10.3 Lake Whitney Hydropower Reallocation

10.3.1 Description of Options

Lake Whitney is a major impoundment located on the Brazos River approximately 30 miles north of the City of Waco in Hill and Bosque Counties. The location of Lake Whitney is shown in Figure 10.3-1. Lake Whitney was completed in 1951 by the U.S. Army Corps of Engineers for the primary purposes of flood control, water supply, and production of hydroelectric power. According to a 1959 volumetric survey, the total storage in Lake Whitney was 1,999,500 acft, making it the largest reservoir in the Brazos River Basin. The vast majority of storage in Lake Whitney is for flood control, comprising 1,372,400 acft (68.6 percent of the total reservoir storage). The original conservation storage capacity was 627,100 acft at elevation 533 ft-msl, but it has since been reduced by sedimentation to 554,203 acft as of 2005[1]. The capacity below elevation 520 ft-msl is reserved for power head and sediment storage, and has a capacity of 320,711 acft according to the 2005 survey (Table 10.3-1). In 1972, the top of the power pool was raised from 520 ft-msl to 533ft-msl, and the top of power head reserve (i.e. the bottom of the power pool) was raised from 510 ft-msl to 520 ft-msl, making 248,000 acft of storage available to hydropower[2]. In 1982, approximately 20 percent of the hydropower storage (50,000 acft) was reallocated to water conservation storage (water supply). A water right was issued to the Brazos River Authority (BRA) that authorizes the BRA to divert and use 18,336 acft/yr from the water conservation storage (Table 10.3-1). By 2005, the amount stored between elevations 520 ft-msl and 533 ft-msl, which includes both the hydropower pool and BRA's storage, was 233,492 acft.

Hydroelectric power generation from Lake Whitney is administered through the Southwestern Power Administration (SWPA), a federal agency. The Whitney Dam powerhouse uses two generators that originally had a capacity of 30 megawatts (MW) but were upgraded in 2014 and now have a capacity of 43 MW. According to the 2005 TWDB volumetric survey, the average annual power production was 73.1 million kilowatt-hours.

The potential for reallocation of the hydropower storage and inactive storage at Lake Whitney to water conservation storage has been studied in various forms in the past and is an option for developing additional water supply in the Brazos River Basin[3]. The conversion of storage to water supply purposes at Lake Whitney can produce a significant supply of water that could be utilized by a number of entities throughout the Brazos River Basin. Potential users include entities in Bosque County and Johnson County, as well as entities downstream in Region H.

In addition to Lake Whitney reallocation, a project was evaluated to deliver supply from the reallocated storage at Lake Whitney downstream towards Milam County to deliver water

[1] Volumetric Survey of Lake Whitney. June 2005 Survey. Prepared by The Texas Water Development Board, September 2006.

[2] Whitney Reservoir Section 216 Initial Appraisal Report. Prepared by the U.S. Army Corps of Engineers. December 2014.

[3] Texas Water Resources Institute, "Reservoir/River System Reliability Considering Water Rights and Water Quality," (TR-165) Texas A&M University, March 1994.

to Williamson County. This water would be diverted through an intake on the Brazos River, treated and delivered to various water users with needs in Williamson County. Figure 10.3-2 displays the suggested route and strategy.

Figure 10.3-1. Map of Lake Whitney

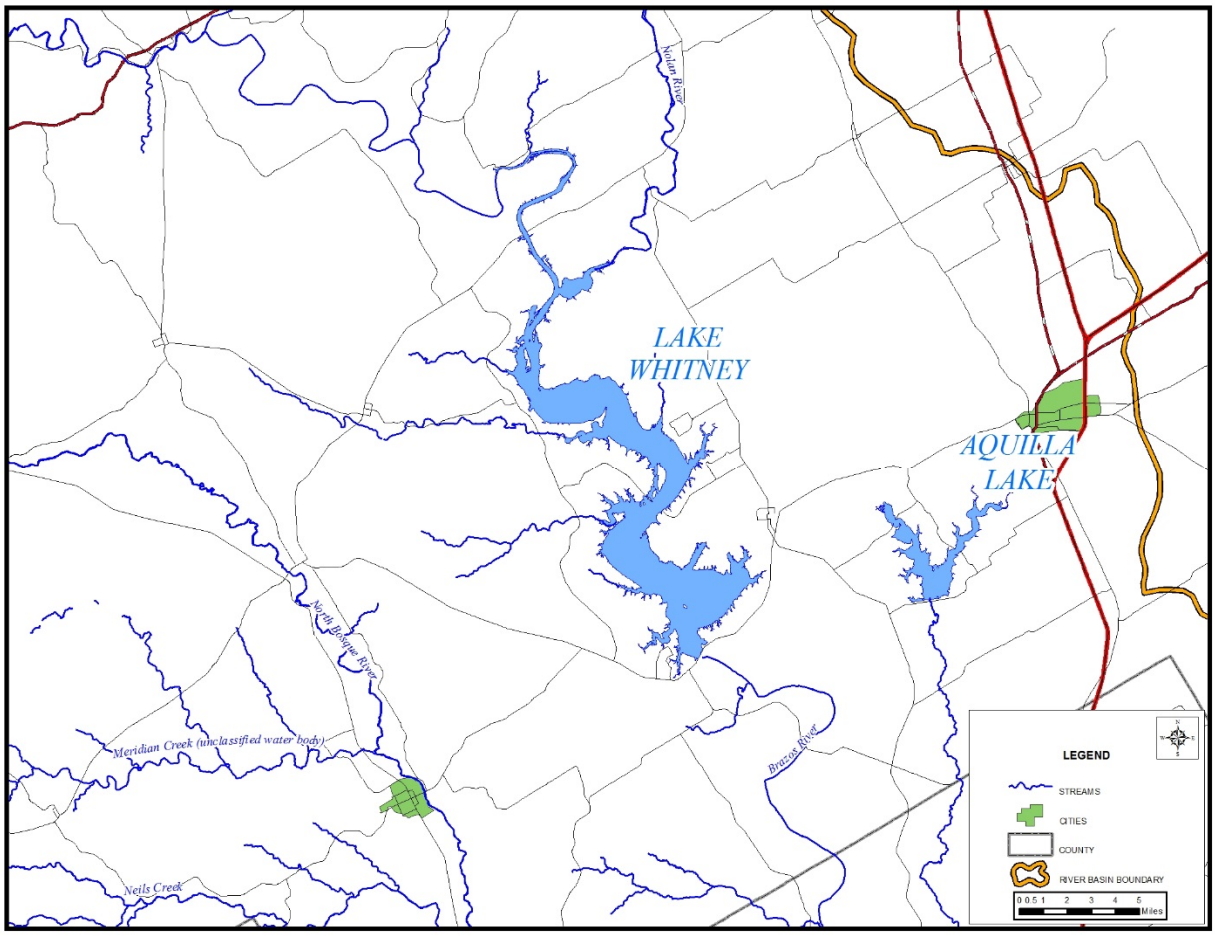

Figure 10.3-2. Map of Lake Whitney Option to Meet Needs in Williamson County

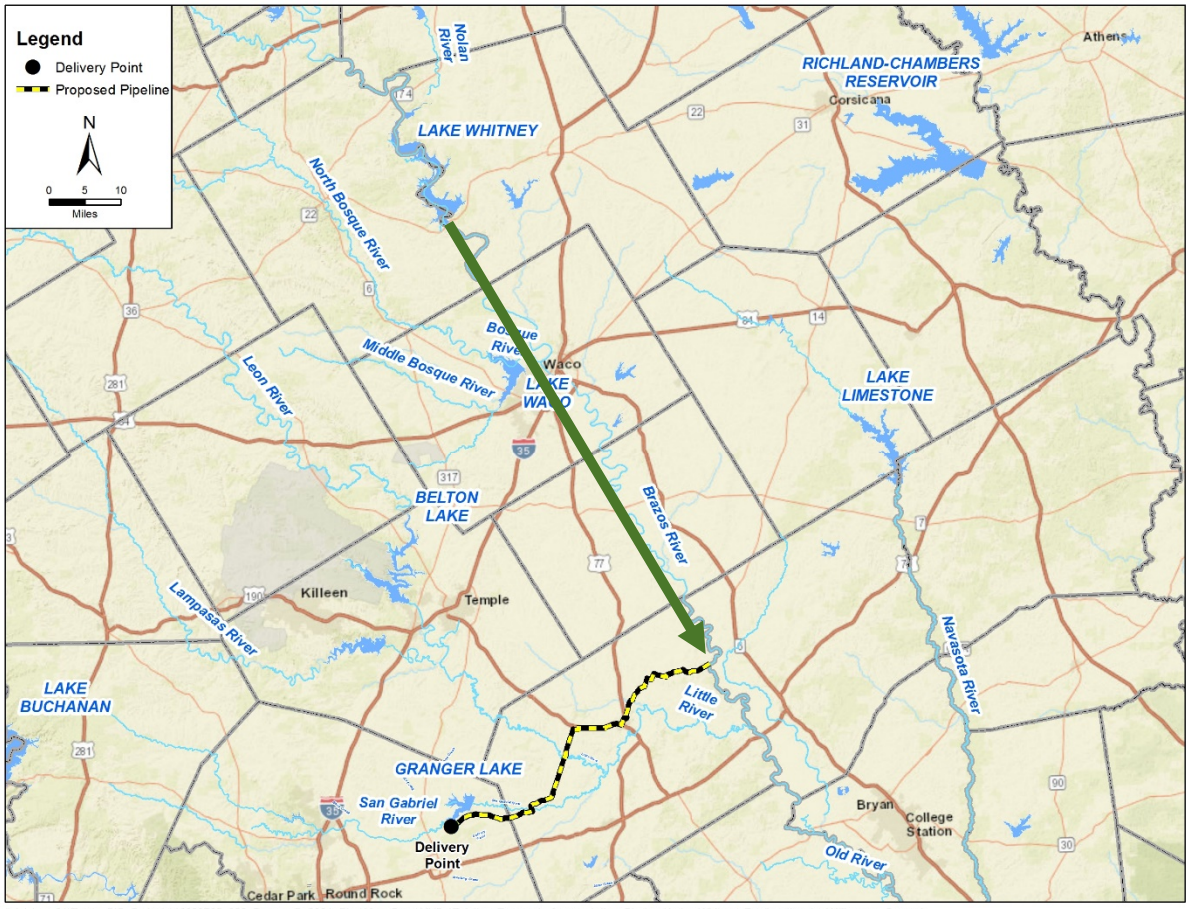

Table 10.3-1. Lake Whitney Characteristics

Ownership	
Reservoir Owner	U.S. Army Corps of Engineers
Water Supply Contract	
Owner	Brazos River Authority
Storage amount	22.017% of conservation storage
Texas Water Right	
Number	CA 12-5157
Owner	Brazos River Authority
Diversion	18,336 acft/yr
Storage	50,000 acft between 520 ft and 533 ft-msl
Priority date	August 30, 1982
Flood Pool[1]	
Top elevation	571 ft
Storage	1,372,400 acft
Conservation Pool[2]	
Top elevation	533 ft
Surface area	23,220 ac
Storage	554,203 acft
Inactive Storage[3]	
Top elevation	520 ft
Storage	320,711 acft

[1]. Based on original 1959 survey. Represents volume of flood pool only (i.e., volume between 533ft and 571ft assuming no sedimentation in flood pool).
[2]. Based on 2005 TWDB volumetric survey. Represents volume from 533ft and below.
[3]. Based on 2005 TWDB volumetric survey. Capacity from 520ft and below is reserved for sediment and power-head storage space.

10.3.2 Available Supply

The firm yield for the reallocation of Lake Whitney was estimated using the Brazos Water Availability Model (WAM) Run 3 with Senate Bill 3 environmental flows and the BRA's System Operation permit. The sedimentation conditions for Lake Whitney were updated to projected storage capacities in 2020 and 2070, while all other reservoirs in the basin remained at their original permitted storage amounts. The WAM simulates streamflows, reservoir operations, and existing water rights for the historical period of 1940-1997. This evaluation does not consider converting flood storage to water supply storage at Lake Whitney, but rather evaluates the reallocation of hydropower storage and a portion of the inactive storage in Lake Whitney to water supply storage. This reallocation could produce a considerable firm yield. Since most of the supply from this strategy would be used as part of the BRA system, this analysis determines the increase in BRA system yield made available from the additional storage. The increase in system yield was measured as the

increase in firm diversions at a downstream point in the basin (i.e. Rosharon Gage) as a result of the reallocation project. The increase in system yield for reallocation of the hydropower storage in Lake Whitney was found to be 38,480 acft/yr for 2070 conditions assuming use of the total storage between elevations 520 feet and 533 feet (Table 10.3-1). If ten feet of previously inactive storage were reallocated to water supply, the increase in yield would be 77,600 acft/yr for 2070 conditions assuming use of the total storage between elevations 510 feet and 533 feet (Table 10.3-2). If an entity other than the BRA were to sponsor and pursue this strategy, then an agreement with the BRA would be required to address concerns related to the potential subordination of the System Operation strategy. The available supply could also be less unless the new supplies are operated as part of the BRA system.

The available supply could be used to meet needs in Williamson County. About 10,561 acft/yr is being considered currently for that purpose.

Table 10.3-2. Storage Capacities and the Increase in System Yields for Existing, Hydropower Reallocation, and Hydropower plus Inactive Storage Reallocation

Bottom of Conservation Elevation (feet)	*Top of Conservation Elevation (feet)*	*2020 conditions*		*2070 conditions*	
		Conservation Storage (acft)	*System Yield Increase (acft/yr)*	*Conservation Storage (acft)*	*System Yield Increase (acft/yr)*
520.00	533.00	50,000	0	50,000	0
520.00	533.00	231,084	59,300	226,999	38,480
510.00	533.00	351,448	82,270	341,301	77,600

10.3.3 Environmental Issues

Reallocation of hydroelectric and inactive storage in Lake Whitney could reduce hydroelectric generation and downstream streamflows and may impact reservoir pool levels. The effect on downstream flows would be greater if the diversions from Lake Whitney were taken lakeside. However, as modeled in this evaluation, it is more likely that the lake will continue to be used to meet system demands downstream, so reservoir releases would mitigate some impacts to hydroelectric generation and downstream flows.

The reallocation of hydroelectric storage in Lake Whitney could possibly have moderate impacts on environmental water needs/instream flows in the Brazos River below the reservoir to the extent those impacts are not mitigated by reservoir releases. The evaluation summarized in Table 10.3-3 was based on a wide range of natural resource databases on threatened and endangered species, and on riparian (stream bank) and littoral (lake side) habitats. Potential effects on aquatic and riparian habitats could result from reduction in stream flow, particularly in the summer months when flows are naturally lower and oxygen depletion in the water is greater. Reduced releases may increase the downstream concentration of pollutants from wastewater treatment plants and other sources, potentially impairing water quality in the stream. Seasonally reduced flows downstream from Lake Whitney could also adversely affect riparian vegetation and habitat, including bottomland hardwoods and wetlands. Changes in reservoir pool elevations could possibly have low impacts on bank vegetation, wildlife habitat, and cultural resources sites.

These issues will be evaluated closely by federal permitting agencies including the U.S. Army Corps of Engineers (for wetlands permitting), and the Federal Energy Regulatory Commission (for hydroelectric permitting).

Table 10.3-3. Environmental Issues: Lake Whitney Reallocation

Water Management Options	Implementation Measures	Environmental Water Needs / Instream Flows	Bays and Estuaries	Fish and Wildlife Habitat	Cultural Resources	Threatened and Endangered Species
Reallocation of Hydroelectric Storage to Conservation Storage in Lake Whitney	Reduced Hydroelectric Discharges to Brazos River below Lake Whitney[1]	Possible Moderate Impacts on Brazos River below Lake Whitney[1]	Possible Low Impacts	Possible Moderate Impacts on Brazos River Segment below Lake Whitney[2]	Possible Low Impacts	Negligible Impacts

1. Assumes decrease in average annual instream flows below Lake Whitney as a result of reduced hydroelectric generation. Does not account for cumulative effects of decreased regional stream flows.

2. Impacts would be variable depending on resulting change in flows. Adverse impacts would be possible for bottomland hardwood forests and wetlands

This preliminary identification of environmental issues is based on an evaluation of the general characteristics of the water management options. Site specific investigations of the potentially affected environments would be necessary to provide detailed evaluations of possible habitat and cultural resources impacts from the reallocation. A quantitative estimate of magnitude and seasonal distribution of potentially reduced downstream flows caused by the reallocation would be needed to assess the effects on environmental water needs/instream flow and on fish and wildlife in the Brazos River below Lake Whitney.

Environmental impacts of the delivery pipeline are equivalent to those of the pipeline from the Williamson County Groundwater Supply – North Option, because the same pipeline route is followed.

10.3.4 Engineering and Costing

Development of the increase in system yield from reallocation of storage in Lake Whitney will not require major facilities for implementation. However, implementation of this alternative requires a detailed evaluation of various issues that will require mitigation of adverse impacts. In addition to these costs, a detailed U.S. Army Corps of Engineers reallocation study is required. The final cost for implementation of this alternative will be dependent on the results of that study.

Table 10.3-4 summarizes the estimated cost for this option. The estimated cost for water supply storage in Lake Whitney is the maximum of two numbers: 1) the updated investment cost of the reallocated hydropower storage as a proportion of the reallocated storage to total useable storage, or 2) the amount of money needed to compensate for lost hydropower revenue. The updated total investment cost for Lake Whitney was estimated to be $244,974,000. The increase in cost for water supply storage was estimated to be $24,258,000. This corresponds to the first number referred to above. The impact to hydroelectric power generation will vary from year to year depending on hydrologic conditions. Based on the WAM simulations and releases from the reservoir to increase the system yield, the impact to hydroelectric power generation could be around 12 percent of

the annual power generation amount. The mitigation cost for the reduction in hydroelectric power generation was based on a replacement cost of $0.08 per kWh, which results in an annual cost of $701,760. This amount was converted from an annual value to a present value of $22,052,000 by assuming a 50-year planning horizon and an inflation rate of 2%. This corresponds to the second number referred to above. Because $24.3 million is larger than $22.1 million, the cost for the increase in storage, rather than hydropower compensation, was taken as the cost for reallocated storage. The total annual cost for this reallocation strategy is estimated to be $2,679,000. Based on the increase in firm yield of 38,480 acft/yr in 2070, this results in a unit cost of raw water of $70 per acft ($0.21 per 1,000 gallons).

Table 10.3-5 summarizes the costs associated with delivering a portion of the Lake Whitney Reallocation supply to Williamson County. This includes an intake, pipeline and a water treatment plant.

Compensation to BRA may be required if this strategy were developed by an entity other than BRA to compensate for any subordination of the System Operations strategy. The available supply could be less if the new supplies were not operated as part of the BRA system.

Table 10.3-4. Cost Estimate Summary for Reallocation of Hydropower Storage in Lake Whitney

Item	Estimated Costs
CAPTIAL COSTS	
Improvements to Dam	$4,444,000
Relocations	$0
TOTAL COST OF FACILITIES	$4,444,000
Engineering, Legal Costs and Contingencies	$1,555,000
Environmental & Archaeological Studies and Mitigation	$888,000
Land Acquisition	$0
Storage Reallocation from USACE to BRA	$24,258,000
Water Rights Permit from TCEQ	$1,500,000
Administrative Cost for USACE Storage Reallocation Process	$3,711,000
Interest During Construction (12 months)	$333,000
TOTAL COST OF PROJECT	$36,689,000
ANNUAL COSTS	
Debt Service (3.5 percent for 20 years)	$2,581,000
Operation and Maintenance	$98,000
TOTAL ANNUAL COST	$2,679,000
Available Project Yield (acft/yr)	38,480
Annual Cost of Water ($ per acft)	$70
Annual Cost of Water ($ per 1,000 gallons)	$0.21

Table 10.3-5. Cost Estimate Summary for Delivery of Lake Whitney Reallocation Supplies to Williamson County

Item	Estimated Costs
CAPTIAL COSTS	
Intake Pump Stations (18.9 MGD)	$41,270,000
Transmission Pipeline (36 in dia.)	$90,689,000
Water Treatment Plant (18.9 MGD)	$52,463,000
TOTAL COST OF FACILITIES	**$184,422,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$60,013,000
Environmental & Archaeology Studies and Mitigation	$1,338,000
Land Acquisition and Surveying (327 acres)	$1,257,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$6,794,000
TOTAL COST OF PROJECT	**$253,824,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$17,859,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$907,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$1,032,000
Water Treatment Plant	$9,798,000
Pumping Energy Costs (7903331 kW-hr @ 0.08 $/kW-hr)	$632,000
Purchase of Water (10,561 acft/yr @ 76.5 $/acft)	$808,000
TOTAL ANNUAL COST	**$31,036,000**
Available Project Yield (acft/yr)	10,561
Annual Cost of Water ($ per acft), based on PF=2	$2,939
Annual Cost of Water After Debt Service ($ per acft), based on PF=2	$1,248
Annual Cost of Water ($ per 1,000 gallons), based on PF=2	$9.02
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=2	$3.83

10.3.5 Implementation Issues

This water supply option has been compared to the plan development criteria, as shown in Table 10.3-6, and the option meets each criterion.

Table 10.3-6. Comparison of Lake Whitney Reallocation Option to Plan Development Criteria

Impact Category	Comment(s)
A. Water Supply	
1. Quantity	1. Significant quantity available for regional use or in Region H
2. Reliability	2. High reliability
3. Cost	3. Low
B. Environmental factors	
1. Environmental Water Needs	1. Moderate impacts possible downstream
2. Habitat	2. Moderate impacts possible
3. Cultural Resources	3. Low impact
4. Bays and Estuaries	4. Low impact
5. Threatened and Endangered Species	5. Low impact
6. Wetlands	6. Low impact
C. Impact on Other State Water Resources	Reduction in intentional hydropower releases, but few other negative impacts on state water resources; no effect on navigation
D. Threats to Agriculture and Natural Resources	No threats to agriculture; possible changes in downstream flows
E. Equitable Comparison of Strategies Deemed Feasible	Option is considered to meet municipal and industrial shortages
F. Requirements for Interbasin Transfers	Not applicable
G. Third Party Social and Economic Impacts from Voluntary Redistribution	None

10.3.6 Potential Regulatory Requirements

Implementation of reallocation of storage in Lake Whitney will require several steps including a detailed reallocation study performed by the U.S. Army Corps of Engineers and potentially an authorization from the U.S. Congress. An outline of the reallocation process is provided below:

1. Local sponsor requests the U.S. Army Corps of Engineers perform a reallocation study. Indicate local interest, purpose, financial capability, etc.
2. Reallocation studies are performed in two phases and follow the General Investigation Process consisting of a Reconnaissance Report and a Feasibility Study. Specific funding would be required for a reallocation study. A reallocation study includes the following:
    a. Define existing project
    b. Define current and projected water supply needs
    c. Alternative solutions considered
    d. Analysis of alternatives

i. Reallocation of flood control storage
ii. Raise top of flood control pool
iii. Reallocate existing conservation pool/power pool
iv. Hydropower compensation and other hydropower issues
v. Other
vi. No action
vii. Screening of alternatives
viii. Selection rationale and selection of a plan

e. Selected plan
i. Value of storage reallocation
ii. Impacts of reallocation
iii. Public involvement
iv. Environmental impacts
v. Hydropower compensation and other hydropower issues

f. Recommended plan

3. NEPA Compliance
4. U.S. Army Corps of Engineers Headquarter Approval of Reallocation Study
5. Authorization from U.S. Congress
6. U.S. Army Corps of Engineers and Local Sponsor execute water supply contract based on Water Supply Storage Reallocation
7. Water Rights Permits from TCEQ
8. Coordination with BRA on any potential subordination agreements for the System Operations strategy (if implemented by others)