in Table , below. The Tentatively Selected Plan requires only changing allowances within existing pool elevations and does not constitute a pool raise into the flood pool, therefore, no additional real estate is required for implementation of the Tentatively Selected Plan.

Table 49. Real Estate Information

LAND USE ACREAGES		
WHITNEY DAM AND RESERVOIR		
	REAL ESTATE DESIGN MEMORANDUM 1C (1966)	CURRENTLY AVAILABLE (GIS / 2016 MASTER PLAN)
FEE	44106	43557
FLOWAGE EASEMENT	9127	9122
PARK AND RECREATION AREAS		
ADMINISTERED BY USACE	4425	2185
ADMINISTERED BY OTHERS	1101	1142
WILDLIFE MITIGATION	310	16278
PUBLIC USE ESTHETICS	12466	1170

6.5. Operations, Maintenance, Repair, Replacement, and Rehabilitation

After reviewing available information, USACE concludes that the turbines can operate at an elevation of 512ft (Appendix D.1.) However, since operation at this elevation has not previously occurred, increased monitoring of the turbines would be prudent when the lake elevation reaches lower than 520 ft. If turbine operators hear sounds associated with potential cavitation below 520 ft, the turbines will cease operations, and an immediate coordination meeting will take place within USACE operations to determine the next steps forward.

6.6. Project Risks

Risk and uncertainty are important considerations in any planning study. Water supply and other large infrastructure projects generally involve long periods of analysis given that alternatives to address associated problems and opportunities are difficult and costly to plan and build. Given the long period of analysis, uncertainty is an important factor in developing water use forecasts.

Uncertainty includes knowledge uncertainty (i.e., unknown non-random factors that will influence water use in the future), and natural variability that involves random influences on future water use. Risk measures the potential impacts or outcomes of uncertainty in light of consequences and the likelihood of a consequence happening. Risks associated with uncertainty involve over or underestimating future water use, which could affect the planning decision in terms of how much water is required in the near term and over the long term. The assumption of different growth rates addresses some uncertainty regarding the number of future customers and economic conditions. Other factors adding uncertainty are changing climate conditions and future water use efficiency. Assumptions were additionally made regarding future population growth, usage, available water supplies, temperatures, and rainfall for the region. If one or more of those factors or assumptions is incorrect, the study could have over or under projected the supply gap for the region.

Extensive Riverware modeling was conducted for this study, there is a risk that assumptions used in the modeling could be incorrect and therefore would over or underestimate impacts to authorized users. This is an accepted risk in order to make a decision. The best available information was used at the time and key inputs were coordinated with the authorized users.

Furthermore, limited data was available about operating the turbines at elevations lower than 520 ft. While the available data illustrates that the turbines should be able to operate successfully at an elevation of 512 ft they have never operated at that elevation, so uncertainty remains. Lake elevations below 520 ft are rare in the period of record at Whitney Lake and Dam. So, the Hydroelectric Design Center (HDC) was engaged to evaluate this situation, and HDC's conclusion was that substantial uncertainty remains regarding the minimum safe operating forebay elevation. HDC's analysis is summarized in Appendix D.1.

Additionally, this report summarizes an analysis of the hydropower impacts resulting from several proposed reservoir reallocation scenarios (Appendix D). The estimates presented are subject to data limitations, modeling imperfections, and other constraints. While the intention of the approached taken is to accurately capture the physical and economic impacts being evaluated, the use of assumptions, proxies, and other simplifications warrants awareness. Further, specific uncertainty related to physical hydropower operations under the Tentatively Selected Plan requires further consideration. Below is a summary of these issues.

Energy and ancillary services prices and replacement value of hydropower. The monetary values associated with simulated power production are based on forecasts provided by the Energy Information Administration and a simple projection method used by USACE. While the underlying forecasts attempt to capture the uncertainty and volatility inherent in energy markets, history – particularly, recent history – have illustrated that actual energy prices can and do diverge significantly from expectations. Pronounced one-sided (upside) risk to energy values, and thus energy benefits, should be acknowledged

*Dependable capacity benefits***.** The regional market (ERCOT) into which Whitney Lake and Dam's output is sold is an "energy-only" market that in theory bundles the economic values of both energy and capacity into a single price per unit of energy. However, experiences in both ERCOT and other US markets tend to suggest that the value of capacity is not reliably embedded in energy prices. Thus, while additional “capacity benefits” over and above energy benefits are omitted from the hydropower analysis, it is likely that they are nonzero.

Hydropower operating regime uncertainty. The users of Whitney Lake and Dam’s hydropower undertook a major shift in operating regime from primarily energy production to primarily reserve capacity provision in the mid-2010’s. A rapidly changing market landscape almost certainly played a role in this decision. The market landscape in this region especially (and in the rest of the country more generally) remains in a state of rapid evolution, and while current operations are assumed to persist through the study horizon, deviations from this regime are possible and could substantially alter the estimates in this report.

6.7. Design and Construction

There is no design and construction associated with the Tentatively Selected plan. The TSP is an operational change only to the reservoir. Since no design and construction are proposed for the TSP, no construction-related environmental commitments such as best management practices and work windows would be needed.

6.8. Project-Specific Considerations

Once a new water supply agreement is in place, the Whitney Lake Water Control Manual would need to be updated to reflect the new agreement. In addition, prior to implementation of the TSP, cultural resource surveys would need to occur in order to meet the requirements of the study’s programmatic agreement. The cost of the cultural resource surveys are expected to be a non-federal sponsor expense and are estimated at approximately $500,000. The cultural resources survey will be completed prior to implementation of the TSP.

A Programmatic Agreement (PA) is a Federal Agency program alternative, pursuant to 36 CFR § 800.14(b), used when a Federal Agency wants to create a Section 106 process that differs from the standard review process outlined in 36 CFR Part 800, of the regulations implementing Section 106 of the National Historic Preservation Act (NHPA) (54 U.S.C. § 306108). The USACE would execute the PA to ensure that once the horizontal and vertical extent of the undertaking has been finalized, the PA process would be implemented. The PA outlines the process by which the USACE will define the Area of Potential Effects (APE), perform a cultural resource survey of the APE to identify prehistoric/historic archaeological sites and buildings, structures and objects (BSO) and evaluate any identified archaeological site and/or BSO for potential inclusion in the NRHP as historic properties (i.e., identified properties determined to be eligible for listing in the NRHP). Further, the PA outlines the process for assessing effects, making an effects determination and consultation with the TX SHPO and appropriate Tribal Nations. USACE would implement the PA prior to the project’s implementation, to ensure compliance with Section 106 of the NHPA.

6.9. Environmental Operating Principles

The USACE Environmental Operation Principles (EOPs) are considered throughout the study process and will continue to be part of the proposed water supply storage reallocation project.

The following environmental operating principles have been integrated into the planning process:

1. *Foster sustainability as a way of life throughout the organization*. Planning for this project incorporated consideration for the sustainability of environmental resources in the project area.

2. *Proactively consider environmental consequences of all USACE activities and act accordingly.* Environmental consequences were considered throughout the planning process, and every effort has been made to avoid, minimize, or mitigate anticipated impacts.
3. *Create mutually supporting economic and environmentally sustainable solutions.* The proposed TSP allows the sponsor to meet an immediate and future need for water in the region.
4. Continue to meet our corporate responsibility and accountability under the law for activities undertaken by USACE, which may impact human and natural environments. A full environmental assessment (EA) will be conducted as part of this study.
5. Consider the environment in employing a risk management and systems approach throughout the life cycles of projects and programs. For this study, coordination has taken place to determine the impacts regarding anticipated environmental impacts.
6. Leverage scientific, economic and social knowledge to understand the environmental context and effects of USACE actions in a collaborative manner. USACE worked closely with the Brazos River Authority and Southwestern Power Administration throughout this study in order to understand potential impacts to authorized users.
7. *Employ an open, transparent process that respects views of individuals and groups interested in USACE activities.* USACE continues to be responsive to stakeholder concerns and has worked to increase engagement during the study.

In coordination with other agencies and stakeholders, the USACE proactively considered the environmental consequences of the water supply reallocation project. In accordance with the mandate of this designation and the EOPs, the USACE has proposed a project that supports economic and environmentally sustainable solutions.

6.10. Views of the Non-federal Sponsor

The BRA supports the Tentatively Selected Plan.

The BRA appreciates the USACE's commitment and hard work in evaluating the feasibility of a reallocation of Lake Whitney. As the Brazos River Basin's sole regional wholesale, raw surface water supplier, the BRA views a water supply reallocation at Lake Whitney as the most regionally beneficial, least environmentally impactful, and cost-effective water management strategy being undertaken in the basin.

The BRA exists to develop, manage, and protect the water resources of the Brazos River Basin. As such, BRA is responsible for pursuing efficient and effective water management strategies to meet the needs of a vast and diverse basin. To that end, the BRA operates its water supply resources as a system across the basin, allowing BRA to maximize the service it provides. BRA's systematic efficiency and commitment to sound water management practices provides BRA with the unique ability to utilize a reallocation of Lake Whitney to serve local and downstream needs, allow storage optimization between system reservoirs to enhance supply reliability system wide, and integrate with existing, and potentially new infrastructure, to provide regional water supply benefits across the basin.

Developing new, reliable water supply, e.g. new reservoir construction, is complex and costly. Scaling up those new water projects to support large areas of the basin can exaggerate project costs and complexity significantly. New water supply projects can also be constrained by their location, volume, environmental concerns, regulatory framework, etc. Meanwhile, water demands exist at every scale, from individual domestic users to large cities and industry with both immediate and future needs; therefore, a future without a Whitney Lake reallocation will require BRA to pursue more expensive, environmentally impactful, and contentious water supply projects to fulfil these demands.

The TSP will provide substantial water supply benefits with little if any impact to other authorized purposes of Whitney Lake. It will provide the basin with significantly more water supply, which otherwise could not have been achieved without substantially greater costs and impacts, thus allowing the BRA to continue to meet growing local and downstream demands in the basin. At the same time, hydropower energy generation would increase and ready-reserve capacity, which is a marked departure from historical operations, would be only minimally affected. More, the analysis shows that the National Economic Development benefits provided by water supply uses far exceed those of other reservoir purposes and uses. In these circumstances, USACE's decision to select the TSP is rational, reasonable, and fully justified.

7. Environmental Compliance

7.1. Environmental Compliance

This section addresses the primary Federal environmental laws, implementing regulations, and executive orders potentially applicable to the proposed TSP. The applicable environmental statutes are summarized below along with a brief description of the law, regulations, and executive orders. The status of compliance and environmental commitments identified for each to date are also included.

7.1.1. Federal Statutes

7.1.1.1. National Environmental Policy Act of 1969

NEPA (42 USC 4321 et seq.) provides a commitment that Federal agencies will consider the environmental effects of their actions. It also requires that an EIS or EA be included in every recommendation or report on proposals for legislation and other major Federal actions. The EIS or EA must provide detailed information regarding the alternatives, the environmental impacts of the alternatives, and potential mitigation measures. Agencies are required to demonstrate that these factors have been considered by decision-makers prior to undertaking actions.

This draft IFR/EA is the primary vehicle to achieve NEPA compliance for the proposed action. The 30-day public review period on the draft IFR/EA provides disclosure of the environmental effects of the alternatives to the public. After review and consideration of agency and public comment on the draft IFR/EA, USACE would proceed to preparation of a final IFR/EA and USACE decision makers would sign a FONSI, outlining the rationale for their decision.

7.1.1.2. Federal Water Pollution Control Act (Clean Water Act)

The Federal Water Pollution Control Act (33 USC 1251 et seq.) is more commonly referred to as the Clean Water Act (CWA). This Act is the primary legislative vehicle for Federal water pollution control programs and the basic structure for regulating discharges of pollutants into waters of the United States. The CWA was established to “restore and maintain the chemical, physical, and biological integrity of the nation’s waters.” The CWA sets goals to eliminate discharges of pollutants into navigable water, protect fish and wildlife, and prohibit the discharge of toxic pollutants in quantities that could adversely affect the environment. The sections of the CWA that may apply to the TSP are Section 401, regarding state water quality certifications that existing water quality standards would not be violated if a Federal permit that causes discharges into navigable waters were issued; Section 402, regarding discharges of pollutants from point sources under the National Pollutant Discharge Elimination System (NPDES); and Section 404, regarding fill material discharged into the waters of the U.S., including wetlands.

The Texas Commission on Environmental Quality (TCEQ) is the agency responsible for reviewing and issuing Water Quality Certifications (WQC) for projects in Texas under Section 401. Section 404(b)(1) of the CWA of 1972 requires that any recommended discharge of dredged or fill material into Waters of the U.S. must be evaluated using the guidelines developed by the Administrator of the EPA in conjunction with the Secretary of the Army. For this study, Sections 401 and 404 are not triggered due to no actions that would impact state water quality standards and no discharged of dredged material into the Waters of the U.S. TCEQ confirmed that Section 401 is not triggered (Appendix I)

7.1.1.3. Clean Air Act

The Clean Air Act (CAA) (42 USC 7401 et seq.), amended in 1977 and 1990, was established "to protect and enhance the quality of the nation's air resources so as to promote public health and welfare and the productive capacity of its population." The CAA authorizes the EPA to establish the National Ambient Air Quality Standards to protect public health and the environment. The CAA establishes emission standards for stationary sources, volatile organic compound emissions, hazardous air pollutants, and vehicles and other mobile sources. The CAA also requires the states to develop implementation plans applicable to particular industrial sources.

The air quality area of interest is the three-county area of Bosque, Hill, and Johnson Counties. Currently Bosque and Hill counties are in attainment for all criteria pollutants. However, Johnson County is in serious non-attainment for ozone air pollution. It's possible, though unlikely, that this slightly lower water elevation observed under the TSP could lead to increased dust as more shoreline and lakebed areas are exposed, which could contribute to higher levels of PM levels, especially on windier days. The slight decrease in water level may increase dry vegetation, which could lead to a marginal increase in wildfire risk, which is a major threat to air quality. Despite this minor concern, the TSP is still expected to be in compliance with the CAA and does not require a General Conformity Determination.

7.1.1.4. U.S. Fish and Wildlife Coordination Act

The Fish and Wildlife Coordination Act (FWCA) of 1934, as amended (16 U.S.C. §§ 661–667e), provides authority for USFWS and NMFS involvement in evaluating impacts to fish and wildlife from proposed water resource development projects. It requires that fish and wildlife resources receive equal consideration to other development project features. It requires Federal agencies that construct, license, or permit water resource development projects to consult with the USFWS, NMFS, and state resource agencies regarding the impacts on fish and wildlife resources and measures to mitigate these impacts when waters of any stream or other body of water are "proposed . . . to be impounded, diverted . . . or . . . otherwise controlled or modified . . ." Section 2(b) requires the USFWS to produce a Coordination Act Report (CAR) that describes fish and wildlife resources in a project area, potential impacts of a proposed project, and recommendations for a project.

USACE has been coordinating with USFWS with regards to FWCA and compliance with FWCA is expected to be completed prior to signing of the FONSI.

7.1.1.5. Endangered Species Act

The Endangered Species Act (ESA) of 1973 (16 U.S.C. §§ 1531–1544), amended in 1988, establishes a national program for the conservation of threatened and endangered species of fish, wildlife, and plants and the habitat upon which they depend. Section 7(a)(2) of the ESA requires that Federal agencies consult with the National Marine Fisheries Service (NMFS) and U.S. Fish and Wildlife Service (USFWS), as appropriate, to ensure that their actions are not likely to jeopardize the continued existence of endangered or threatened species or to adversely modify or destroy their designated critical habitats.

USACE has been coordinating with USFWS throughout the development of this IFR/EA. Effects to threatened and endangered species and critical habitat have been evaluated with respect to Section 7(a)(2) and USACE made a no effects determination (Section 4.8.1). No NMFS ESA-listed species or designated critical habitat are located within the project area.

7.1.1.6. Migratory Bird Treaty Act and Executive Order 13186, Responsibilities of Federal Agencies to Protect Migratory Birds

The Migratory Bird Treaty Act (16 U.S.C. §§ 703–712), as amended, protects over 800 bird species and their habitat, and implements various treaties and conventions between the United States and other countries, including Canada, Japan, Mexico, and Russia, for the protection of migratory birds. Under the act, taking, killing, or possessing migratory birds, or their eggs or nests, is unlawful. The act classifies most species of birds as migratory, except for upland and non-native birds such as pheasant, chukar, gray partridge, house sparrow, European starling, and rock dove. Executive Order 13186, dated January 10, 2001, directs Federal agencies to evaluate the effects of their actions on migratory birds, with emphasis on species of concern, and inform USFWS of potential negative effects to migratory birds.

The proposed action is not expected to permanently impact migratory bird populations. Construction actions are not anticipated to be a direct action as a result of the TSP, therefore there is no concern to nesting bird impacts. The construction activities that may be necessary to offset minor recreation impacts may still take place, but these will also be strategically planned to avoid migratory and nesting bird impacts.

7.1.1.7. Bald and Golden Eagle Protection Act

The bald eagle is protected by the Bald and Golden Eagle Protection Act even though it has been delisted under the Endangered Species Act. This law, originally passed in 1940, protects the bald eagle and golden eagle (as amended in 1962) by prohibiting the take, possession, sale, purchase, barter, offer to sell, purchase or barter, transport, export or import, of any bald or golden eagle, alive or dead, including any part, nest, or egg, unless allowed by permit (16 U.S.C. 668(a); 50 CFR 22).

"Take" includes pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest or disturb (16 U.S.C. 668c; 50 CFR 22.3). The 1972 amendments increased civil penalties for violating provisions of the Act to a maximum fine of $5,000 or 1-year imprisonment with $10,000, or not more than two years in prison for a second conviction. Felony convictions carry a maximum fine of $250,000 or 2 years of imprisonment. The fine doubles for an organization. Rewards are provided for information leading to arrest and conviction for violation of the Act.

The TSP is not anticipated to have take of bald eagles. Given this project does not involve construction efforts, there will not otherwise be a plan to avoid and protect these species under the TSP. Construction activities indirectly induced via recreation impact will utilize information to develop impact avoidance and minimization plans.

7.1.1.8. Farmland Protection Policy Act of 1981 and the CEQ Memorandum on Prime and Unique Agricultural Lands

The purpose of the Farmland Protection Policy Act is to minimize the extent to which Federal programs contribute to the unnecessary and irreversible conversion of farmland to nonagricultural uses. The act requires among other things, agencies to identify and take into account the adverse effects of Federal programs on the preservation of prime and unique farmlands, and consider alternative actions, as appropriate that could lessen such adverse effects. The CEQ issued a memorandum “Analysis of Prime and Unique Agricultural Lands in Implementing the National Environmental Policy Act” that supplemented NEPA procedures to include analysis of these impacts in NEPA documents. The regulation codifying the Act in 7 CFR Part 658 specified procedures and criteria for the analysis of these impacts. The definitions in this regulation specify that farmland does not include land already used as water storage, which would include open water. The recommended plan does not inundate any new lands with water that are typically exposed, it only exposes small amounts of previously open water. Therefore, the TSP would have no impacts to prime and unique agricultural lands.

7.1.1.9. Federal Water Project Recreation Act

In the planning of any Federal navigation, flood control, reclamation, or water resources project, the Federal Water Project Recreation Act, as amended (16 U.S.C. § 460l-12 et seq.) requires that full consideration be given to the opportunities that the project affords for outdoor recreation and fish and wildlife enhancement. The act requires planning with respect to development of recreation potential. Projects must be constructed, maintained, and operated in such a manner if recreational opportunities are consistent with the purpose of the project.

Impacts to recreation would likely be very limited under the TSP. A full discussion of impacts to recreation can be found in section 4.12. The TSP plans in a manner which maintains recreational opportunities which are consistent with the purpose of the project.

7.1.1.10. National Historic Preservation Act

Section 106 of the National Historic Preservation Act (54 U.S.C. § 306108) and its implementing regulations, 36 Code of Federal Regulations (C.F.R.) Part 800, provides a regulatory framework for the identification, documentation, and evaluation of historic and cultural resources that may be affected by Federal undertakings. Under the Act, Federal agencies must take into account the effects of their undertakings on historic properties, which are defined as cultural resources that are listed or eligible for listing in the National Register of Historic Places, and afford the Advisory Council on Historic Preservation a reasonable opportunity to comment on such undertakings. Additionally, a Federal agency shall consult with any tribe that attaches religious and cultural significance to such properties. Section 110(f) of the NHPA (54 U.S.C. § 306107) requires USACE to minimize harm to all National Historic Landmarks (NHL) within the Area of Potential Effects to the maximum extent possible. A programmatic agreement is being developed through consultation to create a process to identify historic properties that stand to be affected by this undertaking and assess effects on them, in accordance with 36 CFR Part 800.

7.1.1.11. Comprehensive Environmental Response, Compensation and Liability Act

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended (42 U.S.C. § 9601 et seq.), which was later amended by the Superfund Amendments and Reauthorization Act of 1986, sets forth regulations for cleanup of hazardous substances after improper disposal; identifies federal response authority; and outlines responsibilities and liabilities of potentially responsible parties, who are past/present owners or operators of the site, a person who arranged disposal of hazardous substances at a site, or a person who transported hazardous substances to a site they selected for disposal. CERCLA also specifies where Superfund money can be used for site cleanup.

The areas directly surrounding Lake Whitney and out to one mile are majority natural, commercial, and residential. These properties are primarily used for recreation with little to no HTRW concerns within the project footprint. The TSP is therefore in compliance with CERCLA with no known HTRW concerns.

7.1.2. Executive Orders

7.1.2.1. Executive Order 11988, Floodplain Management

Executive Order 11988, Floodplain Management Guidelines, May 24, 1977, states that each Federal agency shall take action to reduce the risk of flood loss, minimize the impacts of floods on human safety, and restore and preserve the natural values of floodplains while carrying out its responsibilities for (1) acquiring, managing, and disposing of Federal lands; (2) providing Federal investments in construction and improvements; and (3) conducting activities affecting land use, including water resources planning and regulating activities. To comply with this order, each Federal agency has a responsibility to evaluate the potential effects of any actions it may take in the floodplain, to ensure its planning programs consider flood hazards and floodplain management, and to implement the policies and requirements of the order.

The following eight-step decision-making process was used for the proposed project:

1. Determine if a proposed action is in the base floodplain.
2. Conduct early public review, including public notice.
3. Identify and evaluate practicable alternatives to locating in the base floodplain, including alternative sites outside the floodplain.
4. Identify impacts of the proposed action.
5. If impacts cannot be avoided, develop measures to minimize the impacts and restore and preserve the floodplain, as appropriate.
6. Re-evaluate alternatives.
7. Present the findings and a public explanation.
8. Implement the action.

Under the No Action Alternative, no new project or development would occur within the 100-year floodplain associated with the Brazos River, including Whitney Lake. The existing conditions within the floodplain would remain unchanged, and no federal actions would be taken that could potentially affect the floodplain. The 100-year floodplain would continue to function as a natural flood storage area, providing ecosystem services such as floodwater storage and conveyance, habitat for aquatic and terrestrial species, water quality maintenance, and groundwater recharge. The Brazos River and Whitney Lake would continue to experience periodic flooding, and the floodplain would remain susceptible to inundation during high-water events.

Under the FWOP, there would be no changes to the existing floodplain management practices, including no alterations to the floodplain's hydrology or hydraulics, no changes to the existing vegetation or land use patterns, no construction of new infrastructure or facilities within the floodplain, and no modifications to the existing flood control measures or structures. Since no project or development would occur, there would be no potential impacts to the floodplain or its ecosystem services to evaluate or mitigate. The floodplain would continue to function in its natural state, without any federal actions that could potentially affect its characteristics or functions.

The No Action Alternative is consistent with the requirements of Executive Order 11988, Floodplain Management, as it avoids any potential impacts to the floodplain and does not require the implementation of measures to minimize harm or restore and preserve the floodplain. By not pursuing the proposed project, USACE would be adhering to the principles of floodplain management, which emphasize the importance of avoiding actions that could adversely affect floodplains and their ecosystem services.

The TSP actively minimizes floodplain risks by increasing available flood storage capacity slightly on a month-by-month basis. This change will not exacerbate flooding potential and instead reallocates it for other beneficial uses. Therefore, this alternative is within compliance with EO 11988 and does not lead to negative floodplain impacts.

7.1.2.2. Executive Order 11990, Protection of Wetlands

Executive Order 11990, dated May 24, 1977, requires Federal agencies to take action to avoid adversely impacting wetlands wherever possible, to minimize wetland destruction and preserve the values of wetlands, and to prescribe procedures to implement the policies and procedures of this executive order. In addition, Federal agencies shall incorporate floodplain management goals and wetlands protection considerations into its planning, regulatory, and decision-making processes.

USACE has evaluated potential direct and indirect effects on wetlands from the federal action and taken considerable steps to avoid adverse effects. Since the TSP is expected to have the normal seasonal, yearly lake surface water elevation fluctuations, and downstream flows as the No Action Alternative and therefore would not result in any impacts to quality and quantity of existing wetlands.

7.1.2.3. Executive Order 13751, Safeguarding the Nation from the Impacts of Invasive Species

Executive Order 13751, December 8, 2016, Safeguarding the Nation from the Impacts of Invasive Species, December 5, 2016, amends Executive Order 13112 and directs Federal agencies to "refrain from authorizing, funding, or implementing actions that are likely to cause or promote the introduction, establishment, or spread of invasive species in the United States unless, pursuant to guidelines that it has prescribed, the agency has determined and made public its determination that the benefits of such actions clearly outweigh the potential harm caused by invasive species; and that all feasible and prudent measures to minimize risk of harm will be taken in conjunction with the actions."

It is expected that the TSP would not promote the establishment of invasive species within the project area. There may be small amounts of shoreline exposed which may result in opportunities for invasive species. However, continued service and maintenance around the lake would reduce the abundance of invasive plant species through herbicide or physical controls, as well as replacing those areas with native vegetation. Therefore, the TSP is in compliance with EO 13751.

7.1.2.4. Executive Order 13175, Consultation and Coordination with Indian Tribal Governments

Executive Order 13175, November 6, 2000, Consultation and Coordination with Indian Tribal Governments, November 6, 2000, directs Federal agencies to establish regular and meaningful consultation and collaboration with tribal officials in the development of Federal policies that have tribal implications, to strengthen the United States government-to-government relationships with Indian Tribes, and to reduce the imposition of unfunded mandates upon Indian Tribes.

USACE has consulted from project initiation through the TSP milestone with the relevant Tribal Nations that are believed to have an interest in Bosque and Hill Counties, Texas and will continue to do so to the completion of this study. Tribal consultation performed has followed all relevant Federal guidance beyond EO 13175 to include:

- Presidential Memorandum on Tribal Consultation and Strengthening Nation to Nation Relationships, 26, January 2021

- Presidential Memorandum on Uniform Standards for Tribal Consultation, November 30, 2022
- Memorandum for Commanding General, U.S. Army Corps of Engineers. Subject: Updated U.S. Army Corps of Engineers Civil Works Tribal Consultation Policy, 5, December 2023

7.1.2.5. Executive Order 14156, Declaring a National Energy Emergency

Executive Order 14156, January 20, 2025, Declaring a National Energy Emergency, directs Federal Agencies to identify and exercise any lawful emergency authorities available to them to facilitate the identification, leasing, siting, production, transportation, refining, and generation of domestic energy resources on Federal lands.

Under the Whitney Lake Reallocation Study, hydropower production would continue.

7.1.2.6. Executive Order 14154, Unleashing American Energy

Executive Order 14154, January 20,2025, Unleashing American Energy directs Federal Agencies to encourage energy exploration and production on Federal lands and waters, ensuring that an abundant supply of reliable energy is readily accessible in every State, and to review all existing regulations, orders, guidance documents, policies, settlements, etc to identify those agency actions that impose an undue burden on domestic energy resources.

Under the Whitney Lake Reallocation Study, hydropower production would continue.

7.1.2.7. Executive Order 14262, Strengthening the Reliability and Security of the United States Electric Grid

Executive Order 14262, April 8, 2025, Strengthening the Reliability and Security of the United States Electric Grid directs Federal Agencies to safeguard the reliability and security of the United States' electric grid during periods when relevant grid operator forecasts a temporary interruption of electricity supply to prevent grid failure.

Under the Whitney Lake Reallocation Study, hydropower production would continue.

7.2. Public Involvement and Coordination

7.2.1. Public Involvement

In accordance with 36 CFR 230.12, USACE began its public involvement process with a public scoping comment period to provide an avenue for public and agency stakeholders provide comments. The 30-day public scoping period was August 16 through September 15, 2023. USACE received 19 comment letters (Appendix G). Majority of comments expressed concerns the any reallocation at Whitney Lake would seriously affect the hydropower purpose and threaten the stability and reliability of the electric grid within ERCOT. In addition, suggestion was made that any reallocation from any hydropower projects should be capped at 15% or 50,000 acre-feet, unless reallocated by Congress.

For this draft IFR/EA, the public comment period is open for 30 days. Public comments submitted and received during the 30-day comment period on the draft IFR/EA will be considered in the agency's NEPA analysis and development of the final IFR/EA.

7.2.2. Agency Involvement

USACE asked 10 Federal and State agencies to participate as cooperating and participating agencies based on their jurisdiction by law, or their special expertise with respect to any environmental issue evaluated in this IFR/EA. The cooperating and participating agencies are as follows:

- Southwestern Power Administration (SWPA)
- Environmental Protection Agency (EPA), Region 6
- Texas Department of Transportation
- Natural Resource Conservation Service
- Texas Parks and Wildlife Department
- Texas Commission of Environmental Quality
- Texas Water Development Board

In addition, USACE with our partner BRA have met with these agencies along with USFWS and Texas Department of Transportation in interagency coordination meetings. Furthermore, USACE provided the opportunity for the cooperating and participating agencies to review and provide comments on a preliminary draft of the IFR/EA.

SWPA provided comments via letter on a preliminary draft of the IFR/EA on June 18, 2025 (Appendix I includes the letter). SWPA expressed the following key concerns:

- *Uncertainty regarding the ability of the hydropower units to generate down to elevation 512 ft as assumed in the TSP.* SWPA does not believe that the USACE's HDC analysis is adequate for the feasibility study and that the uncertainty is too great. SWPA requests that the report clearly state what mitigation may occur if the turbines are found to be unable to operate at an elevation of 512 ft once the project is implemented. USACE continues to evaluate SWPA's concern and will include language about monitoring the turbines for signs of operational inefficiency.
- *Complete loss of hydropower capacity for periods of time in the TSP.* SWPA is concerned about the complete loss of capacity for a portion of time under the TSP. SWPA requests that the hydropower storage remain at a level such that hydropower capacity does not reach 0 MW at any time during the period of record. USACE will continue to evaluate and discuss SWPA's concern prior to finalizing the feasibility study.
- *The Corps incorrect definition of the conservation pool.* SWPA requested the conservation pool and inactive pool be better defined to align with the Whitney Lake and Dam water control manual. After discussion, USACE did change how the different pools were defined and identified the storage below 520 ft as the inactive pool available for powerhead reserve and sedimentation.
- *Incomplete List of Executive Orders.* SWPA identified several executive orders that are relevant to the Whitney Lake Reallocation Study. These executive orders are included in Section 7.1.2.

USACE acknowledges the uncertainty in the report analysis relating to lowering the conservation pool from an elevation of 520 ft to 512 ft. Since the turbine units in the Whitney powerhouse were installed, they have not been operated under an elevation below 520 ft. Due to limitations in their engineering and installation, it is not certain that the turbines can be safely operated at corresponding low operating heads. Lake elevations below 520 ft are rare in the period of record at Whitney Lake and Dam. So, the Hydroelectric Design Center (HDC) was engaged to evaluate this situation, and HDC's conclusion was that substantial uncertainty remains regarding the minimum safe operating forebay elevation. HDC's analysis is summarized in Appendix D.1.

The scope of the study analysis will continue to be refined after concurrent public, policy, and technical reviews to incorporate SWPA comments and other comments received on the TSP.

8. District Engineer Recommendation

Based upon the data and analysis provided herein and pursuant to the Water Supply Act of 1958, as amended 43 U.S.C. § 390b, the Tentatively Selected Plan is to reallocate 72,817 AF of storage from the conservation pool and 111,537 AF from the powerhead reserve/inactive pool, in Whitney Lake and Dam to municipal and industrial (M&I) water supply storage through a reallocation. This reallocation would result in lowering the bottom of the conservation pool and the powerhead reserve/inactive pool from an elevation of 520 ft to 512 ft. The top of the conservation pool would remain the same at an elevation of 533 ft. Reallocation of storage, as described in Section 5, is considered the most efficient means to satisfy the current and projected water demands for the Brazos River Authority. The water reallocation would allow a water storage agreement amendment to be executed for 184,354 AF of conservation pool storage after the final approval of this water reallocation report.

The recommendations contained herein reflect the information available at this time and current departmental policies governing formulation of individual projects. They do not reflect program and budgeting priorities inherent in the formulation of a national Civil Works construction program nor the perspective of higher review levels within the Executive Branch. Consequently, the recommendations may be modified before they are transmitted to higher authority as proposals for authorization and implementation funding. However, prior to transmittal to higher authority, the sponsor, the states, interested federal agencies, and other parties will be advised of any modifications and will be afforded an opportunity to comment further.

Date

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