RECLAMATION

Managing Water in the West

APPRAISAL INVESTIGATION

Final Report

Sulphur Pipeline Regional Rural Water Supply Project

Great Plains Region, Oklahoma-Texas Area Office

U.S. Department of the Interior
Bureau of Reclamation

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Mission Statements

The mission of the Department of the Interior is to protect and provide access to our Nation's natural and cultural heritage and honor our trust responsibilities to Indian Tribes and our commitments to island communities.

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

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ACRONYMS

BUMP	Beneficial Use Management Program
CES	Consumer Expenditure Survey
cfs	cubic feet per second
CMP	Comprehensive
CWSRF	Clean Water State Revolving Fund
D&S	Directives and Standards
DOE	Department of Energy
EPA	United States Environmental Protection Agency
FAC	Project Planning and Facility Operations, Maintenance, and Rehabilitation
ft	feet
GPCD	Gallons per Capita Day
GPM	Gallons per Minute
HPU	hydraulic fluid pressure
HVAC	Heating, Ventilation, and Air Conditioning
HUD	Housing and Urban Development
IDC	Interest during construction
in	inch
kVA	kilo Volt-Ampere
M&I	Municipal and Industrial
MCC	Motor Control Center
mgd	million gallons per day
msl	mean sea level
NEPA	National Environmental Policy Act
NPS	National Park Service
NRA	National Recreation Area
O&M	Operations and Maintenance
OCWP	Oklahoma Comprehensive Water Plan
OG&E	Oklahoma Gas and Electric
OWRB	Oklahoma Water Resources Board
P&G	Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies
PAC	Powdered Activated Carbon
REAP	Rural Economic Action Plan
ROW	Right of Way
RWD	Rural Water District
SHPO	State Historic Preservation Office
TDH	Total Dynamic Head
TOC	Total Organic Carbon
USACE	U. S. Army Corps of Engineers
USDA	United State Department of Agriculture
USGS	United States Geologic Survey
WTP	Water Treatment Plant

EXECUTIVE SUMMARY

This appraisal investigation was conducted under Title I of Reclamation's Rural Water Program, which was authorized by the Reclamation Rural Water Supply Act of 2006 (Public Law 109-451). The purpose of this investigation was to (1) identify problems, needs, and opportunities in the study area; (2) formulate and evaluate a range of potentially viable alternatives to meet identified planning objectives, (3) determine which alternative is viable and thereby recommended as a proposed alternative; (4) develop an appraisal-level design and cost estimates on the proposed alternative; (5) assess benefits and costs of the project; and (6) evaluate financial capability of project sponsors to afford project construction and implementation.

The problems and needs in the study area stem from water supply deficits that will occur from groundwater pumping restrictions on the Arbuckle-Simpson Aquifer as ruled by the state of Oklahoma, along with environmental, recreational, and cultural impacts associated with the potential development of new groundwater supplies. If pumping restrictions on the Arbuckle-Simpson Aquifer are in place by 2020[1], a water supply deficit for Sulphur is projected to occur in 2030 and would grow to 295 acre-feet per year by 2060. Reclamation's Rural Water Supply Program encourages a watershed approach to water resources planning efforts that considers regional solutions to meeting the demands of multiple entities in an area. According to a regional needs assessment conducted as part of this viability analysis, Murray County Rural Water District (RWD) No. 1, which lies adjacent to Sulphur, ranked the highest among potential purchasers of water from Sulphur. The needs assessment concluded that a water deficit for Murray County RWD No. 1 (and its customers) would occur immediately upon enactment of pumping restrictions and would grow to 1,144 acre-feet per year by 2060. The combined supplies and demands for Sulphur and Murray County RWD No. 1 indicate that a supply deficit would grow to about 1,439 acre-feet per year by 2060. These water supply deficits could be offset significantly by implementation of water conservation measures.

Alternatives Formulation and Evaluation

Alternatives were formulated based on their ability to meet the planning objective of reducing long-term pumping of the Arbuckle-Simpson Aquifer through use of existing surface water supplies. The alternatives evaluated would convey water to Sulphur and provide at least 707 acre-feet per year of water to Sulphur and Murray Co. RWD No. 1 by 2020, and at least 1,439 acre-feet per year of water by 2060. In addition to the No Action (future without the project), four water supply sources were identified as potentially meeting this planning objective: (1) Washita River, (2) Veterans Lake, (3) water reuse and recycling, and (4) Lake of the Arbuckles. Results of this viability analysis support Lake of the Arbuckles being selected as the proposed alternative water supply source for Sulphur. Subsequently, ten alternatives were formulated to pump, treat, and convey water from Lake of the Arbuckles to Sulphur. These alternatives were evaluated and compared using established ranking criteria.

[1] A Final Order on the Determination of the Maximum Annual Yield of the Arbuckle Simpson-Aquifer was issued on October 23, 2013; although the order does not establish an implementation timeframe, the year 2020 was assumed for this investigation.

Recommended Conveyance Alternatives

Alternative 9 received the highest scores across all four criteria and is therefore recommended as the proposed alternative. Under Alternative 9, 1,997 acre-feet per year would be released through the existing intake structure at Lake of the Arbuckles and pumped through the existing Wynnewood Aqueduct to the existing regulating reservoir, both of which are owned by the Arbuckle Master Conservancy District. Water would then be pumped through a new pipeline to a new treatment and storage facility at the southwest corner of Sulphur's municipal water system along Chickasaw Trail and State Highway 7.

Two conveyance alternatives to deliver water from Sulphur to Murray County RWD No. 1 were formulated and evaluated. The proposed conveyance alternative is to construct a new pipeline from Sulphur water main to the Murray County RWD No. 1 standpipe, which would enable indirect delivery to Buckhorn RWD and Dougherty, which currently purchase their water from Murray County RWD No. 1.

Together, the proposed conveyance alternatives to deliver water from Lake of the Arbuckles to Sulphur and on to Murray County RWD No. 1 comprise the "**Sulphur Pipeline Regional Rural Water Supply Project" (Project)**, as illustrated in Figure ES-1 on the following page.

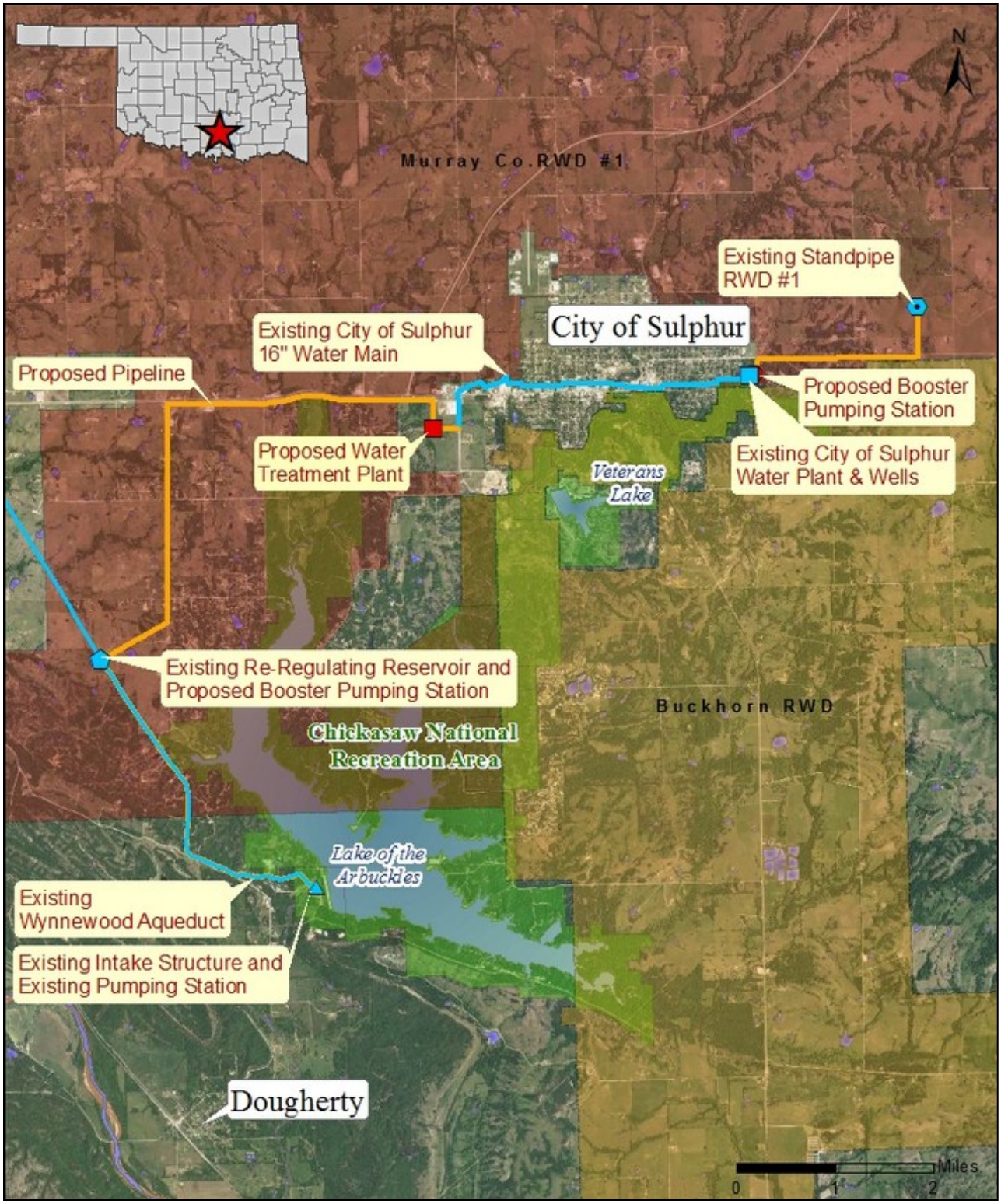


Figure ES-1. An illustration of the Sulphur Pipeline Regional Rural Water Supply Project.

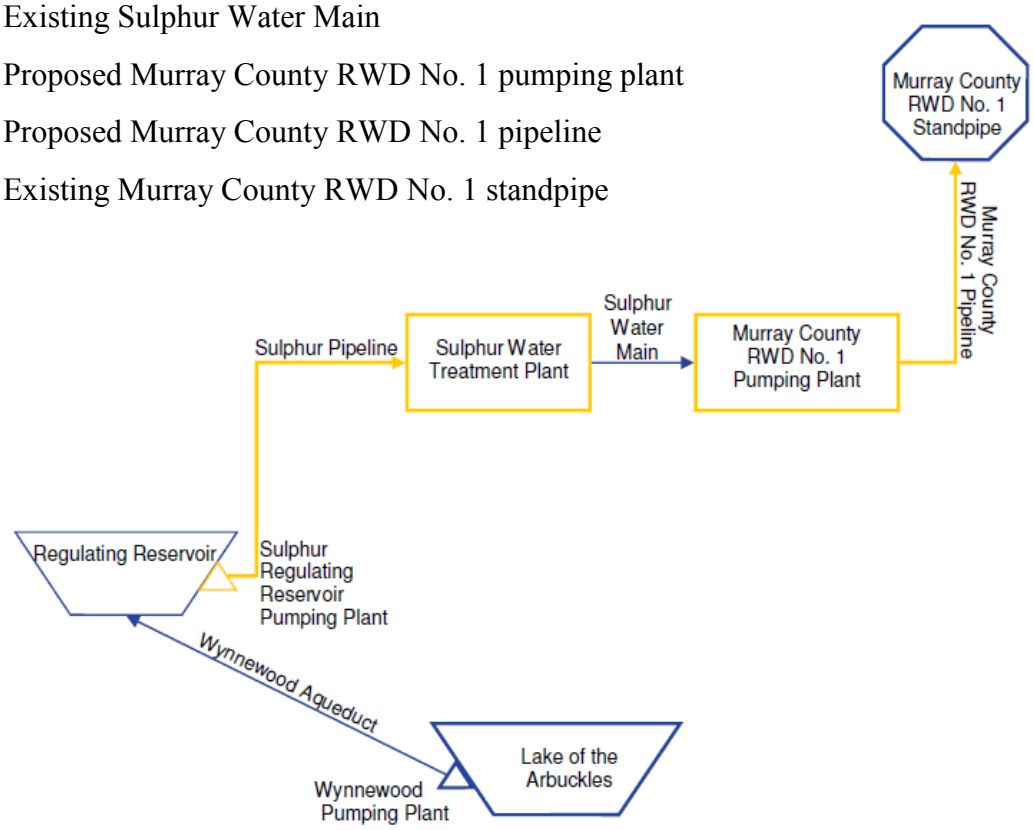
Appraisal-Level Design and Cost Estimates

Detailed design narratives for the proposed alternative, known as the Sulphur Pipeline Regional Rural Water Supply Project (Project) are organized in Chapter III by major project feature and presented in the order by which water would flow from Lake of the Arbuckles to Sulphur and on to the Regional Connection. For each major project feature, a description of the details, assumptions, risk factors, and additional considerations (as applicable) is provided for the three design components: (1) structural/architectural; (2) mechanical/hydraulic; and (3) electrical. Designs represent state-of-the-art technologies and incorporate components that reduce energy use and increase energy efficiency where possible.

A list and conceptual illustration of major project features is below, followed by a brief description of each component. Existing facilities are shown in blue, and proposed facilities are shown in gold:

Project Features

- Existing Wynnewood pumping plant
- Existing Wynnewood Aqueduct
- Existing Regulating Reservoir
- Proposed Sulphur regulating reservoir pumping plant
- Proposed Sulphur pipeline
- Proposed Sulphur water treatment plant
- Existing Sulphur Water Main
- Proposed Murray County RWD No. 1 pumping plant
- Proposed Murray County RWD No. 1 pipeline
- Existing Murray County RWD No. 1 standpipe



Wynnewood Pumping Plant

The Project would utilize and modify the existing pumping plant will be upgraded with four constant speed split case horizontal centrifugal pumps (three primaries; one standby), each rated for 4.37 cubic feet per second (cfs) at 180 feet of Total Dynamic Head (TDH) with 125 horsepower motors. This modification would require replacement of all four existing reinforced concrete pedestals along with the piping and valve changes within each leg between the suction and discharge manifolds.

Wynnewood Aqueduct

The Project would utilize the existing aqueduct from the Wynnewood pumping plant to the regulating reservoir. Investigations undertaken by Reclamation concluded that this segment of pipeline is sized to meet the combined peak demands of all users, including Sulphur's full water right allocation (Reclamation 2011). It should be noted that for cost estimation purposes, it was assumed that Sulphur would be required to pay back a proportionate share of original construction costs associated with the portion of the Wynnewood Aqueduct used to convey water to the Sulphur (i.e., from the existing reservoir pump station to the existing regulation reservoir). For the purposes of this analysis, the original construction cost of the pipeline was converted to present value and then depreciated by its assumed useful service life based on the performance of the pipeline to date. The proportionate share was determined based on Sulphur's water right allocation relative to other member cities. The actual value, based on service life and depreciation, would need to be determined by negotiation between the owner (Arbuckle Master Conservancy District) and Sulphur, and it should be based on performance history, inspection of the current condition of the pipeline, etc.

Regulating Reservoir

A new outlet works would be installed in the embankment of the existing regulation reservoir. The regulating reservoir is owned by the Arbuckle Master Conservancy District and used to regulate and store fluctuating volumes delivered by the existing Wynnewood Aqueduct. The existing regulating reservoir has a design capacity of 5.4 acre-feet; this would provide the storage capacity needed to guarantee the entire allocated amounts to each entity for at least an 8-hour period if the Wynnewood pumping plant is ever out-of-service. The existing regulating reservoir is an open reinforced concrete lined reservoir with the following structures: inlet, outlet, drain, overflow, and wasteway baffled outlet. The new outlet works would include a 14-inch (in) by 14-in slide gate and a 14-in diameter pipeline to feed the new pumping plant described below.

Sulphur Regulating Reservoir Pumping Plant

A new pumping plant would be installed near the new regulating reservoir outlet works to pump up to 3.5 cfs to the Terminal Storage Tank at the new Sulphur water treatment plant (WTP). The pumping plant would consist of constant speed split case horizontal centrifugal pumps that would each provide a design flow rate of 1.75 cfs at 140 feet TDH (two primary; one standby).

Sulphur Pipeline

A new pipeline would connect the Sulphur regulating reservoir pumping plant to the terminal storage tank at the Sulphur WTP. The Sulphur pipeline would consist of 6.3 miles of 14-in pipe

to deliver 3.5 cfs. This size was based on a 1.25 peaking factor above the average flow of 2.75 cfs needed to deliver the full contracted amount of 1,997 acre-feet per year.

Sulphur Water Treatment Plant

The new WTP would begin at the 200,000 gallon terminal storage tank, which would store the water to maintain a stable feed flow of 3.5 cfs (2.26 million gallons per day) through the treatment system. The primary treatment unit would be a packaged treatment system that consists of an adsorption clarifier and mixed media filter. Disinfection would occur at the clearwell through free chlorine before distribution. A small connection would be made to the existing Sulphur 16-in water main and distribution system.

Sulphur Water Main

Sulphur's existing distribution system has a 16-inch diameter water main which runs east-west through Sulphur. The 16-inch water main would provide the sufficient capacity throughout Sulphur's system to convey the additional 2060 demands of Sulphur and Murray County RWD No. 1

Murray County RWD No. 1 Pumping Plant

A new Murray County RWD No.1 pumping plant would be constructed at Sulphur's existing WTP. The pumping plant would consist of two horizontal split case pumps (one primary; one standby) with a service capacity of 2.0 cfs each. This represents a 1.25 peaking factor above the average flow of 1.6 cfs needed to deliver the 2060 water demand for RWD No. 1 and Buckhorn RWD of 1,220 acre-feet per year.

Murray County RWD No. 1 Pipeline

The new Murray County RWD No.1 pumping plant would pump treated water 2.3 miles through a new 10-in HPDE RWD pipeline to the existing standpipe for Murray County RWD No. 1 where it would be stored and distributed.

Murray County RWD No. 1 Standpipe

The existing 72-feet standpipe provides storage for Murray County RWD No. 1 with a capacity of 838,000 gallons.

Cost Summary

Table ES-1 below provides a summary of project cost estimates. Cost information, sources, and assumptions are provided in Chapter III. Detailed quantity estimates for each project feature and totals are provided in Appendix D.

Table ES-1. Summary of appraisal-level cost estimates for the Sulphur Pipeline Regional Rural Water Supply Project. Costs are provided for conveying water from Lake of the Arbuckles to Sulphur (i.e., "Lake to Sulphur) and from Sulphur to Murray County Rural Water District No. 1 (i.e., "Regional Connection").

Components	Infrastructure Totals		
	Lake to Sulphur	Regional Connection	Total
Wynnewood Pumping Plant	$1,050,000	$ -	$1,050,000
Wynnewood Pumping Plant and Pipeline (Proportionate Share)	$480,000	$ -	$480,000
Regulating Reservoir Outlet Structure and Pumping Station	$1,100,000	$ -	$1,100,000
Pipeline (pipe, earthwork, and structures)	$1,900,000	$430,000	$2,330,000
Sulphur Water Treatment Plant	$5,800,000	$ -	$5,800,000
Murray County RWD No. 1 Pumping Plant	$ -	$530,000	$530,000
Land Cost	$70,000	$30,000	$100,000
Subtotal	*$10,400,000*	*$990,000*	*$11,390,000*
Contract Costs[1]	$2,700,000	$260,000	$2,960,000
Construction Contingencies	$3,300,000	$310,000	$3,610,000
Non-Contract Costs[2]	$2,500,000	$240,000	$2,740,000
Total Construction Cost	**$18,900,000**	**$1,800,000**	**$20,700,000**
Annual O&M Cost	**$410,000**	**$16,000**	**$426,000**
Lifecycle O&M Cost	$20,500,000	$800,000	$21,300,000
Annualized Construction Cost per 1000 gallons	$1.30	$0.20	$1.50
Annual O&M Cost per 1000 gallons	$0.63	$0.04	$0.67
Annualized Life-Cycle Cost per 1000 gallons	$1.93	$0.24	$2.17

[1] Contract costs includes: Mobilization, Design Contingencies, and Allowance for Procurement Strategies

[2] Non Contract costs includes: Feasibility Study, Environmental Compliance, Engineering Designs, and Construction Management

Economics and Benefits Analysis

A comparison of project benefits and costs was conducted as part of this investigation in accordance with requirements of 43 CFR §404.44. Two approaches were used to quantify project benefits: (1) Cost of No Action and (2) Willingness to Pay. Benefits associated with environmental and recreational resources also were evaluated, but they were not quantified in terms of being project-associated. The methodologies and results are discussed in Chapter IV.

Cost of No Action (Future without the Project)

The Cost of No Action entails identifying the costs that would be expended to meet water supply needs if the Project was not implemented. This avoided cost can be considered as a benefit of the project because it is a resource cost saved that would be available for use elsewhere (a reduced opportunity cost). In the absence of the Project, some type of water conservation/restriction measures would be required as well as acquisition of additional groundwater water rights. Preliminary investigations (Chapter II) indicate that water conservation alone would not bridge the full 1,439 acre-foot (847 acre-feet with conservation) gap between supply and demand that is projected by the year 2060 in the service area. For the purposes of this preliminary analysis, it was assumed that acquisition of groundwater rights would occur either directly through purchase/leasing of water rights or indirectly through purchasing/leasing land. The amount of land needed to secure 1,439 acre-feet per year of water rights in 2060 was estimated to be 7,195 acres; the amount of land needed to secure 847 acre-feet per year of water rights in 2060 was estimated to be 4,235 acreas. The present land value was calculated using a planning rate of 3.75 percent under the assumption that Sulphur and Murray County RWD No. 1 would purchase enough land to meet projected deficits that may occur each decade, both with and without implementation of water conservation measures (Table ES-2).

Willingness to Pay (Domestic Benefits)

A commonly used measurement standard for valuing goods and services is the willingness of users to pay for each increment of output from a plan. Willingness to pay can be defined as the dollar amount that an individual or firm is willing to give up or pay, *above and beyond the actual amount currently being paid*, to acquire a good or service. This measurement standard is applied to all water related resources, including municipal and industrial (M&I) water supplies.

The benefits transfer approach was used in this willingness to pay analysis to estimate the domestic benefits of the Sulphur Pipeline Regional Rural Water Supply Project. Application of the benefit transfer method assumes that the relationship between a resource improvement and economic value in one area can be estimated and applied to another geographic area or resource. The accuracy of benefits transfer based estimates is dependent on the similarity of the site where the original detailed analysis was completed and the site of interest where the transferred benefits are applied. Similarity can be defined in terms of economic conditions, population characteristics, resources within an area, or other characteristics.

The source of information used to estimate the domestic water supply benefits of the Sulphur Pipeline Regional Rural Water Supply Project was a previously completed survey on a study of the benefits associated with the a proposed northwest Oklahoma Water Supply Project (Piper and Martin, 1997). The survey asked for the willingness of households to pay for a water supply system that would reduce groundwater overdraft in the region. Recognizing that differences certainly exist between the northwest and southcentral Oklahoma (the current study area), the survey represents the best available known data for this approach in that project concept generally could be representative of the groundwater overdraft situation in the Sulphur area. Table ES-2 summarizes results. Details are provided in Chapter IV.

Table ES-2. Present value range of total quantified project benefits over 50 years, Sulphur Pipeline Regional Rural Water Supply Project.

Entity	No Action; Future without Project[1]		Domestic Benefits		Total Quantified Benefits[4]	
	Low[2]	High[3]	Low	High	Low	High
Sulphur	N/A[5]	$900,000	$9,100,000	$13,500,000	$9,100,000	$14,500,000
Murray County RWD No. 1	$1,250,000	$7,400,000	$9,800,000	$14,500,000	$11,000,000	$22,000,000
Total	$1,100,000[6]	$8,500,000	$18,900,000	$27,000,000	$20,000,000	$36,000,000

[1] Based on amount of land needed assuming a 0.2 acre-feet per acre equal proportionate share
[2] Assumes future with conservation measures, as well as the lowest estimated cost per water right.
[3] Assumes future without conservation measures, as well as the highest estimated cost per water right.
[4] Small difference in total due to rounding.
[5] With water conservation measures in place, a water surplus of 162 acre-feet per year in 2060 is expected for the City of Sulphur, so project benefits associated with acquisition of land for water rights are not applicable.
[6] Sulphur's expected 2060 water supply surplus with conservation would decrease the overall project benefits associated with acquisition of land for water rights when combined with Murray County RWD No. 1.

Unquantified Recreation/Environmental Benefits

A preliminary assessment also was performed on the potential future lost benefits resulting from the impacts of continued groundwater withdrawal on springs and other nearby resources was evaluated. A detailed quantitative analysis was not performed because it was beyond the scope of this investigation. The current level of recreation use at the Chickasaw National Recreation Area (NRA), along with the value of that use, was evaluated to measure of the magnitude and importance of recreation and environmental resources in the area that could ultimately be impacted by continued groundwater drawdown and associated impacts on springs and other resources.

Using the NRA visitation data, along with regional data sources on the value of various recreation and non-recreation activities, the total annual economic value of the Chickasaw NRA was estimated (Table ES-3). Details of this analysis are provided in Chapter IV.

Table ES-3. Visitation and estimated economic value of recreation at Chickasaw NRA

Recreation activity	Average 2009 to 2011 visitation	Estimated recreation days	Value per day in 2012 dollars		Total annual recreational value in 2012 dollars	
			Low	High	Low	High
Camping	70,805	270,120	$32		$8,600,000	$8,600,000
Boaters and boats	37,877	70,070	$67	$72	$4,700,000	$5,000,000
Other recreation	1,126,071	2,083,230	$38	$52	$79,200,000	$108,300,000
Total	**1,234,753**	**2,423,420**	**-**	**-**	**$92,500,000**	**$121,900,000**

Based on these values, it appears that an impact on resources that translates into a change in visitation at the Chickasaw NRA will result in approximately a $1.0 million impact on recreational value each year for each one percent of visitation change. It should be noted that this analysis is preliminary and based on the benefits transfer approach that assumes recreation values based on broad regional surveys. A more accurate estimate of recreation and

environmental values would entail a more localized analysis and a survey of resources in the study area. Even though quantifying the resources that could potentially be adversely impacted by continued groundwater pumping is beyond the scope of this investigation, Chapter IV provides a summary of preliminary calculations on the cumulative volume of groundwater that would be pumped from the Arbuckle-Simpson Aquifer under three different implementation scenarios.

Project Costs

The appraisal-level capital and O&M costs for the Sulpur Pipeline Regional Rural Water Supply Project are presented in detail within Chapter III. O&M costs were converted to a present value based on a 50-year period and a project interest rate of 3.75 percent. Interest during construction (IDC), which accounts for costs incurred when project construction begins until the project is brought into service, were calculated. Total Sulphur Pipeline Regional Rural Water Supply Project Construction, O&M, and IDC costs are shown in Table ES-4.

Table ES-4. Total Sulphur Pipeline Rural Water Supply Project Costs. Costs are provided for conveying water from Lake of the Arbuckles to Sulphur (i.e., "Lake to Sulphur) and from Sulphur to Murray County Rural Water District No. 1 (i.e., "Regional Connection").

Category of Cost	Lake to Sulphur	Regional Connection	Total
Construction cost	$18,900,000	$1,800,000	$20,700,000
Present value of annual O&M costs	$9,500,000	$400,000	$9,900,000
Interest during construction	$1,100,000	$100,000	$1,200,000
Total project cost	**$29,500,000**	**$2,300,000**	**$31,800,000**

Benefits and Costs Comparison

The present value of total project costs stated above is estimated to be $31.8 million. The present value of total quantified project benefits associated with avoided land costs and willingness to pay range from $20.0 million to $36.0 million. These values alone correspond to net positive economic benefits when considering the higher range of project benefits. Additional benefits also may exist that are associated with reducing future groundwater withdrawals and subsequent potential impacts to recreation and environmental resources. The value of recreation and environmental resources at the Chickasaw NRA were estimated to range from $92.11 to $122.73 million annually, which correspond to a present value of about $2 billion over the 50-year period of analysis. Quantifying the project benefits associated with those values was beyond the scope of this investigation. However, even a one percent benefit value would bring the net project benefits well above project costs.

Financial Capability Analysis

Under the Rural Water Supply Act, Reclamation has the authority to pay up to 75 percent of construction costs, dependent on financial capability of the project sponsor. Furthermore, 43 CFR §404.44 requires appraisal investigations to analyze whether the project sponsor has the capability to pay 100 percent of the costs associated with O&M. Results indicate that project sponsors could afford both 25 percent of construction costs and 100 percent of O&M.

The capability of water users to pay for M&I water supplies can be defined as the maximum amount water users can pay for water after accounting for household income, business revenues, and household or business expenses. Although no universal method exists for measuring payment capability or affordability for domestic water supplies, two general approaches have been used to estimate capability to pay. One common technique involves the use of an affordability threshold, which is measured as a percentage of median household income. Using this technique, threshold percentages of household income are applied to households in the study area to determine total water payment affordability. A second approach is based on an evaluation of a range of actual water payments made by households and businesses relative to household income after accounting for necessary expenses, and taking the upper end of the relative payment range.

For the Sulphur Pipeline Regional Rural Water Supply Project investigation, along with the United States Environmental Protection Agency (EPA) threshold of 2.5 percent of median household income, data from previously completed ability to pay analyses were used, including the Lewis and Clark Rural Water System (Piper and Martin, 1999), the Eastern New Mexico Rural Water System (Smith Engineering Company, 2003), and the Equus Beds Aquifer Storage Recharge and Recovery Project (Bureau of Reclamation, 2009). Discretionary income for the Sulphur Pipeline Regional Rural Water Supply Project water users was estimated using median or average household income data obtained from the U.S. Census Bureau American Consumer Survey five-year data for 2006 to 2010 and the Bureau of Labor Statistics, Consumer Expenditure Survey data (U.S. Bureau of Labor Statistics, 2012).

The range of estimated annual payment capability for the Sulphur Pipeline Regional Rural Water Supply Project water users is presented in Table ES-5.

Table ES-5. Average annual payment capability for users of the Sulphur Pipeline Regional Rural Water Supply Project over the 50 year period of analysis (Lowest, Highest, and Average).

Entity	EPA	Lowest Estimate[1]	Highest Estimate[2]	Average Estimate[3]
Sulphur	$2,500,000	$1,200,000	$4,500,000	$2,300,000
Murray County RWD No. 1	$2,400,000	$1,500,000	$4,400,000	$2,300,000
Buckhorn RWD	$520,000	$360,000	$960,000	$520,000
Dougherty	$280,000	$140,000	$510,000	$260,000
Total	**$5,700,000**	**$3,200,000**	**$10,500,000**	**$5,400,000**

[1]The lowest estimate represents the 3.21 percent threshold of discretionary income, which is the low end of the Lewis and Clark Project.
[2]The highest estimate represents the 13.09 percent threshold of discretionary income, which is the high end of the Equus Beds Project.
[3]The average estimate represents an average of the EPA threshold with five percentages taken from previously completed projects.

Affordability of the Sulphur Pipeline Regional Rural Water Supply Project was then determined by comparing the estimated annual payment capability to the combined annual costs of the Project and existing water service. Two options were analyzed: Option 1 assumes that infrastructure would be constructed to deliver water only to Sulphur and would be funded solely by Sulphur without a cost-share from Murray County RWD No. 1; Murray County RWD No. 1

would acquire and fund groundwater rights instead. Murray County RWD No. 1 in-turn would acquire and fund groundwater rights independently. Option 2 assumes that infrastructure would be constructed to deliver water to both Sulphur and Murray County RWD No. 1 and would be funded in partnership between Sulphur and Murray County RWD No. 1.

Option 1 – Conveyance infrastructure constructed from Lake of the Arbuckles to Sulphur only and funded solely by Sulphur; RWDs acquire and fund groundwater rights independently

Under Option 1, assuming a repayment period of 20 years and a 3.75 percent interest rate (the current project planning rate), the annual costs to Sulphur would be approximately $1.44 million for construction and $410,000 for O&M. The combined annual costs equal $1.85 million for Sulphur. Under Option 1, Murray County RWD No. 1 is assumed to make up their projected water deficit though acquisition of additional groundwater rights, as proposed under the No Action. The annual costs of both construction and O&M for Murray County RWD No. 1 are estimated to be approximately $1.25 million and would be funded solely by Murray County RWD No. 1.

This next step is to add the estimated annual costs of new service associated with the proposed conveyance infrastructure to the estimated annual cost of water that users pay for their existing service (i.e., baseline service). The cost of baseline service for Sulphur was estimated to be $1.04 million annually for 2010 and would increase to $1.56 million annually by 2060. The total cost for Murray County RWD No. 1 is $954,000 annually for 2010 and would increase to $1.43 million by 2060.

For Sulphur, the combined costs of new service from the Project with existing, baseline service in 2060 is estimated to be about $3.41 million annually[2]. For Murray County RWD No. 1, the combined costs of new service from additional groundwater rights with existing, baseline service in 2060 is estimated to be about $2.68 million annually[3].

Option 2 – Conveyance infrastructure constructed from Lake of the Arbuckles to Sulphur, as well as to RWDs; funded in partnership between Sulphur and RWDs

Under Option 2, the following assumptions were made regarding the cost-share of new service associated with the Sulphur Regional Rural Water Supply Project: (1) The infrastructure to deliver water from Lake of the Arbuckles to Sulphur would be cost-shared assuming a proportionate distribution of costs between Sulphur and Murray County RWD No. 1 based on total volume of demands in 2060[4]; (2) The infrastructure to deliver water from Sulphur to Murray County RWD No. 1 would be paid 100 percent by Murray County RWD No. 1. Under Option 2, the cost-share provided by Murray County RWD No. 1 would reduce annual costs for new service from $1.85 million to $1.00 million for Sulphur and from $1.25 million to $1.00

[2] Equals $1.85 million, the annual cost of new service from the project, plus $1.56 million, the maximum future annual cost for existing, baseline service.

[3] Equals $1.25 million, the annual cost of new service from the project, plus $1.43 million, the maximum future annual cost for existing, baseline service.

[4] Sulphur demands in 2060 are projected to be 1,441 acre-feet per year (54 percent); Demands of Murray County RWD No. 1 are projected to be 1,220 acre-feet per year in 2060 (46 percent).

million for Murray County RWD No. 1. The combined annual costs of new service with existing, baseline service in 2060 would be $2.56 million for Sulphur and $2.43 million for Murray County RWD No. 1.

It is important to point out that these costs were calculated based on assumptions made for the purposes of this preliminary analysis; more accurate annual costs would be determinate based on a number of factors, including the actual costs of construction/O&M, as well as the results of potential negotiated contracts between Sulphur, Murray County RWD No. 1, Buckhorn, and Dougherty.

Affordability Conclusions

Figure ES-2 provides an illustration summarizing the affordability results. A comparison of annual project costs to payment capability indicates that under Option 1, where only the Sulphur portion of the project is constructed, Sulphur has sufficient payment capability to afford 100 percent of the construction/O&M of the project based on the highest annual payment capability threshold ($3.41 million cost versus $4.50 million capability, respectively). Similarly, the Murray County RWD No. 1 has sufficient payment capability to afford 100 percent of the construction/O&M associated with acquisition of groundwater rights under all but the lowest financial capability threshold ($2.68 million cost versus $1.99 million capability). However, Under Option 2, if the full project is constructed to deliver water to both Sulphur and Murray County RWD No. 1, then Sulphur, along with the Murray County RWD No. 1, would both have sufficient payment capability to afford construction/O&M regardless of the financial capability threshold used.

Under the Rural Water Supply Act, Reclamation has the authority to pay up to 75 percent of construction costs, dependent on financial capability of the project sponsor. Furthermore, 43 CFR §404.44 requires appraisal investigations to analyze whether the project sponsor has the capability to pay 100 percent of the costs associated with O&M. The results above indicate that project sponsors could afford both 25 percent of construction costs and 100 percent of O&M costs.

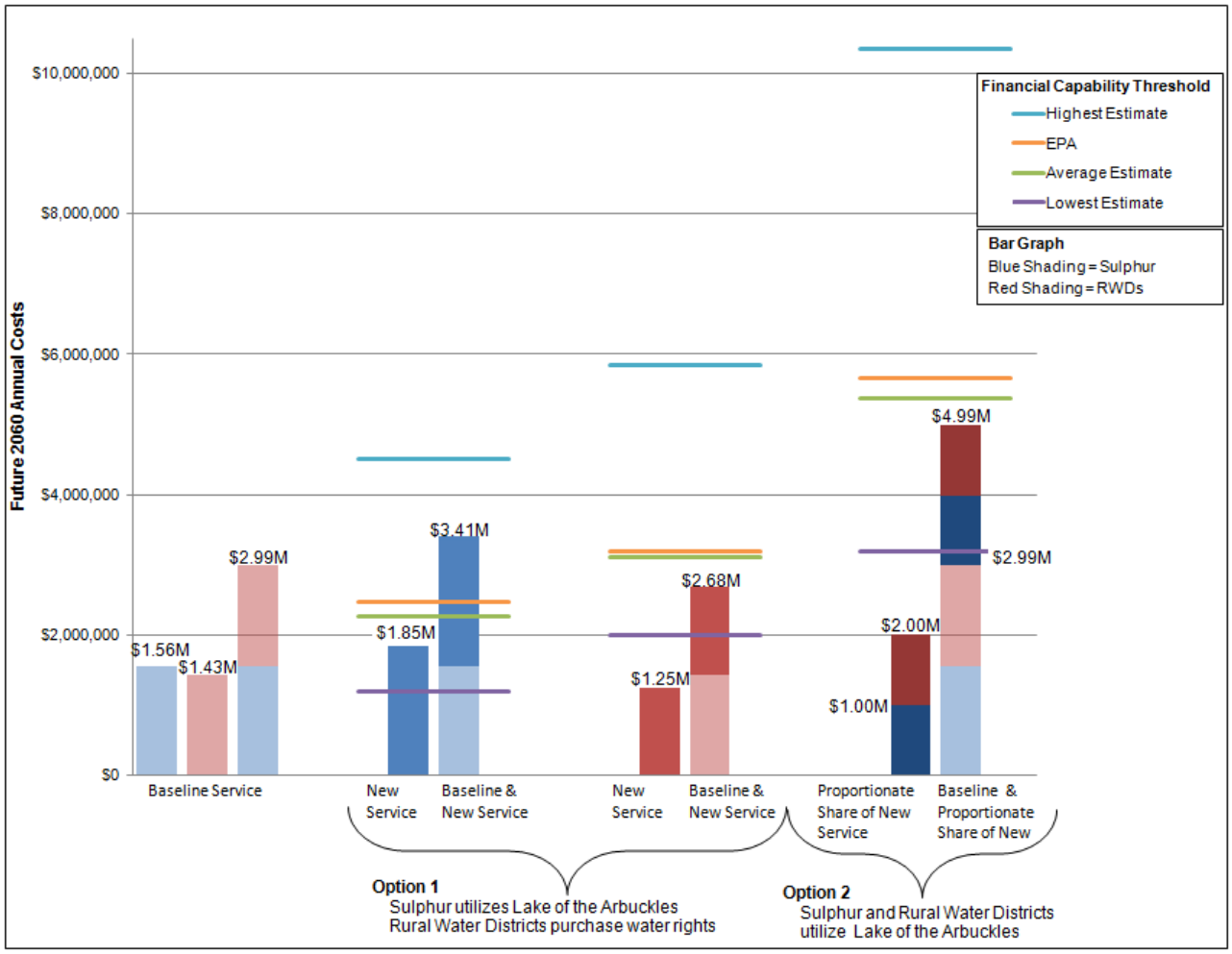


Figure ES-2. An illustration summarizing the affordability results by comparing the cost of baseline and new services to the financial capability thresholds. This figure assumes that Murray County RWD No. 1 would continue to sell water to Buckhorn and Dougherty; therefore, Buckhorn and Dougherty's financial capability for each threshold was included with Murray County RWD No. 1.

Conclusions and Recommendations

Interim Final Rule 43 CFR §404.44 establishes several criteria that Reclamation must apply to determine whether it is appropriate to recommend that a feasibility study be conducted under the Reclamation Rural Water Supply Program. For reasons discussed in Chapter VII, Reclamation concludes the following:

1. A reasonable range of alternatives have been formulated and evaluated in this investigation.
2. This investigation identified viable water supplies and water rights sufficient to supply water to the proposed service area, including all practicable water sources such as lower quality waters, non-potable waters, and water reuse based water supplies.
3. The Project would have no anticipated adverse impacts on public health or safety effects

4. The Project would meet water demand, including projected future needs.
5. The Project yields environmental benefits, including source water protection.
6. The Project applies a regional or watershed perspective and promotes benefits in the region in which the project is carried out.
7. The Project implements an integrated water resources management approach.
8. The Project enhances water management flexibility, including providing for local control of water supplies and, where applicable, encouraging participation in water banking and markets.
9. The Project promotes long-term protection of water supplies.
10. The appraisal investigation includes cost estimates that are reasonable and supported.
11. The Project is cost-effective and generates national net economic benefits.
12. The Project sponsor has the capability to pay 100 percent of the operations, maintenance, and replacement costs.

Based on this Appraisal Investigation, Reclamation finds that the Sulphur Pipeline Regional Rural Water Supply Project is viable and appropriate for more detailed analysis in a feasibility study. This study also should include a more detailed evaluation on the role of water conservation, acquisition of groundwater rights, and water reuse in meeting supply deficits.

Consultation and Coordination

This Report and Investigation were carried out in coordination with several Federal, State, tribal, and local stakeholders to: (1) Ensure that resources were leveraged and that duplicative efforts, as applicable, were avoided; (2) Maintain transparency and accountability for methods and approaches employed throughout the planning process; and (3) Improve the credibility and value of Reclamation's findings and recommendations. The following stakeholders were identified and consulted with throughout this investigation: (1) Arbuckle Master Conservancy District; (2) National Park Service; (3) Chickasaw Nation; (4) Oklahoma Water Resources Board; (5) Oklahoma Department of Wildlife Conservation; (6) Murray County RWD No. 1; (7) Buckhorn RWD; and (8) Citizens for the Protection of the Arbuckle Simpson Aquifer. Consultation with representatives from U.S. House Representative Tom Cole (R - 4th District) also occurred throughout the process.

The following stakeholder meetings were held:

1. August 18, 2011: A kick-off meeting with stakeholders was held to provide an overview and solicit feedback about Reclamation's Rural Water Supply Program (discussed below), the draft scope of work for the investigation, and on expectations regarding roles, responsibilities, information sharing, and timeframes.
2. October 25, 2011: Assess Murray County RWD No. 1 and Buckhorn RWD's need and/or interest in having its supplies and demands evaluated in this investigation.
3. January 26, 2012: A meeting with stakeholders was held to discuss and solicit feedback on the methods and results of Reclamation's preliminary screening analysis and alternatives evaluation.

4. April 30, 2013: A meeting with stakeholders was held to discuss and solicit feedback on the results of investigation, including selection of a preferred conveyance alternative, costs, benefits, and financial capability. Also discussed were options moving forward in terms of scoping and financing a feasibility-level investigation.

In an effort to inform the general public about the investigation, Reclamation hosted a public meeting at Sulphur's City Hall on August 12, 2013 and presented an overview on the results of the appraisal investigation and solicited feedback on the findings and recommendations. Public comments were documented and will be considered as additional planning studies are undertaken in the future.

CHAPTER I

PROBLEMS, NEEDS, AND OPPORTUNITIES

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PROBLEMS, NEEDS, AND OPPORTUNITIES

Introduction

Authority

This appraisal investigation was conducted under Title I of Reclamation's Rural Water Program, which was authorized by the Reclamation Rural Water Supply Act of 2006 (Act; Public Law 109-451). The Act authorized Reclamation to establish a program to work with rural communities and tribes throughout the 17 western United States to assess potable water supply needs and to identify options to address those needs through appraisal investigations and feasibility studies. The program is administered in accordance with Interim Final Rule 43 CFR Part 404 and Reclamation's Directives and Standards (CMP 09-03), both of which set forth programmatic standards governing eligibility, prioritization criteria, and specific content and review requirements of appraisal investigations and feasibility studies conducted under the program. Detailed information can be found at *www.usbr.gov/ruralwater*.

Funds for this investigation were provided through a competitive grant under Funding Opportunity Announcement R11SF80307 using Fiscal Year 2011 appropriations. A total of $190,063 was awarded to Sulphur, which subsequently allocated those funds through a Memorandum of Agreement (dated July 2011) to Reclamation's Oklahoma-Texas Area Office to conduct the appraisal investigation.

Rural Water Supply Program Background and Process Overview

Reclamation has significant experience in the development of rural water projects. Since 1980, Congress has directed Reclamation to undertake 10 specific rural water projects, and Reclamation has a century of experience developing and managing water delivery systems in the West. However, prior to the passage of the Act in 2006, Reclamation did not have a formal rural water program. The program in place now, as established by the Interim Final Rule, allows Reclamation to be involved in planning and prioritizing rural water projects to ensure that the projects selected are cost-effective and that they are in the Federal interest.

The method by which Reclamation selects projects for implementation is centered on a two-step planning process that includes development of an appraisal investigation (Step I) and a feasibility study (Step II). An appraisal investigation uses existing data to analyze the water supply problems, needs, and opportunities in the planning area, includes a preliminary-level assessment (i.e., viability analysis) of alternatives to address those needs, and determines if there is at least one viable alternative that warrants a more detailed investigation through a feasibility study. A completed appraisal report provides the basis by which Reclamation may recommend proceeding to a feasibility study. A feasibility study is a detailed investigation requiring the acquisition of data, an in-depth analysis on the technical and economic feasibility of a proposed alternative, an environmental impact analysis pursuant to the National Environmental Policy Act (NEPA), and a formal assessment of the project sponsor's financial capability to pay the non-Federal share of project construction, operations, and maintenance. A completed feasibility study provides the basis for whether Reclamation may make a recommendation to Congress for authorization to construct a project. The specific content requirements of both appraisal investigations and

feasibility studies are included in Reclamation's Directives and Standards CMP 09-03 (*http://www.usbr.gov/recman/cmp/cmp09-03.pdf*).

Appraisal Investigation Purpose

The purpose of this appraisal investigation was to (1) identify problems, needs, and opportunities in the investigation area; (2) formulate and evaluate a range of potentially viable alternatives to meet identified planning objectives, (3) determine which alternative is viable and thereby recommended as a proposed alternative; (4) develop an appraisal-level design and cost estimates on the proposed alternative; (5) assess benefits and costs of the project; and (6) evaluate financial capability of project sponsors to afford project construction and implementation.

Resources

The Bureau of Reclamation's Arbuckle Project is located in south-central Oklahoma in Murray County near Sulphur. The Project was authorized in 1962 by P.L. 87-594 for the purposes of storing, regulating, and providing water for municipal, domestic, and industrial use; flood control; fish and wildlife use; and the enhancement of recreation. The Act authorized the following features: Arbuckle Dam and Reservoir; a system of two pipelines to deliver water to Ardmore, Dougherty, Davis, Wynnewood, a refinery at Wynnewood, and the Ardmore Air Park industrial site; and two pumping plants. All of these features have been constructed and are in operation. A third pipeline was authorized to deliver water to Sulphur, which has an existing contract with the Arbuckle Master Conservancy District for 1,997 acre-feet/year of surface water stored within the Lake of the Arbuckles[5]. However, because Sulphur had an adequate groundwater supply which required minimal treatment, it elected not to build the pipeline at that time, so the infrastructure necessary to deliver the water to Sulphur does not currently exist.

The Arbuckle-Simpson Aquifer underlies six counties and about 500 square miles of south-central Oklahoma. It is an Environmental Protection Agency-designated sole source aquifer for the cities of Ada and Sulphur, and is the source of water for a number of important springs and streams in the region, including those associated with Reclamation's Arbuckle Project, Chickasaw NRA, and the Chickasaw Nation. The aquifer provides an ideal geographic setting for a regional water supply system that is connected both physically and hydrologically. At the same time, the setting provides an opportunity to manage conjunctive uses of both surface and groundwater in an area where there is a need to reduce groundwater pumping.

The Chickasaw NRA, administered by the National Park Service (NPS), was originally authorized in 1902 as Sulphur Springs Reservation and was renamed and redesignated as Platt National Park in 1906. In 1976, Platt National Park, the Arbuckle NRA, and additional lands were combined to establish the Chickasaw NRA. Its name honors the Chickasaw Nation, who were relocated to the area from the southeastern U.S. during the 1830s (and who later sold the original 640 acres of land for the park to the Federal government). Surrounding what is now Lake of the Arbuckles, the Chickasaw NRA provides an abundance of wildlife habitat, as well as opportunities for wildlife viewing, swimming, boating, fishing, picnicking, camping, and hiking. One of the major attractions to the Chickasaw NRA is water. Located in southern Oklahoma, the park offers mineralized and freshwater springs, clear streams, and lakes. The springs are located

[5] The contract between the District and Sulphur includes Sulphur's proportionate share of Arbuckle Project construction and O&M costs and does not include separate cost for water.

throughout the Travertine District in the northeastern section of the Chickasaw NRA and provide numerous ecosystem, recreation, and cultural benefits. The number of springs and the volume of their flow have varied over the years and is a matter of great concern for many stakeholders, especially the NPS and Chickasaw Nation. The springs are fed by the Arbuckle-Simpson Aquifer, which is recharged by local rainfall. Artesian pressure forces the water upward through cracks and fissures to form prominent freshwater springs such as Buffalo Springs and Antelope Springs, which serve as a primary source of Travertine Creek and Rock Creek, which contribute significant flows into Lake of the Arbuckles.

Lake of the Arbuckles is formed by Arbuckle Dam, which regulates flows of Rock Creek. The reservoir has a total capacity of 108,839 acre-feet at elevation 885.3 and an active conservation capacity of 62,571 acre-feet at elevation 872.0. The surface area of the reservoir is 3,127 acres at elevation 885.3. With 36 miles of shoreline and protective coves, Lake of the Arbuckles is widely known as one of the best fisheries in Oklahoma, supporting catfish, perch, bass, and crappie. Together, the Chickasaw NRA with Lake of the Arbuckles support over 1.2 million recreation visitors per year.

Another prominent feature of the area is the Chickasaw Cultural Center, the largest tribal cultural center in the United States. The Cultural Center sits on 109 acres and has 96,000 square feet of buildings, including a welcome center, gift shop, research center, theater and café, exhibit center, honor garden, amphitheater, and a traditional village. The Chickasaw Nation also is in the process of constructing a hotel, gaming center, and botanical gardens. Combined, the Chickasaw NRA and Chickasaw Cultural Center bring an estimated four million visitors to Sulphur annually, which brings a significant economic benefit to the city and the region.

Problems and Needs

The problems and needs in the study area stem from water supply deficits that will occur from groundwater pumping restrictions on the Arbuckle-Simpson Aquifer as ruled by the state of Oklahoma, as well as the long-term environmental, recreational, and cultural impacts associated with the potential development of new groundwater supplies. If pumping restrictions on the Arbuckle-Simpson Aquifer are in place by 2020[6], a water supply deficit for Sulphur is projected to occur in 2030. For other entities in the area, this deficit would occur immediately. Several entities in the region, including Sulphur, RWDs, and Ada, currently utilize groundwater supply from the Arbuckle-Simpson Aquifer for their drinking water. In recognition of the aquifer's historical, environmental, cultural, and recreational significance, and in response to proposals to transfer groundwater out of the basin, state legislation (Senate Bill 288) was enacted that mandated an evaluation of the impacts of groundwater pumping on the aquifer and its associated springs, streams, and lakes. The Oklahoma Water Resources Board (OWRB), in collaboration with Reclamation, U.S. Geological Survey (USGS), National Park Service (NPS), and several local entities, completed a seven-year study in 2010 on the hydrology of the Arbuckle-Simpson Aquifer (OWRB and USGS 2011). Following the study, the OWRB issued a Final Determination of Maximum Annual Yield ordering a 0.2 acre-foot per acre per year equal proportionate part of the yield to be allocated to each surface acre overlying the aquifer (OWRB

[6] A Final Order on the Determination of the Maximum Annual Yield of the Arbuckle Simpson-Aquifer was issued on October 23, 2013; although the order does not establish an implementation timeframe, the year 2020 was assumed for this investigation.

2013). This represents a *90 percent* reduction from the current temporary pumping rates of 2.0 acre-feet per acre.

Therefore, many entities, including Sulphur, that currently depend on the aquifer, are seeking alternative surface water supply options in preparation for future pumping restrictions. These alternative supplies will not only help meet future water needs, they will potentially help mitigate long-term impacts on the numerous resources associated with the Arbuckle-Simpson Aquifer.

Existing and Projected Supplies and Demands

Sulphur's Supplies and Demands

Sulphur receives its water from seven groundwater wells in the Arbuckle-Simpson Aquifer. The City provides this water through two types of existing groundwater right permits: (1) a 1,120 acre-feet per year "prior right" permit; and (2) a 257 acre-feet per year "temporary right" permit, the sum of which totals 1,377 acre-feet per year. Sulphur also has an allocation of 1,997 acre-feet per year of surface water rights from Lake of the Arbuckles, which are held by the Arbuckle Master Conservancy District. However, the infrastructure to convey this water was never built, so Sulphur is currently limited to its existing 1,377 acre-feet per year groundwater right.

It is important to note that, although Sulphur's prior right permit would not be subject to pumping restrictions, its temporary permit will be subject to restrictions. A prior right is a right to use groundwater established under state laws as they existed prior to July 1, 1973, with such rights being recognized in final orders of the OWRB determining prior rights to use groundwater. A temporary right, as defined by 82 O.S. Section 102.11B, is an authorization to put groundwater to beneficial use prior to completion of a hydrologic survey and determination of the maximum annual yield of an aquifer. With the recent completion of a Final Determination on the maximum annual yield of the Arbuckle-Simpson Aquifer, the OWRB has set forth a proposed process by which Sulphur's temporary permits would be converted to "regular" permits that impose the reduced equal proportionate share of the maximum annual yield to be allocated to each acre overlying the aquifer. Under the Determination, pumping rates will be reduced from 2.0 acre-feet per acre to 0.2 acre-feet per acre, thereby decreasing Sulphur's temporary groundwater right by 90 percent, from 257 acre-feet per year[7] to 25.7 acre-feet per year. Sulphur's total existing water supply would be reduced to 1,146 acre-feet per year. For the purposes of this analysis, reductions are assumed to be in place by 2020. Detailed supply and demand projections are provided in Table 1 on page 29.

Based on the recently published 2012 Oklahoma Comprehensive Water Plan (OWCP), Sulphur's 2010 water demand was 961 acre-feet per year. Using population data and a 165 gallons per capita per day usage (GPCD) from prior years, the Oklahoma Comprehensive Water Plan (OCWP) projected Sulphur's water demand to be 1,441 acre-feet per year by 2060. These supply and demand data show that a water supply deficit would exist around 2030 and would grow to 295 acre-feet per year by 2060.

Water Conservation

The future demands projected by the OCWP could be reduced through implementation of water conservation measures. These include, but are not limited to, (1) volumetric pricing (i.e., conservation-based rate structure) where water rates are allocated based on volume used[8]; (2) developing a drought contingency plan that includes restrictions on outdoor water use during drought conditions; (3) installing/updating water meters to better account for water use and improve leak detection; (4) maintaining conveyance infrastructure to improve water delivery

[7] The land dedicated to this temporary water rights permit totals 128 acres.

[8] Generally, the first rate block should include the average usage per residential meter per month, with 25 – 50 percent rate increases for each subsequent block, with no more than three blocks.

efficiency; (5) mandating or providing incentives for installation of high water efficiency fixtures in residential/commercial developments; (6) increasing public awareness through education.

For the purposes of this investigation, a 2060 water consumption target of 114 GPCD was estimated as an amount that could potentially be realized through implementation of long-term water conservation measures[9] . This would require about a 10 GPCD reduction each decade from 2020 to 2060. Based on this usage, Sulphur's projected 2060 water demands could be reduced from 1,441 acre-feet per year to 984 acre-feet per year, thereby eliminating a potential water supply deficit by 2060 (Figure 1). It is important to note that recent investments into Sulphur's economic development may promote population growth (and water demands) beyond that which was assumed to occur under these current estimates.

[9] This usage value was determined to be an aggressive, yet achievable target based on usage rates of other communities with water conservation programs.

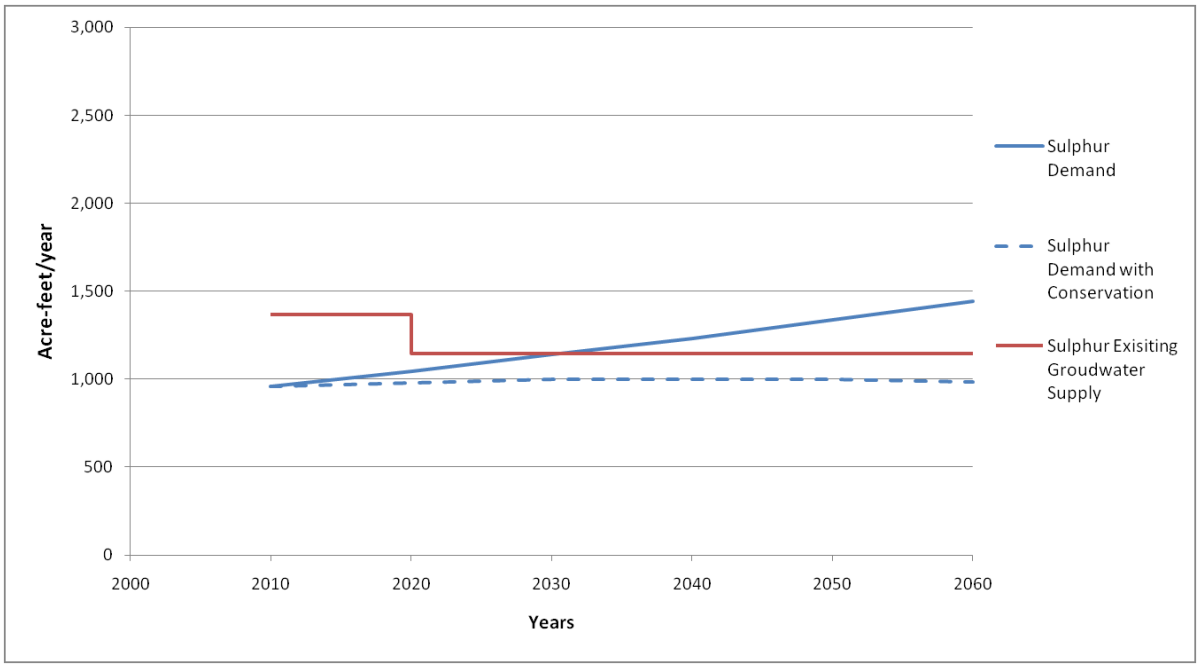

Figure 1. Existing and projected supplies and demands for Sulphur, both with and without conservation. Projections assume a 90 percent reduction in temporary groundwater rights. Note – pumping restrictions are assumed to be in place by 2020.

Regional Supplies and Demands

Reclamation's Rural Water Supply Program highly encourages project sponsors to incorporate a watershed approach to water resources planning efforts that considers regional solutions to meeting the demands of multiple entities in an area. The first step in this approach was to perform a regional needs assessment to identify the extent to which needs exist in the area beyond Sulphur and how those needs relate to supplies, with a particular focus on identifying entities that currently rely on groundwater as their sole supply. For the purposes of this assessment, a 40-mile radius was selected as the cut off range in consideration of the geographic extent of the Arbuckle-Simpson Aquifer.

A total of 55 water providers were identified within the 40-mile radius. Using the OCWP, pertinent data on projected demands, existing water rights, and supply sources were collected. Water providers were then ranked based on relative need (1 = greatest need) using factors related to demand increases, water right exceedances, water and infrastructure needs, proximity to Sulphur, and groundwater use. According to the regional needs assessment, Murray County RWD No. 1 ranked the highest, followed by Buckhorn RWD, which currently purchases its water from Murray County RWD No. 1. Both RWDs are adjacent to Sulphur to the north and east, respectively. Figure 2 includes a map which depicts the results of the regional assessment's ranking analysis.

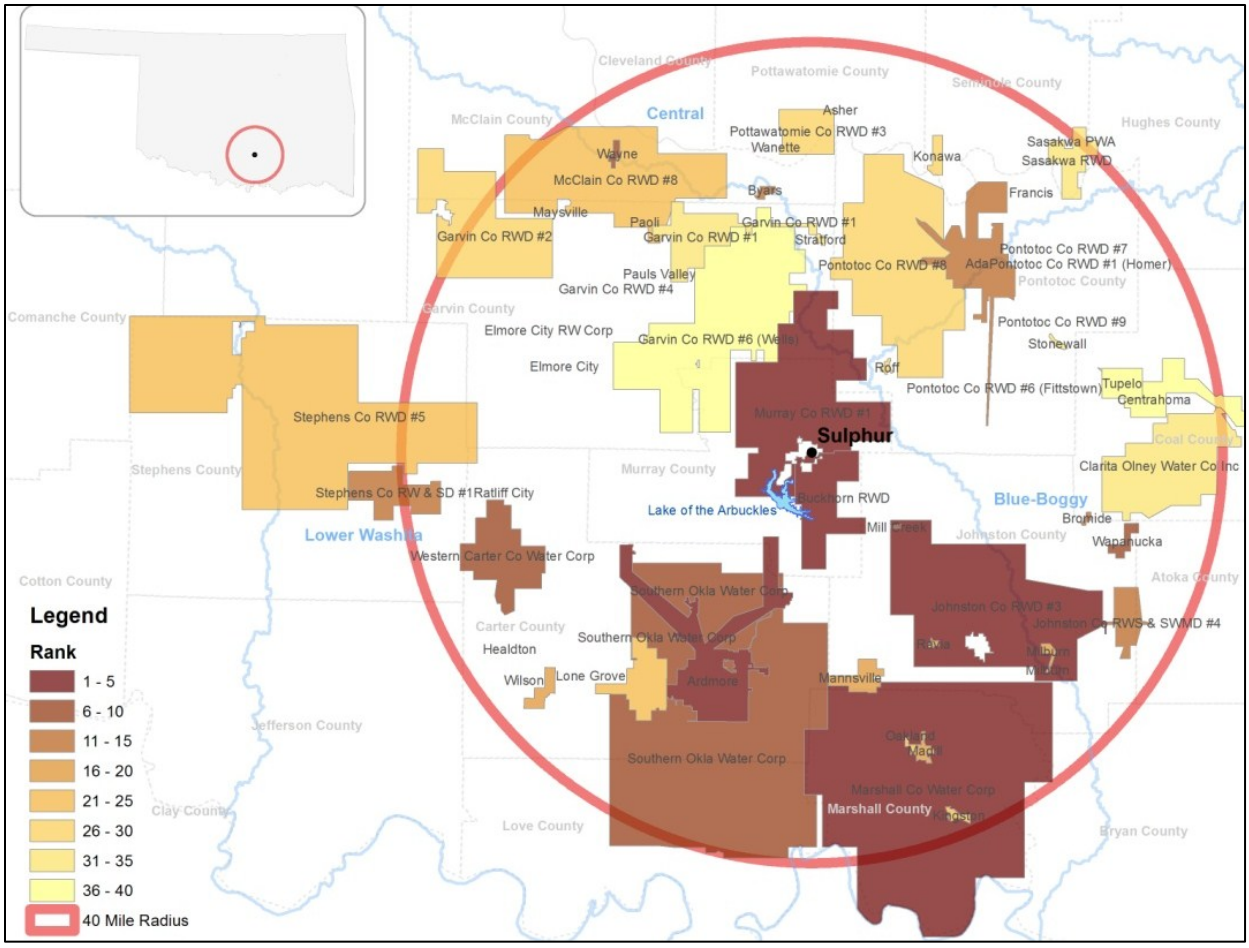

Figure 2. Map showing the results of a regional water needs assessment to identify potential customers that could purchase water from Sulphur.

Considering the fact that the other water providers which scored as high as Murray County RWD No. 1 and Buckhorn RWD were not adjacent to Sulphur, it was decided to exclude those from further analysis and to focus only on the supplies and demands of Murray County RWD No. 1.

Murray County RWD No. 1 operates three groundwater wells in the Arbuckle-Simpson Aquifer through an existing temporary groundwater right permit for 764 acre-feet per year[10]. It does not have a prior right groundwater permit. Murray County RWD. No. 1 currently sells water to the town of Dougherty[11] and to Buckhorn RWD, the latter of which does not have any other water supply source. Assuming pumping rates are reduced from 2.0 acre-feet per acre to 0.2 acre-feet per acre, Murray County RWD No. 1's temporary groundwater right would be projected to decrease by 90 percent, from 764 acre-feet per year to 76 acre-feet per year. As previously stated, for the purposes of this analysis, these reductions will be in place by 2020. Details are provided in Table 1 below.

Based on the 2012 OWCP, Murray County RWD No. 1's 2010 demands were 813 acre-feet per year. Using population data and average per capita day use, the OCWP projected Murray

[10] The land dedicated to this temporary permit totals 382 acres.

[11] Dougherty also has a contract with Arbuckle Master Conservancy District for 112 acre-feet per year of water.

County RWD No. 1's water demands to be 1,220 acre-feet per year. These supply and demand data show that a water supply deficit currently exists and would grow to 1,144 acre-feet per year by 2060. Figure 3 below illustrates the supplies and demands of both RWDs combined.

Water Conservation

Similar to Sulphur, demands could be reduced through implementation of water conservation measures. Using a 2060 usage target of 114 GPCD, 2060 demands of Murray County RWD No. 1 could be reduced from 1,220 acre-feet per year to 1,088 acre-feet per year, thereby slightly reducing their 2060 water deficit from 1,144 acre-feet per year to 1,009 acre-feet per year[12]. Figure 3 below illustrates Murray County RWD No. 1's supplies and demands, both with and without water conservation.

Summary of Supplies and Demands

Pumping restrictions on the Arbuckle-Simpson Aquifer would result in a water supply deficit for Sulphur in 2030 that would grow to 295 acre-feet per year by 2060. For Murray County RWD No. 1 and Buckhorn RWD, a water deficit would occur immediately and grow to 1,144 acre-feet per year by 2060. Water conservation measures would reduce this deficit slightly by 2060. Assuming pumping restrictions are in place by 2020[13], the combined supplies and demands for Sulphur and Murray County RWD No. 1 indicate that a supply deficit would exist immediately upon pumping restrictions and would grow to about 1,439 acre-feet per year by 2060. This deficit could be reduced, but not eliminated, through long-term water conservation measures aimed at reducing per capita day usage. Figure 4 below illustrates the combined supplies and demands of Sulphur, along with both RWDs, both with and without water conservation measures.

[12] The benefits of water conservation would be realized through measures undertaken by Buckhorn RWD and Dougherty, which currently have a GPCD usage of 185 and 174, respectively. The GPCD usage of Murray County RWD No. 1 is already at 114.

[13] A Final Order on the Determination of the Maximum Annual Yield of the Arbuckle Simpson-Aquifer was issued on October 23, 2013; although the order does not establish an implementation timeframe, the year 2020 was assumed for this investigation.

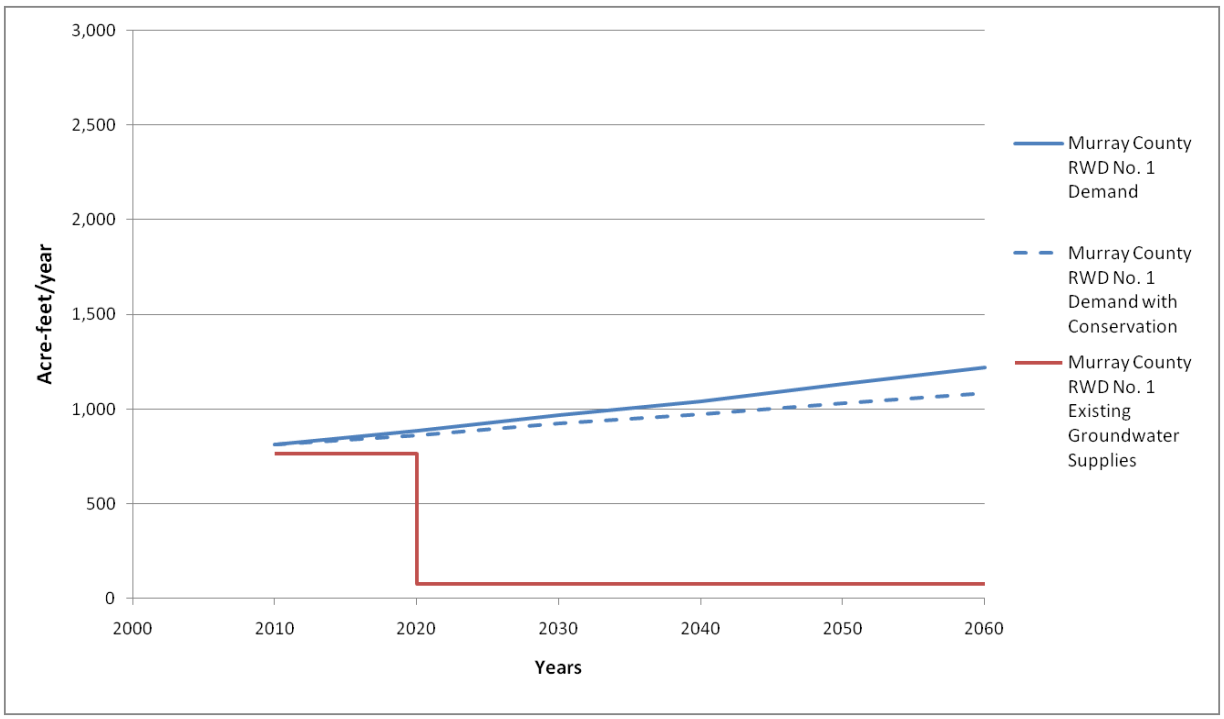

Figure 3. Existing and projected supplies and demands for Murray County RWD No. 1, both with and without conservation. Projections assume a 90 percent reduction in temporary groundwater rights. Note – pumping restrictions are assumed to be in place by 2020. Buckhorn RWD and Dougherty demands are included.

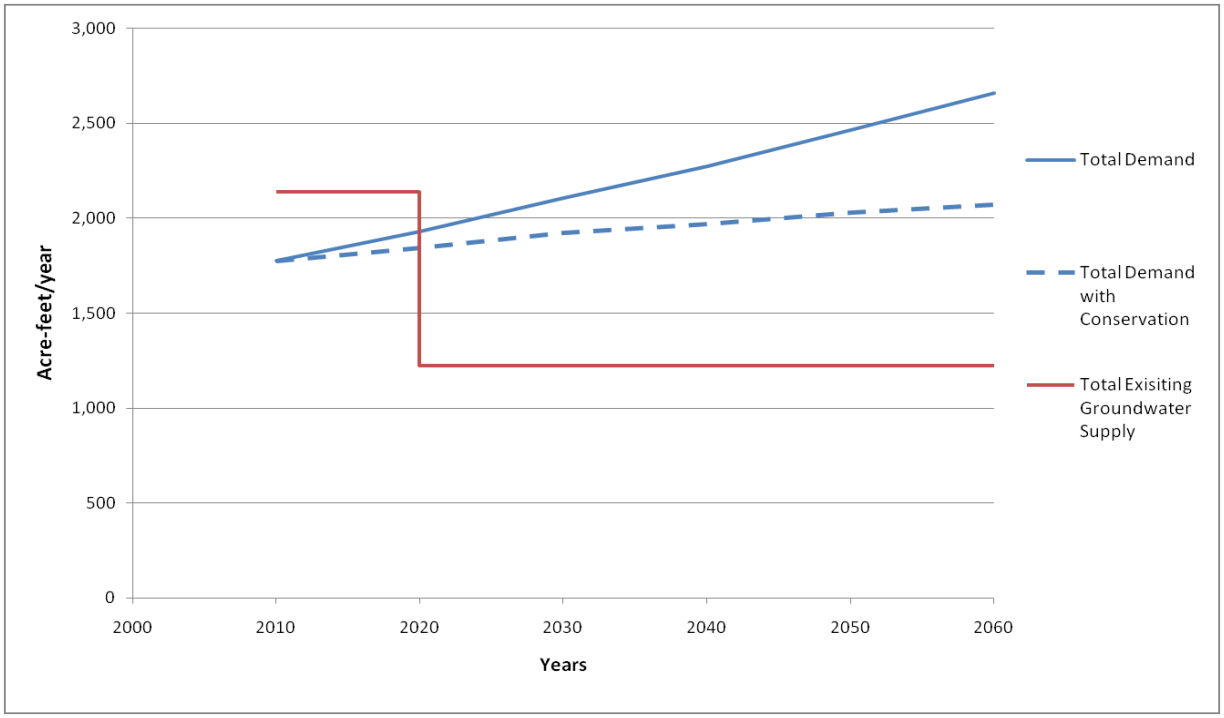

Figure 4. Existing and projected supplies and combined demands for Sulphur and Murray County RWD No. 1, both with and without water conservation. Projections assume a 90 percent reduction in temporary groundwater rights. Note – pumping restrictions are assumed to be in place by 2020. Buckhorn RWD and Dougherty demands are included.

Table 1. Summary of supplies and demands of Sulphur, Murray County RWD No. 1, Buckhorn RWD, and Dougherty.

DEMANDS (acre-feet per year)							
		2010	**2020**	**2030**	**2040**	**2050**	**2060**
Sulphur		961	1,045	1,142	1,232	1,336	1,441
Murray Co. RWD No. 1		576	625	684	738	801	863
Buckhorn RWD		192	209	228	246	267	288
Dougherty		45	50	54	58	63	69
Total		**1,774**	**1,929**	**2,108**	**2,274**	**2,466**	**2,661**
DEMANDS with Conservation (acre-feet per year)							
		2010	**2020**	**2030**	**2040**	**2050**	**2060**
Sulphur		961	979	997	998	997	984
Murray Co. RWD No. 1		576	625	684	738	801	863
Buckhorn RWD		192	192	193	189	185	177
Dougherty		45	47	47	46	46	45
Total		**1,774**	**1,843**	**1,921**	**1,971**	**2,029**	**2,069**
EXISTING SUPPLIES - Groundwater							
		2010	**2020**	**2030**	**2040**	**2050**	**2060**
Sulphur	Prior Rights Permit	1,120	1,120	1,120	1,120	1,120	1,120
	Temporary Rights Permit[2]	257	26	26	26	26	26
	Total	*1,377*	*1,146*	*1,146*	*1,146*	*1,146*	*1,146*
	Surplus*(Deficit)[1]	***416****	***101****	***4****	***(86)***	***(190)***	***(295)***
	***Surplus(Deficit)** with Conservation*	**416***	**167***	**148***	**148***	**148***	**162***
Murray Co. RWD No. 1[3]	Prior Rights Permit	0	0	0	0	0	0
	Temporary Rights Permit[2]	764	76	76	76	76	76
	Total	*764*	*76*	*76*	*76*	*76*	*76*
	Surplus*(Deficit)	***188****	***(549)***	***(608)***	***(662)***	***(725)***	***(787)***
	***Surplus*(Deficit)** with Conservation*	***188****	***(549)***	***(608)***	***(662)***	***(725)***	***(787)***
Buckhorn RWD	Prior Rights Permit	0	0	0	0	0	0
	Temporary Rights Permit	0	0	0	0	0	0
	Total	*0*	*0*	*0*	*0*	*0*	*0*
	Surplus*(Deficit)	***(192)***	***(209)***	***(228)***	***(246)***	***(267)***	***(288)***
	***Surplus(Deficit)** with Conservation*	***(192)***	***(192)***	***(193)***	***(189)***	***(185)***	***(177)***
Dougherty	Prior Rights Permit	0	0	0	0	0	0
	Temporary Rights Permit	0	0	0	0	0	0
	Total	*0*	*0*	*0*	*0*	*0*	*0*
	Surplus*(Deficit)	***(45)***	***(50)***	***(54)***	***(58)***	***(63)***	***(69)***
	***Surplus*(Deficit)** with Conservation*	***(45)***	***(47)***	***(47)***	***(46)***	***(46)***	***(45)***
Total Surplus*(Deficit)		**367***	**(707)**	**(886)**	**(1,052)**	**(1,245)**	**(1,439)**
Total Surplus*(Deficit) with Conservation		**367***	**(621)**	**(699)**	**(749)**	**(807)**	**(847)**

[1] Blue font and an asterisk indicate a surplus & red font insider the parenthesis indicates a deficit.
[2] Assumes pumping restrictions are in place by 2020
[3] Buckhorn RWD and Dougherty purchases water from Murray Co. RWD No. 1

Opportunities

The recent groundwater permitting restrictions has created a unique opportunity for Sulphur to collaborate with other stakeholders in the region on a study to evaluate the viability of developing surface water supply options that meet the immediate and long-term water supply needs of the area. At the same time, these options would reduce long-term pumping rates on the Arbuckle-Simpson Aquifer and help avert any potential adverse impacts on the economic, recreational, historic, cultural, and natural resources associated with the aquifer.

An opportunity also exists to fulfill the Arbuckle Project's original Congressionally-authorized purpose of providing water to five entities in the region, *including Sulphur*. As previously stated, Reclamation's Arbuckle Project consists of Arbuckle Dam and Reservoir; a system of two pipelines to deliver water to Ardmore, Dougherty, Davis, Wynnewood, a refinery at Wynnewood, and the Ardmore Air Park industrial site; and two pumping plants. A third pipeline was authorized to deliver water to Sulphur, which has an existing contract with the Arbuckle Master Conservancy District for 1,997 acre-feet per year of surface water stored within the Lake of the Arbuckles. However, the pipeline was never built so the infrastructure necessary to deliver the water to Sulphur does not exist. Coincidentally, the 1,997 acre-feet per year of surface water available from Lake of the Arbuckles is more than enough to meet the 2060 water supply needs of Sulphur and Murray County RWD No. 1 (1,439 acre-feet per year).

The fact that Sulphur has an existing surface water right allocation from Lake of the Arbuckles, which is more than enough to meet its long-term water supply needs, sets up the opportunity for Sulphur to become a wholesale water provider in the area. According to Reclamation's regional needs assessment, Murray County RWD No. 1 (and its customers) is an excellent candidate to participate in a project to develop infrastructure from Lake of the Arbuckles. Sulphur, along with Murray County RWD No. 1, expressed an interest in this arrangement and thus requested that Reclamation include the needs of Murray County RWD No. 1, including its customers (Buckhorn RWD and Dougherty) in its infrastructure assessment for the area. Furthermore, given the previously cited demand projections of all three entities, Sulphur would still have a 558 acre-feet per year water surplus in 2060. This creates additional opportunities for Sulphur to sell water to other customers and further mitigate potential adverse impacts on the aquifer.

The NPS and Chickasaw NRA are highly supportive of this appraisal investigation and support development of Lake of the Arbuckles' Sulphur water right allocation thereby decreasing long-term demands on groundwater supplies. This may potentially improve flow in the springs and streams in the Chickasaw NRA. These water sources are critical to sustaining the local ecosystem, preserving the Chickasaw Nation's rich cultural heritage, and maintaining the economic viability of the area.

Planning Objective

In consideration of the problems, needs, and opportunities in the investigation area, the planning objective of this appraisal investigation is to reduce long-term pumping from the Arbuckle-Simpson Aquifer through development of a surface water supply alternative that conveys water to Sulphur and provides at least 707 acre-feet per year of water to Sulphur and Murray Co. RWD No. 1 by 2020, and at least 1,439 acre-feet per year of water by 2060.

CHAPTER II
ALTERNATIVES VIABILITY ANALYSIS

Alternatives Formulation and Evaluation

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ALTERNATIVES FORMULATION

Alternatives were formulated based on their ability to meet the planning objective of reducing long-term pumping from the Arbuckle-Simpson Aquifer through development of a surface water supply alternative that conveys water to Sulphur and provides at least 707 acre-feet per year of water to Sulphur and Murray Co. RWD No. 1 by 2020, and at least 1,439 acre-feet per year of water by 2060. The first step was to formulate alternative water supply sources for the area and select a preferred water supply source. The second step was to formulate alternatives to convey the water from the preferred supply source to Sulphur, and then on to Murray County RWD No. 1.

No Action Alternative (Future without the Project)

Reclamation standards require an analysis of the No Action Alternative as part of an appraisal investigation carried out under the Rural Water Supply Program. The No Action Alternative includes steps that would most likely be taken within the investigation area during the planning horizon to address the identified problems, needs, or opportunities if the Project is not constructed. The analysis must include the estimated cost of those steps and projected results, including risks and uncertainties. The No Action Alternative is generally used to assess the benefit/cost of the Project relative to doing nothing. For the purposes of this investigation, the No Action Alternative was assumed to include acquisition of groundwater rights that would be obtained either directly through purchase/leasing of water rights or indirectly through purchasing/leasing land. The costs of this approach was estimated to range from $1.1 million to $8.7 million, respectively. It is important to point out that although acquisition of additional groundwater rights is attractive from a cost standpoint, it does not meet the planning objective of reducing groundwater withdrawals from the Arbuckle-Simpson Aquifer, and may not generate domestic, recreation, and environmental benefits. A more detailed assessment is described in Chapter IV - Economics and Benefits Analysis.

Supply Source Alternatives - Methods and Results

Surface water supply source alternatives were formulated using quadrangle maps and aerial photographs of the investigation area, and by evaluating water availability and water quality information. The following surface water supply sources were identified as potentially meeting the planning objective: (1) Washita River, (2) Veterans Lake and (3) Lake of the Arbuckles. A viability analysis resulted in Lake of the Arbuckles being selected as the proposed alternative water supply source for Sulphur. The Washita River and Veterans Lake alternatives were eliminated from further consideration in this assessment. Below is a brief discussion for this rationale.

Water Supply Alternatives Considered but Eliminated

Washita River

The quality of the Washita River is considered poor due to high turbidity, total dissolved solids, sulfate, and total coliforms (including fecal coliform and E. Coli) (OWRB 2011). Conventional water treatment methods would be sufficient to provide treatment for the high levels of

constituents in the river, but when measurable limits of sulfate exceed the Maximum Contaminant Level limit of 250 milligram per liter, which has been the case in the Washita River, advanced treatment measures would be required. No accepted Best Available Treatment exists for Sulfate removal, but the most documented treatment techniques are nanofiltration and ion exchange (Reclamation 2010). A description of each treatment technique is summarized below to document the additional expense in comparison to conventional water treatment.

- Nanofiltration is expensive, particularly for small systems, and disposal of residuals can be an issue. Further, nanofiltration may produce a reject stream of as much as 30 percent of the daily plant flow (EPA, 2005). Membrane technologies, like nanofiltration, are energy intensive which is reflected in operational costs.
- Ion exchange has a lower initial cost of treatment. Ion exchange for a surface water source with high sulfates and total dissolved solids would need to be an additive to a conventional treatment plant to reduce total dissolved solid concentrations of the treated water.

Regarding conveyance costs, the Washita River is located about nine miles west of Sulphur. For this preliminary analysis, elevations and distances were measured using geographic information systems topographic maps to determine an approximate pipeline length and pump head required to transport water from the river to Sulphur. An assumption that the optimal pipeline route would follow State High 7 was used to determine the elevations at the beginning, end, and high point of the pipeline. These elevations were determined to be:

- 780 feet (ft) at the river south of Davis and east of State Highway 77;
- 928 ft at the west edge of Sulphur, along State Highway 7; and
- 1,038 ft at the high point along State Highway 7.

It was determined that six of the nine mile pipeline would require pumping the water from the river and only three miles could be gravity fed. Based strictly on the elevation difference, 258-ft of pressure head would be required to transport the water from the river to the highest point resulting in relatively high energy costs that would occur throughout the life of the project.

Although this alternative was eliminated in this investigation due to the relatively high costs that would be associated with storage, advanced water treatment, pumping, and conveyance, consideration should be given to evaluating potential benefits associated with maintaining aquifer and reservoir levels. This analysis was beyond the scope of this investigation, but is recommended in the conclusions section of this report. .

Veterans Lake

Veterans Dam and Lake is located three miles from Sulphur within the Chickasaw NRA on Wilson Creek, a tributary to Rock Creek which flows into Lake of the Arbuckles. The Lake was constructed in 1936 by the Works Project Administration and is currently owned and operated by the NPS. It has a surface area of about 67 acres, a storage capacity of 600 acre-feet, and firm yield of about 40 acre-feet per year (C.H. Guernsey & Company 1986). Veterans Lake was eliminated as a supply source for Sulphur because the firm yield is insufficient and does not meet the planning objective. Although eliminated as a supply source, Veterans Lake was considered

viable from the standpoint of intermediate storage for regulating flows emanating from Lake of the Arbuckles. This is discussed in more detail under the alternatives conveyance section.

Water Reuse and Recycling

The reuse of highly treated wastewater effluent for non-potable purposes such as irrigation is a commonly employed method of reducing potable water needs. Sulphur completed the construction of a new wastewater treatment plant in 2010. The plant is located southwest of the city and has a design capacity of 1.5 mgd. The plant recovered approximately 42 percent of the water produced by Sulphur's WTP in September 2012 that could then be available for reuse. Assuming this trend continues, the maximum amount of recycled wastewater supply that could be available would be 609 acre-feet based on 2060 demands (without conservation). This alternative would still require pumping of an additional 834 acre-feet per year of water from the Arbuckle-Simpson Aquifer to meet the projected 2060 water deficit. Although this alternative was eliminated as a supply source because it would require continued pumping of the aquifer, it should still be considered in future analyses that seek to expand Sulphur's water supply portfolio. This is because the source in and of itself does not negatively impact either Lake of the Arbuckles or the aquifer, and is normally discharged into the Washita River which is poor quality and considered unusable.

Preferred Surface Water Supply Alternative

The preferred surface water supply source alternative is Lake of the Arbuckles. Lake of the Arbuckles is the primary feature of Reclamation's Arbuckle Project and has a firm yield of 24,000 acre-feet per year. The Arbuckle Master Conservancy District holds a 24,000 acre-feet per year water right to the Lake, which is fully contracted to Ardmore (13,844 acre-feet per year), Davis (2,538 acre-feet per year), Wynnewood Refining Company (2,940 acre-feet per year), City of Sulphur (1,997 acre-feet per year), Wynnewood (1,445 acre-feet per year), Dougherty (112 acre-feet per year), and Goddard Youth Camp (3.1 acre-feet per year). Sulphur's contractual share of the lake has never been utilized because the infrastructure necessary to deliver the water to Sulphur does not currently exist. Regarding water quality, the OWRB's Beneficial Use Monitoring Program (BUMP) reported water quality levels in the lake after sampling from October 2008 to July 2009. The BUMP reported treatable levels of nutrients, neutral to slightly alkaline pH levels, and low turbidity readings. This indicates that the source water in the lake will require only a minimum level of treatment.

Conveyance Alternatives - Methods and Results

From Lake of the Arbuckles to Sulphur

Alternatives to pump, convey, and treat water from Lake of the Arbuckles to Sulphur were formulated using data from existing reports, stakeholder input, and new data collected from recent quadrangle maps, aerial photography, and field reconnaissance visits. First, data from previously completed reports were compiled in an effort to identify data gaps and reduce redundancy. One report of particular importance to this effort was the *Sulphur Municipal and Industrial Water Supply Facilities Phase I Preliminary Studies and Investigations Report* (C.H. Guernsey & Company 1986). The 1986 C.H. Guernsey Report evaluated eight alternatives for supplying water from Lake of the Arbuckles to Sulphur. The recommended alternative included construction of a new intake and pump station on the east side of the Rock Creek arm of the lake, a pipeline through the Chickasaw NRA, and a new WTP northwest of Sulphur. Reclamation presented the findings of the 1986 C.H. Guernsey Report at a stakeholder meeting in August 2011, and comments were solicited regarding the acceptability of these alternatives in a current setting, almost 20 years after the report. The consensus among the stakeholders was that Reclamation should re-evaluate all eight alternatives, to the extent practical, and determine their viability using current Reclamation procedures and standards; as well, stakeholders recommended that Reclamation evaluate new alternatives that maximize use of existing infrastructure and minimize disturbance within the Chickasaw NRA.

The preliminary evaluation of the 1986 C.H. Guernsey Report alternatives resulted in the elimination of two of the eight alternatives: Alternatives 7 and 8 were eliminated. Alternative 7, as conceived in the 1986 Report, was eliminated because it only included infrastructure to deliver water to the nearby Murray County RWD No. 1 and Buckhorn RWD instead of Sulphur, and thus, did not meet the planning objective. Alternative 8, as conceived in the 1986 Report, was eliminated because it included utilization of an existing segment of pipeline for a portion of the delivery system. Specifically, Alternative 8 included utilization of the existing Wynnewood Aqueduct to convey water to the City of Davis, where it would subsequently be conveyed to Sulphur through a new pipeline. Based on a recent review of the Wynnewood Aqueduct Designers' Operating Criteria, Reclamation concluded that the segment of the Wynnewood Aqueduct pipeline from the existing reregulation reservoir to the City of Davis was *not* sized to meet the combined peak water demands of Sulphur along with the cities of Davis and Wynnewood. Therefore, Alternative 8 was eliminated from further consideration. However, it is important to point out that, although this segment is undersized to meet the total peak demands of all users, the segment of the Wynnewood Aqueduct from the Wynnewood pumping plant to the reregulation reservoir *is* sized to meet the combined peak demands of all users, including Sulphur's full water right allocation (Reclamation 2011). This revelation was critical in allowing Reclamation to consider utilization of this segment as part of a new alternative to deliver water to Sulphur, which is discussed in detail in the next section. Overall, Reclamation concluded that Alternatives 1 – 6, as conceived in the 1986 C.H. Guernsey Report[14], were considered worthy of further consideration in this assessment.

[14] The locations of infrastructure components associated with these Alternatives were modified, as necessary, to account for current conditions on the ground.

The next step in the alternatives formulation process was to build upon stakeholder recommendations to consider alternatives that maximize use of existing infrastructure and minimize disturbances to the Chickasaw NRA. In doing so, Reclamation formulated four new alternatives, Alternatives 5, and Alternatives 8 – 10, which were not considered in the 1986 C.H. Guernsey Report. All three alternatives propose conveyance options primarily outside the Chickasaw NRA along the west side of Lake of the Arbuckles. In addition, one alternative from the 1986 C.H. Guernsey Report was added which included a different pipeline alignment. An illustration of the ten alternatives is provided in Figure 5. A summary description and more detailed map of each alternative are provided in the next section.

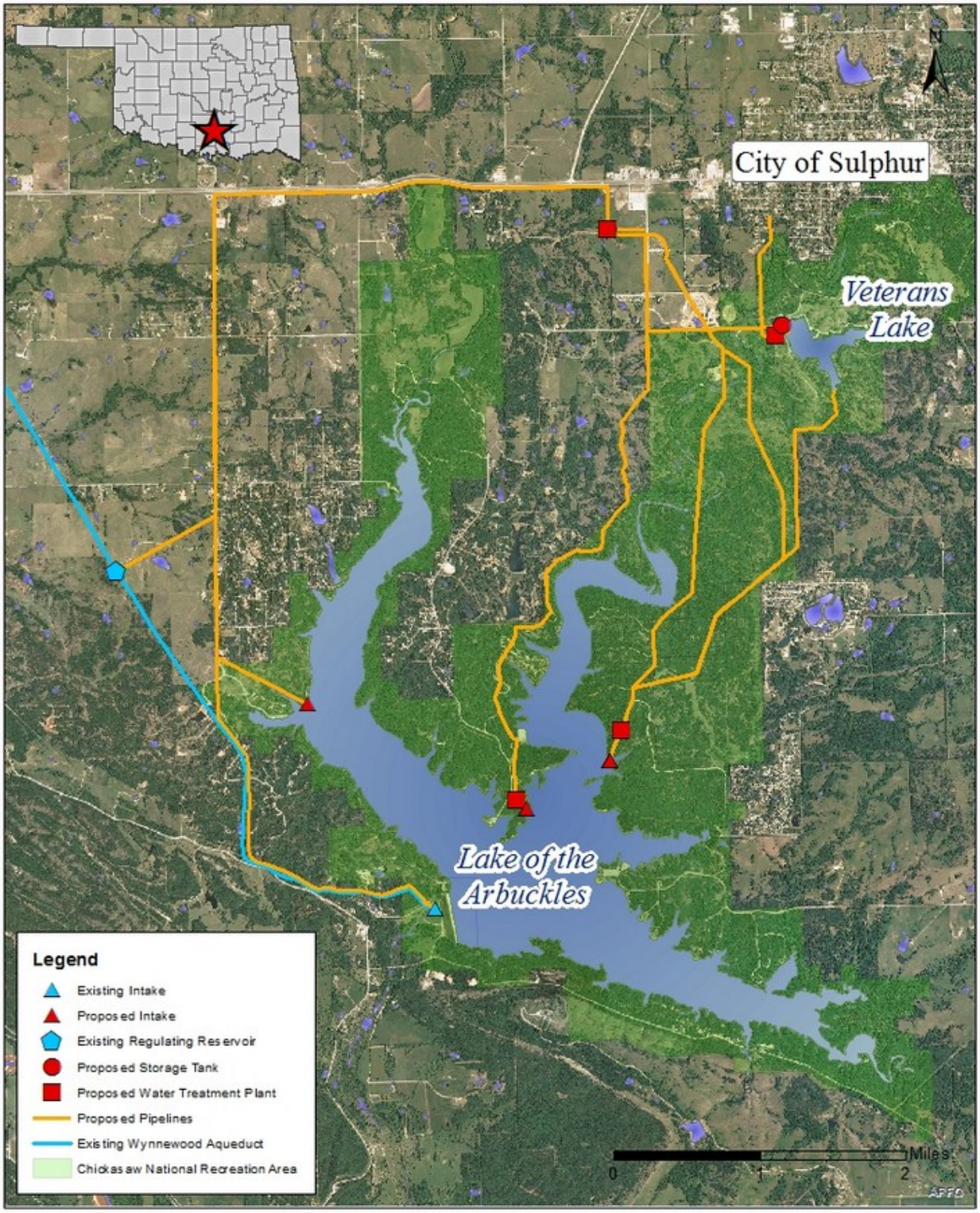


Figure 5. An illustration of ten alternatives formulated to convey water from Lake of the Arbuckles to Sulphur. Alternatives consist of various combinations of existing and proposed intakes, pipelines, storage tanks/reservoirs, and treatment plant locations.

Conveyance Alternatives - Methods and Results

From Sulphur to Murray County RWD No. 1 and Buckhorn RWD

Alternatives to deliver water from Sulphur to Murray County RWD No. 1 were formulated using stakeholder input and new data collected from recent quadrangle maps, aerial photography, and field reconnaissance visits. Two alternatives were formulated:

1. Utilize the existing water taps and infrastructure to deliver water to both RWDs; or
2. Construct a new pipeline from Sulphur water main to the Murray County RWD No. 1 standpipe. This would enable indirect delivery to Buckhorn RWD, which currently purchases water from Murray County RWD No. 1.

Alternative 1 was eliminated from consideration because the existing water taps are located on large water mains, which would have caused pressure issues and required installation of multiple pump stations, thereby driving up costs to maintain an adequate flow rate and pressure. Alternative 2 was selected as the proposed alternative to deliver water to Murray County RWD No. 1 (Figure 6).[15]

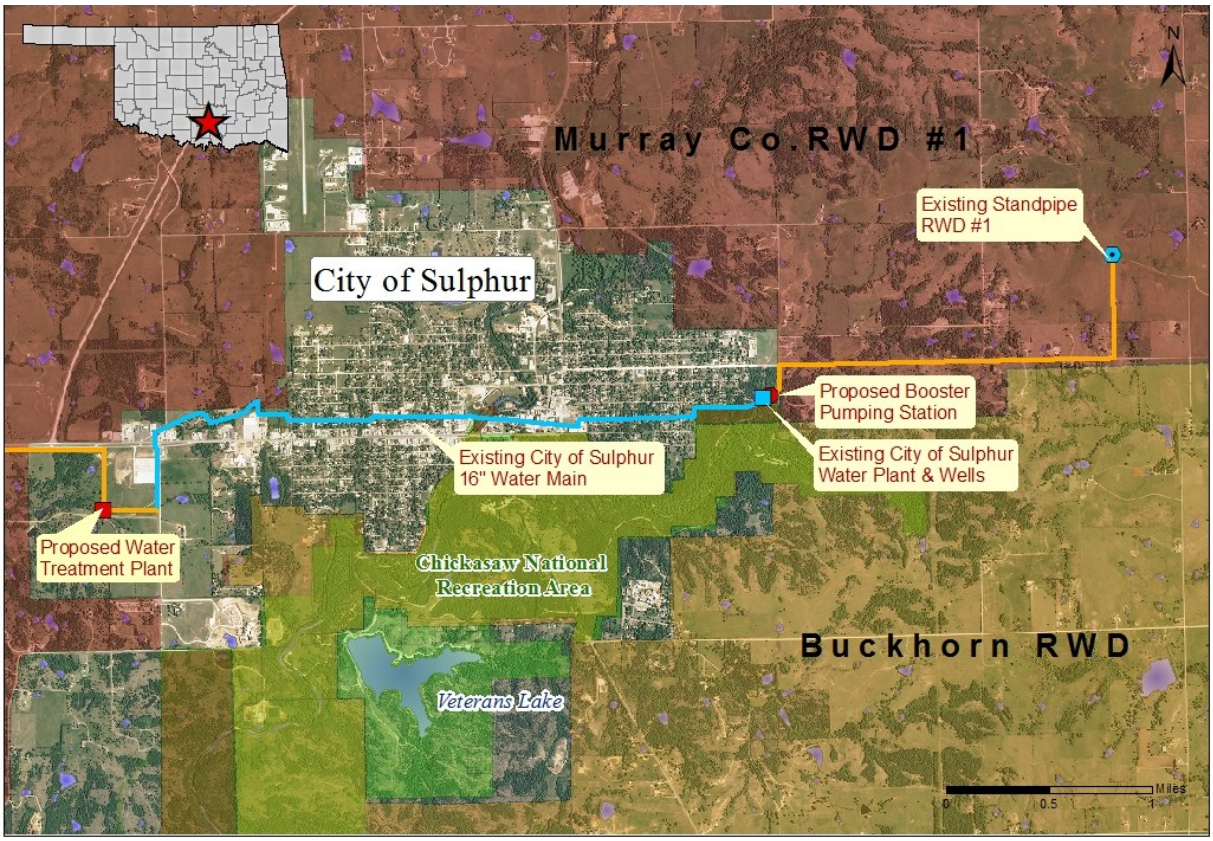


Figure 6. Illustration of the existing and new infrastructure proposed to convey treated water from Sulphur to Murray County RWD No. 1 and Buckhorn RWD.

[15] The proceeding section presents a detailed evaluation screening of conveyance options to deliver water from Lake of the Arbuckles to Sulphur. This screening evaluation was not necessary for conveyance alternatives to Murray County RWD No. 1 because only two alternatives were considered, one of which was eliminated due to high costs.

ALTERNATIVES - EVALUATION AND COMPARISON
From Lake of the Arbuckles to Sulphur

The next step was to evaluate and compare the ten conveyance alternatives using current Reclamation standards and procedures and to recommend a viable, proposed alternative for an appraisal-level design.

Methods

The ten conveyance alternatives were evaluated and compared based on criteria set forth in the Principles and Guidelines (P&Gs) for Water and Related Land Resources Implementation Studies (Water Resources Council 1983). The P&Gs were developed to ensure proper and consistent planning by Federal agencies in the formulation and evaluation of water-related resources studies, including appraisal and feasibility investigations. The four criteria are as follows:

1. **Effectiveness:** The extent to which an alternative reliably meets the planning objective by alleviating a specified problem and achieving goals.
2. **Efficiency:** The extent to which an alternative is cost effective. NOTE: the annualized life-cycle costs for this analysis were based on order-of-magnitude construction cost estimates and were developed solely for comparison of project alternatives. **Refined project cost estimates for the proposed alternative are presented in Chapter III – Appraisal-Level Design and Costs.**
3. **Acceptability:** The workability and viability of an alternative with respect to how compatible it is with authorities, regulations, policies, and environmental law.
4. **Completeness:** The extent to which an alternative accounts for all necessary investments or other actions to ensure realization of goals.

Although the P&Gs list the above criteria as requirements to consider in the evaluation of alternatives, the P&Gs do not specify the manner by which these criteria would be analyzed, a discretion that is allowed due to the wide variation among project types. For this appraisal investigation, criteria were analyzed based on a variety of key factors considered important to each criterion. For instance, the Effectiveness criterion was analyzed based on factors related to the reliability of water deliveries, as well the challenges associated with construction and servicing the project. Next, points were allocated based on whether a criterion and/or factor scored a “high”, “moderate”, or “low”. The point allocation system is described later in this section; below is a detailed description of each criterion and its associated ranking factors.

Effectiveness

Effectiveness measures the extent to which an alternative reliably meets the planning objective by alleviating a specified problem and achieving goals. Specifically, effectiveness was measured in terms of the following three factors:

1. **Water Delivery**: The extent to which proposed facilities can deliver water at all reservoir levels:

a. High Effectiveness – The alternative uses an intake that would deliver water at all expected reservoir levels.
b. Low Effectiveness – The alternative uses an intake that may not facilitate water deliveries at some expected reservoir levels.

2. **Constructability**: The challenges associated with construction of proposed facilities:
    a. High Effectiveness – Construction challenges are minimal:
        i. Physical factors such as terrain and soil type are favorable for pipeline construction
        ii. Physical factors such as terrain and soil type are favorable for pumping plant construction
        iii. Physical factors such as terrain and soil type are favorable for treatment plant construction
        iv. A new intake is not required

    Moderate Effectiveness – Construction challenges are moderate:
        i. Physical factors such as terrain and soil type are moderately favorable for pipeline construction
        ii. Physical factors such as terrain and soil type are moderately favorable for pumping plant construction.
        iii. Physical factors such as terrain and soil type are moderately favorable for treatment plant construction

    Low Effectiveness – Construction challenges are significant:
        i. Physical factors such as terrain and soil type are not favorable for pipeline construction
        ii. Physical factors such as terrain and soil type are not favorable for pumping plant construction
        iii. Physical factors such as terrain and soil type are not favorable for treatment plant construction
        iv. A new intake is required

3. **Serviceability**: The challenges associated with operations and serviceability:
    a. High Effectiveness – Operational challenges are minimal:
        i. The intake structure requires low maintenance.
        ii. The pumping plant(s) are accessible, conveniently located, and near existing utilities.
        iii. The treatment plant is accessible, conveniently located, and/or near existing utilities.
    b. Moderate Effectiveness – Operational challenges are moderate:
        i. The intake structure requires moderate maintenance.
        ii. The pumping plant(s) may be accessible, conveniently located, and/or may be near existing utilities.
        iii. The treatment plant may be accessible, conveniently located, and/or may be located existing utilities.
    c. Low Effectiveness – Operational challenges are significant:
        i. The intake structure requires high maintenance.
        ii. The pumping plant(s) are difficult to access, not conveniently located, and/or are not near existing utilities.

iii. The treatment plant is difficult to access, conveniently located, and/or is not near existing utilities.

Efficiency

Efficiency measures the extent to which an alternative is cost effective based on *preliminary-level* capital costs, annual O&M costs, and life-cycle costs of the alternative[16]:

1. High Efficiency – The annualized life-cycle cost of treated water is less than $1.50 per 1,000 gallons.
2. Moderate Efficiency – The annualized life-cycle cost of treated water is more than $1.50 but less than $4.00 per 1,000 gallons.
3. Low Efficiency – The annualized life-cycle cost of treated water is more than $4.00 per 1,000 gallons

Engineering Assumptions and Cost Estimations

The annualized life-cycle costs were based on order-of-magnitude construction cost estimates and were developed solely for comparison of project alternatives. **Refined project cost estimates for the proposed alternative are presented in Chapter III – Appraisal-Level Design and Costs.** The following discussion provides a brief summary of the methods and assumptions used for each of the major infrastructure components.

Pipeline

For new pipe, Reclamation used the RSMeans Heavy Construction Cost Data, along with market research, to estimate costs based on the following assumptions:

- Pipelines were sized to meet a peak demand of 3.5 cubic feet per second (cfs). This represents a 1.25 peaking factor above the average flow of 2.75 cfs needed to deliver the full contracted amount of 1,997 acre-feet per year.
- High Density Poly Ethylene pipe was used.
- Excavation for the pipe would have vertical sides and a width equal to the inside diameter of the pipe plus two feet.
- The total volume of backfill equals the total volume of excavation.
- A USGS topographic map was correlated to local utility company subsurface exploration experience in the area and was generalized to three areas with the following rock percentages: 10 percent rock for alignments parallel to U.S. Hwy 7; 50 percent rock for alignments parallel to Chickasha Trail; and 80 percent rock for alignments in the Chickasaw NRA.
- County road crossings would be made by open cutting, compacting backfill about the pipe, and restoring the road surface.
- Highway road crossings would be made through borehole drilling.

[16] The cost ranges used to describe high, moderate, and low efficiency ratings were based on local water market conditions and best professional judgment.

- Stream crossings would be made by open cutting; the stream cross section would be restored as close as possible to its original section and protection would be provided as required.
- Blow-off structures exist to drain the pipe at all low points in the pipeline; air inlet/release valve structures with an isolating gate valve exist at all high points in the pipeline.
- Easement costs would be $14,000 per mile. This estimate was based on indexing actual costs for easements associated with the Wynnewood Aqueduct and a generalized land price of $2,500 per acre.
- The pipeline terminal point is a concrete storage structure, which provides water to the treatment plant.

For alternatives that utilize the existing Wynnewood Aqueduct, it was assumed that Sulphur would be required to pay back a proportionate share of original construction costs associated with the portion of the Wynnewood Aqueduct used to convey water to Sulphur (i.e., from the existing reservoir pump station to the existing regulation reservoir). For the purposes of this viability analysis, the following assumptions were made:

- The original construction cost of the aqueduct was converted to present value and then depreciated by its assumed useful service life based on the performance of the pipeline to date.
- The proportionate share was determined based on Sulphur's contractual water allocation relative to other member cities. The actual value, based on service life and depreciation, will need to be determined by negotiation between the owner (Arbuckle Master Conservancy District) and Sulphur, and it should be based on performance history, inspection of the current condition of the pipeline, etc.

Reservoir Pumping Plant

For alternatives that included construction of a new reservoir pumping plant, costs were based on a combination of actual construction costs of the existing reservoir pumping plant, quoted prices for major components, and a pumping plant cost estimating program developed by Reclamation. Costs were based on the following assumptions:

- The pumping plant would consist of two vertical pumps (one primary; one standby) with a service capacity of 3.5 cfs each. This represents a 1.25 peaking factor above the average flow of 2.75 cfs needed to deliver the full contracted amount of 1,997 acre-feet per year.
- Locations were selected in areas above elevation of 890 feet, the top of the flood control pool, and with an intake elevation of no more than 830 feet, so as to facilitate water delivery during critical drought periods.
- The pumping plant would be fully automated with pump operations controlled by the surface water level in the terminal storage tank. Multiple water intake levels would exist to ensure the ability to pump water at all reservoir levels.

For alternatives that utilize the existing reservoir pumping plant, costs were based on the upgrades that would be necessary to pump the full volume of water to end users, as well as Sulphur's proportionate share of original construction costs associated with the reservoir pumping plant. Assumptions are as follows:

- Replacement pumps at the existing reservoir pumping plant would be comprised of four horizontal pumps (three primary; one standby) with a service capacity of 13.1 cfs (9.6 cfs original + 3.5 cfs for Sulphur)
- The original construction cost of the pumping plant was converted to present value and then depreciated by its assumed useful service life based on the performance of the pump station to date.
- The proportionate share was determined based on Sulphur's contractual water allocation relative to other member cities. The actual value, based on service life and depreciation, will need to be determined by negotiation between the owner (Arbuckle Master Conservancy District) and Sulphur, and should be based on performance history, inspection of the current condition of the pumping plant.

Reservoir Intake Tower
Based on a comparison of sample construction costs, the reservoir intake tower costs were assumed to be 30 percent of the reservoir pumping plant cost. Assumptions are as follows:

- Multiple water intake levels are required for water quality and assurance of ability to pull water from all reservoir levels.
- Underwater placement of concrete for the submersible pump system would be required for placement of the intake assembly.

Booster Pumping Plant
Booster pumping plant costs were based on a combination of actual construction costs of the existing reservoir pumping plant, indexed to current dollars, quoted prices for major components, and a pumping plant cost estimating program developed by Reclamation. Costs were based on the assumption of two horizontal pumps (one primary; one standby) with a service capacity of 3.5 cfs each.

Booster Intake Tower
Based on a comparison of sample construction costs, the booster intake tower costs were assumed to be 50 percent of the booster pumping plant cost.

Water Treatment Plant
The costs of the new WTP were based on preliminary findings from the 1986 C.H. Guernsey Report and indexed to current prices using 2011 inflation rates. Costs were estimated based on the following assumptions:

- The plant would have a maximum design treatment capacity of 3.5 cfs (2.25 mgd).
- The plant would include prominent features such as: rapid mix unit, flocculation, clarification, filters, backwash ponds, and temporary storage.

- The plant would require appurtenances such as storage and feeding systems for various chemicals, raw and treated water flow meters, pumps, rate of flow control equipment, and quality control laboratory.

Contingencies
Cost estimates include a percentage allowance for construction contingencies as a separate item to cover minor differences in actual and estimated quantities, unforeseeable difficulties at the site, changed site conditions, possible minor changes in plans, and other uncertainties.

- A contingency of 5% of the subtotal was included for mobilization.
- A contingency of 20% of the subtotal with mobilization was included for unlisted items.
- A contingency of 25% of the contract subtotal was included for contract costs.
- A contingency of 40% was included for non-contract costs such as: design, environmental/cultural compliance, and construction management.

Operations and Maintenance (O&M) Costs
The O&M costs for the pipeline, reservoir pumping plant/intake, booster pumping plant/intake, as well as the Regulation Reservoir, were calculated using existing data on the O&M over the last three years from the Arbuckle Master Conservancy District associated with existing infrastructure. The O&M of the WTP was calculated using data from the 1986 C.H. Guernsey Report and indexed to current prices using 2011 inflation rates.

- Energy costs would be based on the flow rate and required pump head at each pumping plant at a cost of $0.09 per kilowatt hour (based on statewide averages).
- Actual O&M costs will vary depending on negotiated rates and quality of constructed features.

Acceptability
Acceptability measures the workability and viability of an alternative with respect to how compatible it is with authorities, regulations, policies, and environmental law. Acceptability was measured in terms of the following six factors:

1. **Authorities/Policies**: The extent to which placement of proposed facilities may be in conflict with existing authorities or policies of agencies with statutory jurisdiction over the investigation area:
    a. High Acceptability – Unlikely that the placement of proposed facilities is in conflict with existing authorities and policies of agencies with jurisdiction over the investigation area.
    b. Medium Acceptability – The placement of proposed facilities may be in conflict with existing authorities, regulations and/or policies of agencies with jurisdiction over the study area.
    c. Low Acceptability – The placement of proposed facilities is likely in conflict with existing authorities, regulations, and/or policies of agencies with jurisdiction over the study area.

2. **Recreation**: The extent to which construction and/or operations would impact recreation.
    a. High Acceptability
        i. Not likely to have any physical impacts on recreation facilities.
        ii. Not likely to have temporary or permanent visual or audible impacts on recreation users.
    b. Moderate Acceptability
        i. Likely to have physical impacts on primitive or non-permanent facilities, including camping areas, vault toilets, trails, etc.
        ii. Likely to have temporary visual or audible impacts on recreation users.
    c. Low Acceptability
        i. Likely to have physical impacts on permanent facilities, including flush restrooms, showers, paved roads, designated tent spaces, RV spaces, shelters, potable water delivery system, dump stations, etc.
        ii. Likely to have temporary and permanent visual or audible impacts on recreation users.
3. **Residents**: The extent to which construction and/or operations would impact residents.
    a. High Acceptability
        i. Pumping plant(s) would not likely have permanent and significant physical, visual, and/or audible impacts on residents.
        ii. Pipeline would have temporary, but not likely have permanent and significant physical, visual, and/or audible impacts on residents.
        iii. Treatment plant would not likely have permanent and significant physical, visual, and/or audible impacts on residents.
    b. Moderate Acceptability
        i. Pumping plant(s) would likely have permanent and potentially significant physical, visual, and/or audible impacts on residents.
        ii. Pipeline would likely have potentially significant temporary and permanent and physical, visual, and/or audible impacts on residents.
        iii. Treatment plant would likely have permanent and potentially significant physical, visual, and/or audible impacts on residents.
    c. Low Acceptability
        i. Pumping plant(s) would likely have permanent and significant physical, visual, and/or audible impacts on residents.
        ii. Pipeline would likely have significant permanent and temporary physical, visual, and/or audible impacts on residents.
        iii. Treatment plant would likely have permanent and significant physical, visual, and/or audible impacts on residents.
4. **Natural Environment**: The extent to which construction and/or operations would impact the natural environment such as fish and wildlife, and sensitive areas.
    a. High Acceptability
        i. Impacts are primarily in disturbed areas
        ii. Results in a temporary loss of fish and wildlife habitat
        iii. Impacts would have no effect on sensitive, state-listed, candidate, or threatened and endangered species

iv. No impacts on sensitive or unique habitat such as wetlands, riparian or bottomland hardwood areas, etc.

b. Moderate Acceptability
   i. Impacts located on an equal proportionate share of disturbed and undisturbed areas
   ii. Results in both temporary and permanent losses of fish and wildlife habitat, but impacts are insignificant
   iii. Impacts may affect, but are not likely to adversely affect, sensitive, state-listed, candidate, or threatened and endangered species
   iv. May impact sensitive or unique habitat such as wetlands, riparian or bottomland hardwood areas, etc.

c. Low Acceptability
   i. Impacts are primarily in undisturbed areas
   ii. Results in both temporary and permanent losses of fish and wildlife habitat, and impacts are likely significant
   iii. Impacts may affect, and are likely to adversely affect, sensitive, state-listed, candidate, or threatened and endangered species.
   iv. Would impact sensitive or unique habitat such as wetlands, riparian or bottomland hardwood areas, etc.

5. **Cultural Resources**: The extent to which construction and/or operations would impact cultural resources.
   a. High Acceptability – Not likely to impact archeological and/or historic sites because the environment is unsuitable, and/or surveys have been completed, and no significant sites exist.
   b. Moderate Acceptability – May impact archeological and/or historic sites because the environment may be suitable, and/or surveys have been completed and significant sites may exist.
   c. Low Acceptability – Likely to impact archeological and/or historic sites because the environment is suitable, and/or surveys have been completed and significant sites exist.

6. **Public Safety**: The extent to which proposed facilities may impact public safety:
   a. High Acceptability – Not likely to significantly and permanently increase risk to public safety.
   b. Moderate Acceptability – May significantly and permanently increase risk to public safety.
   c. Low Acceptability – Likely to significantly and permanently increase risk to public safety.

Completeness

Completeness measures the extent to which an alternative accounts for all necessary investments or other actions to ensure realization of goals. Completeness was measured in terms of risk factors which may be present due to uncertainty and variability, as well as the amount of additional coordination and/or investigations needed to affect timely or successful completion of the project. Completeness was measured in terms of the following three factors:

1. **Coordination**: The extent to which multi-organizational coordination would be required for construction and/or operation of proposed facilities:
    a. High Completeness – Little to no coordination would be required with other organizations.
    b. Moderate Completeness – Some coordination would be required with other organizations.
    c. Low Completeness – Substantial coordination would be required with other organizations.
2. **Risk**: The degree of engineering uncertainty and associated risk:
    a. High Completeness – Low risk factors and associated engineering uncertainty; minimal additional investigations are needed to implement the alternative.
    b. Moderate Completeness – Moderate risk factors and associated engineering uncertainty; a moderate amount of investigations are needed to implement the alternative.
    c. Low Completeness – High risk factors and associated engineering uncertainty; substantial investigations are needed to implement the alternative.
3. **Permitting**: The extent to which proposed facilities would require the issuance of permits or clearances which entail risk that could affect the timing or successful completion of the project.
    a. High Completeness:
        i. Right of way (ROW) easements would be routine and/or certain to obtain.
        ii. Environmental permits and clearances would likely be easy to obtain and mitigation not likely required.
        iii. Cultural resources clearance by the State Historic Preservation Office (SHPO) would likely be easy to obtain and mitigation not likely required.
    b. Moderate Completeness:
        i. ROW easements may not be routine and/or certain to obtain.
        ii. Environmental permits and clearances may not be easy to obtain and/or mitigation may be required.
        iii. Cultural resources clearance by the SHPO may not be easy to obtain and/or mitigation may be required.
    c. Low Completeness:
        i. ROW easements would not be routine and/or certain to obtain.
        ii. Environmental permits and clearances would likely be difficult to obtain and mitigation would likely be required.
        iii. Cultural resources clearance by the SHPO would likely be difficult to obtain and mitigation would likely be required.

Point Allocations

Points were allocated based on whether a factor scored a "high", "moderate", or "low" rating. For instance, the Completeness criterion is divided into three factors: coordination, risk, and permitting. If an alternative scored "high" on coordination, then it was allocated 5 points; if it scored "moderate" on coordination, then it was allocated 3 points; and if it scored "low" on completion, then it was allocated 1 point. Some factors, such as permitting, were further divided into categories in order to capture the full variation that exists among alternatives. In the case of

permitting, three categories were assigned [rights-of-way easements (ROW), environmental permitting, and cultural clearances], each of which was distributed an even amount of points within each score. For example, in the case of permitting, the maximum points an alternative that scores "low" can achieve is a 1; therefore, ROW easements, environmental permits, and cultural clearance categories were each allocated 0.33 points, roughly one third of the points available. Conversely, if an alternative scored a "high" on permitting, which has a maximum score of a 5, then each of the three categories was allocated 1.66 points. The purpose of making these distinctions was to capture situations in which one alternative may score "low" in one category (i.e., environmental permitting) but score "high" on another (i.e., ROW easements). An illustration of the point allocation methodology is provided in Appendix A.

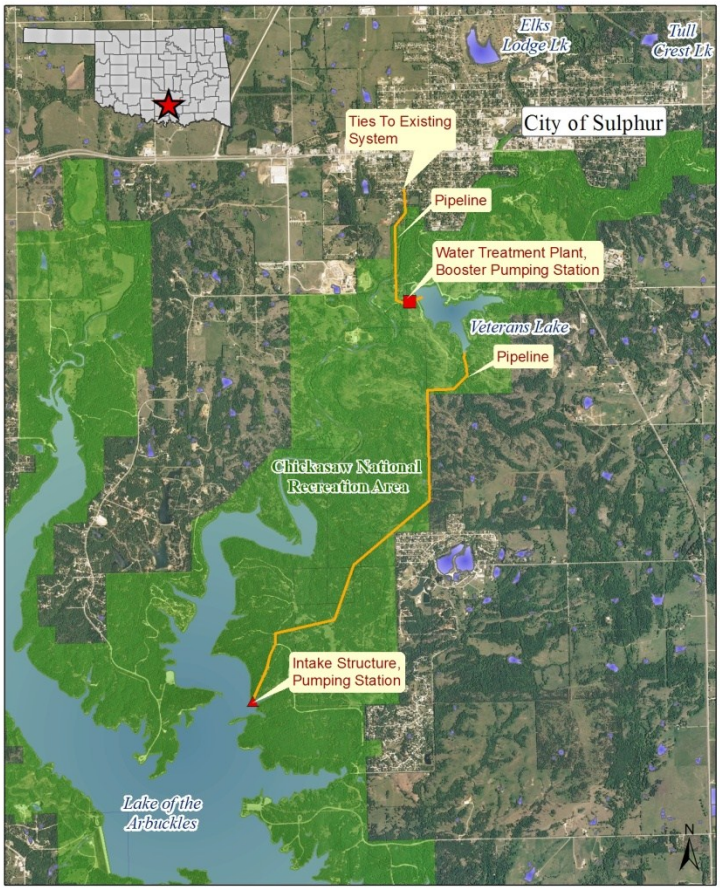
Alternative Descriptions

This section is divided into two parts. The first part presents an overview of each alternative, including a brief summary, engineering components, and qualitative scores (denoted in parentheses as "low", "moderate", or "high"). For clarification purposes, it should be noted that a score of "low" means that an alternative has relatively **more negative impacts** when compared to a score of a "high", which indicates a "good" outcome, meaning that impacts are relatively minor, benign, or otherwise discountable. The second part of this section presents the quantitative results in a summary table, along with a brief discussion. Detailed scores for each criterion across all alternatives are provided in Appendix A.

Alternative 1: Convey water to Veterans Lake for Regulation; treat water near Veterans Lake before conveying to Sulphur[17]

Summary

Water is pumped from a new intake on the East side of the Rock Creek Arm of Lake of the Arbuckles to Veterans Lake. Water is then withdrawn from Veterans Lake by gravity and treated at a new facility near the lake. Water is then pumped into the City's existing water system near the southwest corner of the City.



Sulphur Pipeline Regional Rural Water Project
Alternative 1

Engineering Components

Proposed infrastructure includes 4.2 miles of pipe; 1 reservoir pumping plant; 1 reservoir intake tower; 1 booster intake tower; 1 booster pumping plant; and 1 WTP. Infrastructure components are sized to deliver a peak demand of 3.5 cfs, which includes a 1.25 peaking factor above the 2.75 cfs average flow needed to deliver Sulphur's full contracted amount of 1,997 acre-feet per year.

Effectiveness

- ***Water Delivery*** (Low) – A new reservoir intake tower would not reliably deliver water at all reservoir levels.

[17] This Alternative corresponds to Alternative 1 of the *Sulphur Municipal and Industrial Water Supply Facilities, Phase I Preliminary Studies and Investigations Report* (C.H. Guernsey & Company 1986).

- ***Constructability*** (Low) – The pipeline alignment is in rocky/hilly terrain so construction would be challenging. A new intake would present many construction challenges. The reservoir pumping station, reservoir intake tower, booster intake tower, booster pumping station, and WTP are all located near a reservoir shoreline and would be less favorable for construction because of steeper terrain and rock.
- ***Serviceability*** (Moderate to Low) – The reservoir intake and pumping station would be relatively remote, making it difficult to access by both operators and utilities. The WTP would be located relatively close to Sulphur, making it slightly more accessible.

Efficiency

- ***Annualized life-cycle cost*** (Moderate) –The annualized life-cycle cost of treated water is $1.78, which is more than $1.50 but less than $4.00 per 1,000 gallons.

Acceptability

- ***Authorities*** (Low) – Placement of facilities within the Chickasaw NRA, which is owned by the NPS, may not be compatible with NPS policy and regulations.
- ***Impacts on Recreation*** (Moderate to Low) – The pipeline alignment crosses through several trails and primitive recreation areas. Recreation users would be impacted during construction and operations.
- ***Impacts on Residents*** (High) – The only potential impacts on residents would occur from the new WTP, but impacts would be mitigated by both the distance to the nearest resident, as well as by the construction of berms to obscure the plant's location.
- ***Impacts on Natural Environment*** (Moderate to Low) – Most facilities would be constructed in undisturbed habitat; the pipeline alignment would cross Rock Creek; the lowering of Veteran's Lake could have adverse impacts on the lake's fish populations.
- ***Impacts on Cultural Resources*** (Low) – The pipeline alignment crosses archeological sites; conditions are favorable for additional sites to be encountered.
- ***Impacts on Public Safety*** (Moderate) – A new reservoir intake would create a boater safety hazard.

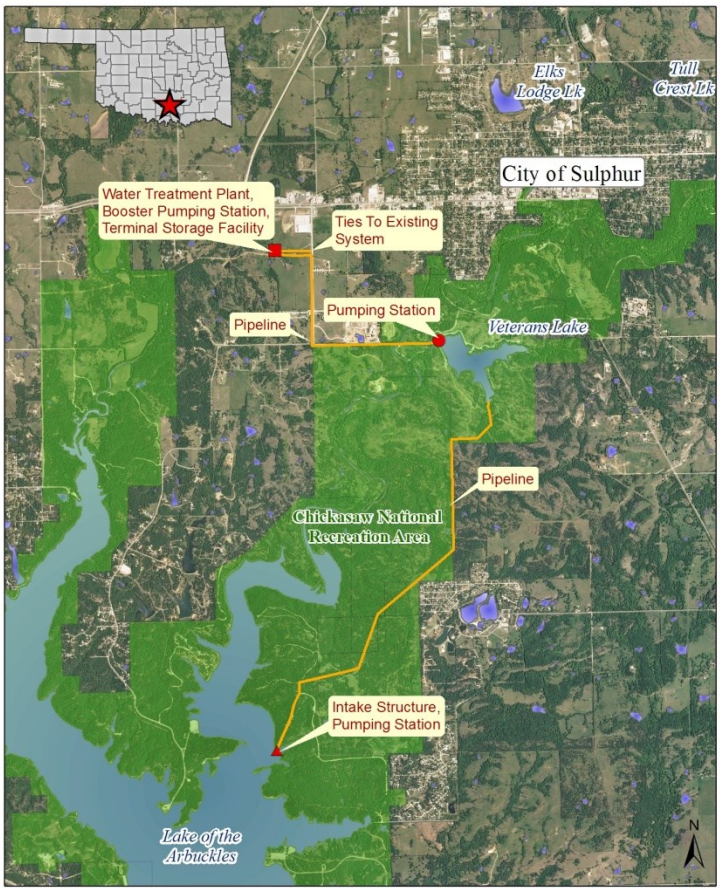
Completeness

- ***Agency Coordination*** (Low) – A substantial amount of coordination would be required construct facilities through the Chickasaw NRA.
- ***Engineering Uncertainty/Risk*** (Low) – The use of Veteran's Lake as a regulating reservoir presents uncertain operational constraints.
- ***Permitting*** (Low) – A new intake would require an individual Section 404 permit; the level of NEPA compliance would be uncertain given the substantial amount of environmental impacts.

Alternative 2: Utilize Veterans Lake for Regulation; treat water at Sulphur[18]

Description

Water is pumped from a new intake on the East side of the Rock Creek Arm of Lake of the Arbuckles to Veterans Lake. Water is then withdrawn from Veterans Lake and pumped to a new WTP on the southwest corner of the existing City of Sulphur municipal water system.



Sulphur Pipeline Regional Rural Water Project
Alternative 2

Engineering Components

Proposed infrastructure includes 5.6 miles of pipe; 1 reservoir pumping plant; 1 reservoir intake tower; 1 booster intake tower; 2 booster pumping plants; 1 terminal storage tank; and 1 WTP. Infrastructure components are sized to deliver a peak demand of 3.5 cfs, which includes a 1.25 peaking factor above the 2.75 cfs average flow needed to deliver Sulphur's full contracted amount of 1,997 acre-feet per year.

Effectiveness

- ***Water Delivery*** (Low) – A new reservoir intake tower would not reliably deliver water at all reservoir levels.
- ***Constructability*** (Moderate to Low) – The pipeline alignment is in rocky/hilly terrain so construction would be challenging. A new intake would present many construction challenges. The reservoir pumping station, reservoir intake tower, booster intake tower, and booster pumping station are all located near a reservoir shoreline and would be less favorable for construction because of steeper terrain and rock. The placement of the WTP at Sulphur is favorable due to flatter terrain and less rock.
- ***Serviceability*** (High to Low) – The reservoir intake and pumping station would be relatively remote, making it difficult to access by both operators and utilities. The WTP would be located in Sulphur, making it more accessible.

Efficiency

- ***Annualized life-cycle cost*** (Moderate) –The annualized life-cycle cost of treated water is $2.10, which is more than $1.50 but less than $4.00 per 1,000 gallons.

[18] This Alternative corresponds to Alternative 2 of the *Sulphur Municipal and Industrial Water Supply Facilities, Phase I Preliminary Studies and Investigations Report* (C.H. Guernsey & Company 1986).

Acceptability

- ***Authorities*** (Low) – Placement of facilities within the Chickasaw NRA, which is owned by the NPS, may not be compatible with NPS policy and regulations.
- ***Impacts on Recreation*** (Moderate to Low) – The pipeline alignment crosses through several trails and primitive recreation areas. Recreation users would be impacted during construction and operations.
- ***Impacts on Residents*** (High) – The only potential impacts on residents would occur from the new WTP, but impacts would be mitigated by both the distance to the nearest resident, as well as by the construction of berms to obscure the plant's location.
- ***Impacts on Natural Environment*** (Moderate to Low) – Most facilities would be constructed in undisturbed habitat; the pipeline alignment would cross Rock Creek; the lowering of Veteran's Lake could have adverse impacts on the lake's fish populations.
- ***Impacts on Cultural Resources*** (Low) – The pipeline alignment crosses archeological sites; conditions are favorable for additional sites to be encountered.
- ***Impacts on Public Safety*** (Moderate) – A new reservoir intake would create a boater safety hazard.

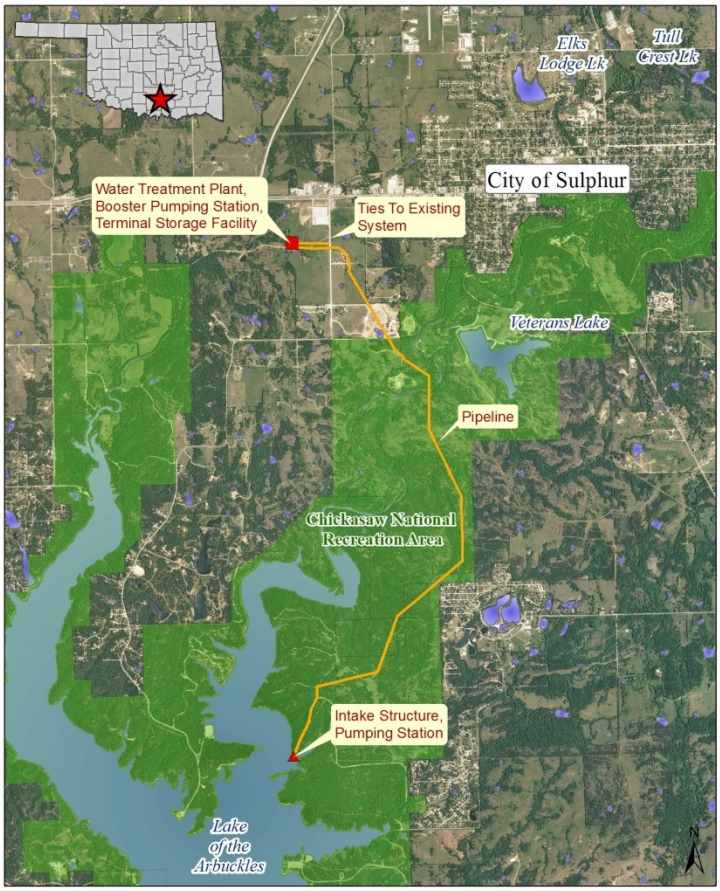
Completeness

- ***Agency Coordination*** (Low) – A substantial amount of coordination would be required construct facilities through the Chickasaw NRA.
- ***Engineering Uncertainty/Risk*** (Low) – The use of Veteran's Lake as a regulating reservoir presents uncertain operational constraints.
- ***Permitting*** (Low) – A new intake would require an individual Section 404 permit; the level of NEPA compliance would be uncertain given the substantial amount of environmental impacts.

Alternative 3: Pump water from the east side of Rock Creek; convey water directly to Sulphur; treat water at Sulphur[19]

Description

Water is pumped from a new intake on the East side of the Rock Creek Arm of Lake of the Arbuckles to a new water treatment facility at the southwest corner of Sulphur municipal water system.



Sulphur Pipeline Regional Rural Water Project
Alternative 3

Engineering Components

Proposed infrastructure includes 5.1 miles of pipe; 1 reservoir pumping plant; 1 reservoir intake tower; 1 booster pumping plant; 1 terminal storage tank; and 1 WTP. Infrastructure components are sized to deliver a peak demand of 3.5 cfs, which includes a 1.25 peaking factor above the 2.75 cfs average flow needed to deliver Sulphur's full contracted amount of 1,997 acre-feet per year.

Effectiveness

- ***Water Delivery*** (Low) – A new reservoir intake tower would not reliably deliver water at all reservoir levels.
- ***Constructability*** (Moderate to Low) – The pipeline alignment is in rocky/hilly terrain so construction would be challenging. A new intake would present many construction challenges. The reservoir pumping station, reservoir intake tower, booster intake tower, and booster pumping station are all located near a reservoir shoreline and would be less favorable for construction because of steeper terrain and rock. The placement of the WTP at Sulphur is favorable due to flatter terrain and less rock.
- ***Serviceability*** (High to Low) – The reservoir intake and pumping station would be relatively remote, making it difficult to access by both operators and utilities. The WTP would be located in Sulphur, making it more accessible.

[19] This Alternative corresponds to Alternative 3 of the *Sulphur Municipal and Industrial Water Supply Facilities, Phase I Preliminary Studies and Investigations Report* (C.H. Guernsey & Company 1986).

Efficiency

- ***Annualized life-cycle cost*** (Moderate) –The annualized life-cycle cost of treated water is $1.80, which is more than $1.50 but less than $4.00 per 1,000 gallons.

Acceptability

- ***Authorities*** (Low) – Placement of facilities within the Chickasaw NRA, which is owned by the NPS, may not be compatible with NPS policy and regulations.
- ***Impacts on Recreation*** (Moderate to Low) – The pipeline alignment crosses through several trails and primitive recreation areas. Recreation users would be impacted during construction and operations.
- ***Impacts on Residents*** (High) – The only potential impacts on residents would occur from the new WTP, but impacts would be mitigated by both the distance to the nearest resident, as well as by the construction of berms to obscure the plant's location.
- ***Impacts on Natural Environment*** (Moderate to Low) – Most facilities would be constructed in undisturbed habitat; the pipeline alignment would cross Rock Creek.
- ***Impacts on Cultural Resources*** (Low) – The pipeline alignment crosses archeological sites; conditions are favorable for additional sites to be encountered.
- ***Impacts on Public Safety*** (Moderate) – A new reservoir intake would create a boater safety hazard.

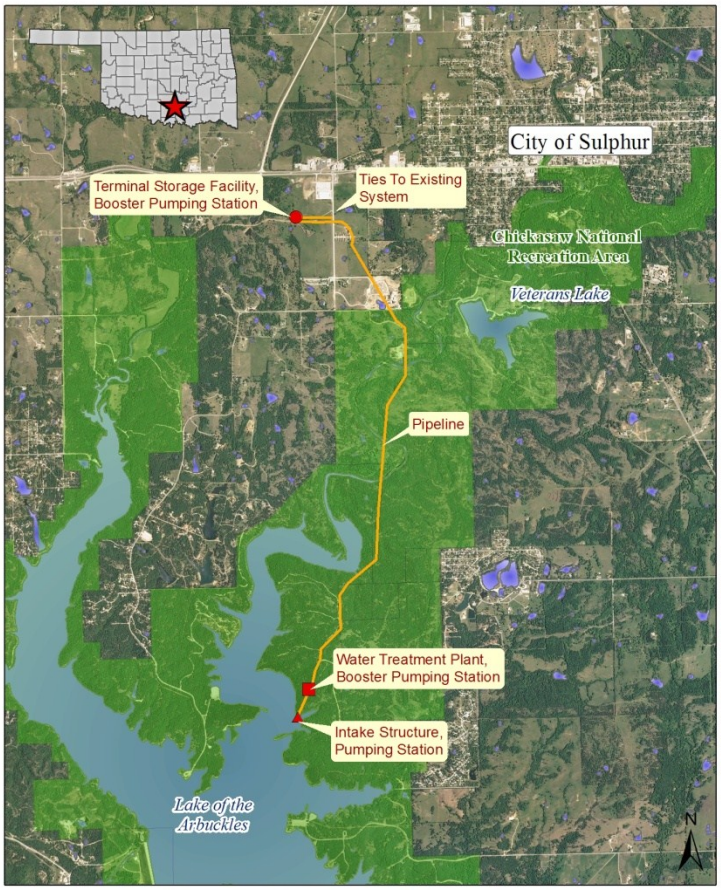
Completeness

- ***Agency Coordination*** (Low) – A substantial amount of coordination would be required construct facilities through the Chickasaw NRA.
- ***Engineering Uncertainty/Risk*** (Moderate) – Construction of a new reservoir intake would require additional investigations to ensure appropriate location and depth.
- ***Permitting*** (Low) – A new intake would require an individual Section 404 permit; the level of NEPA compliance would be uncertain given the substantial amount of environmental impacts.

Alternative 4: Pump water from the east side of Rock Creek; convey water directly to Sulphur; treat water near Lake of the Arbuckles[20]

Description

Water is pumped from a new intake on the East side of the Rock Creek Arm of Lake of the Arbuckles to a new water treatment facility located near the reservoir. Treated water would then be pumped to a new storage facility at the southwest corner of Sulphur municipal water system.



Sulphur Pipeline Regional Rural Water Project

Alternative 4

Miles 0 0.5 1

Engineering

Proposed infrastructure includes 4.6 miles of pipe; 1 reservoir pumping plant; 1 reservoir intake tower; 2 booster pumping plants; 1 terminal storage tank; and 1 WTP. Infrastructure components are sized to deliver a peak demand of 3.5 cfs, which includes a 1.25 peaking factor above the 2.75 cfs average flow needed to deliver Sulphur's full contracted amount of 1,997 acre-feet per year.

Effectiveness

- ***Water Delivery*** (Low) – A new reservoir intake tower would not reliably deliver water at all reservoir levels.
- ***Constructability*** (Low) – The pipeline alignment is in rocky/hilly terrain so construction would be challenging. A new intake would present many construction challenges. The reservoir pumping station, reservoir intake tower, booster intake tower, booster pumping station, and WTP are all located near a reservoir shoreline and would be less favorable for construction because of steeper terrain and rock.
- ***Serviceability*** (Low) – The reservoir intake, pumping station, and WTP would be relatively remote, making it difficult to access by both operators and utilities.

Efficiency

- ***Annualized life-cycle cost*** (Moderate) –The annualized life-cycle cost of treated water is $1.96, which is more than $1.50 but less than $4.00 per 1,000 gallons.

[20] This Alternative corresponds to Alternative 4 of the *Sulphur Municipal and Industrial Water Supply Facilities, Phase I Preliminary Studies and Investigations Report* (C.H. Guernsey & Company 1986).

Acceptability

- ***Authorities*** (Low) – Placement of facilities within the Chickasaw NRA, which is owned by the NPS, may not be compatible with NPS policy and regulations.
- ***Impacts on Recreation*** (Moderate to Low) – The pipeline alignment crosses through several trails and primitive recreation areas. Recreation users would be impacted during construction and operations.
- ***Impacts on Residents*** (High) – The only potential impacts on residents would occur from the new WTP, but impacts would be mitigated by both the distance to the nearest resident, as well as by the construction of berms to obscure the plant's location.
- ***Impacts on Natural Environment*** (Moderate to Low) – Most facilities would be constructed in undisturbed habitat; the pipeline alignment would cross Rock Creek.
- ***Impacts on Cultural Resources*** (Low) – The pipeline alignment crosses archeological sites; conditions are favorable for additional sites to be encountered.
- ***Impacts on Public Safety*** (Moderate) – A new reservoir intake would create a boater safety hazard.

Completeness

- ***Agency Coordination*** (Low) – A substantial amount of coordination would be required construct facilities through the Chickasaw NRA.
- ***Engineering Uncertainty/Risk*** (Moderate) – Construction of a new reservoir intake would require additional investigations to ensure appropriate location and depth.
- ***Permitting*** (Low) – A new intake would require an individual Section 404 permit; the level of NEPA compliance would be uncertain given the substantial amount of environmental impacts.

Alternative 5: Pump water from the east side of Rock Creek; convey water directly to Sulphur; treat water at Sulphur

Description

Water is pumped from a new intake on the East side of the Rock Creek Arm of Lake of the Arbuckles to a new water treatment and storage facility at the southwest corner of Sulphur municipal water system.

Sulphur Pipeline Regional Rural Water Project

Alternative 5

Engineering

This alternative has major facilities placed identical to Alternative 3 except the pipeline alignment matches Alternative 4. Proposed infrastructure includes 5.1 miles of pipe; 1 reservoir pumping plant; 1 reservoir intake tower; 1 booster pumping plant; 1 terminal storage tank; and 1 WTP. Infrastructure components are sized to deliver a peak demand of 3.5 cfs, which includes a 1.25 peaking factor above the 2.75 cfs average flow needed to deliver Sulphur's full contracted amount of 1,997 acre-feet per year.

Effectiveness

- ***Water Delivery*** (Low) – A new reservoir intake tower would not reliably deliver water at all reservoir levels.
- ***Constructability*** (Moderate to Low) – The pipeline alignment is in rocky/hilly terrain so construction would be challenging. A new intake would present many construction challenges. The reservoir pumping station, reservoir intake tower, booster intake tower, and booster pumping station are all located near a reservoir shoreline and would be less favorable for construction because of steeper terrain and rock. The placement of the WTP at Sulphur is favorable due to flatter terrain and less rock.
- ***Serviceability*** (High to Low) – The reservoir intake and pumping station would be relatively remote, making it difficult to access by both operators and utilities. The WTP would be located in Sulphur, making it more accessible.

Efficiency

- ***Annualized life-cycle cost*** (Moderate) –The annualized life-cycle cost of treated water is $1.79, which is more than $1.50 but less than $4.00 per 1,000 gallons.

Acceptability

- ***Authorities*** (Low) – Placement of facilities within the Chickasaw NRA, which is owned by the NPS, may not be compatible with NPS policy and regulations.
- ***Impacts on Recreation*** (Moderate to Low) – The pipeline alignment crosses through several trails and primitive recreation areas. Recreation users would be impacted during construction and operations.
- ***Impacts on Residents*** (High) – The only potential impacts on residents would occur from the new WTP, but impacts would be mitigated by both the distance to the nearest resident, as well as by the construction of berms to obscure the plant's location.
- ***Impacts on Natural Environment*** (Moderate to Low) – Most facilities would be constructed in undisturbed habitat; the pipeline alignment would cross Rock Creek.
- ***Impacts on Cultural Resources*** (Low) – The pipeline alignment crosses archeological sites; conditions are favorable for additional sites to be encountered.
- ***Impacts on Public Safety*** (Moderate) – A new reservoir intake would create a boater safety hazard.

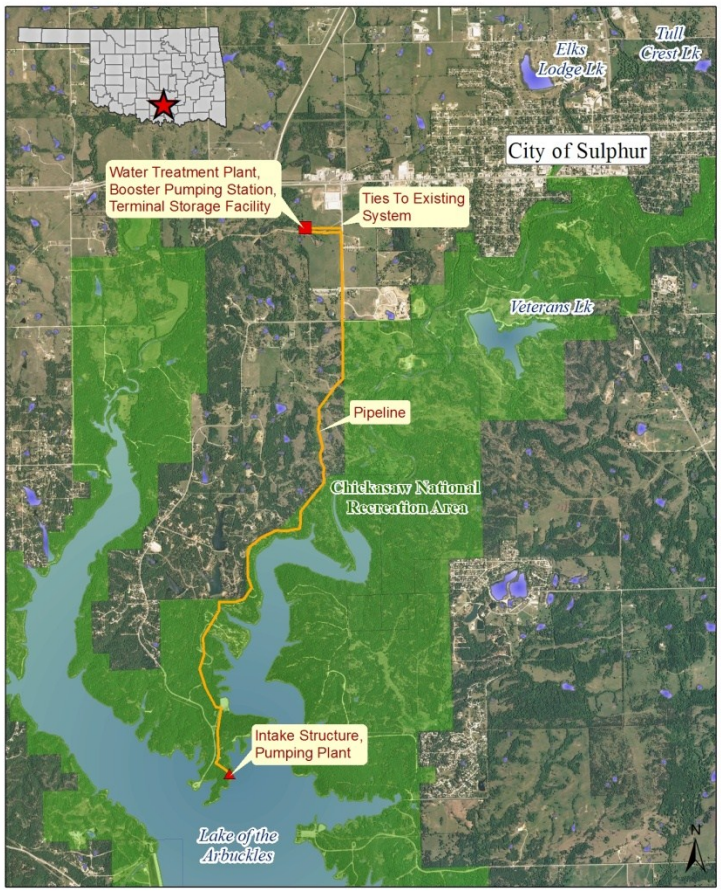
Completeness

- ***Agency Coordination*** (Low) – A substantial amount of coordination would be required construct facilities through the Chickasaw NRA.
- ***Engineering Uncertainty/Risk*** (Moderate) – Construction of a new reservoir intake would require additional investigations to ensure appropriate location and depth.
- ***Permitting*** (Low) – A new intake would require an individual Section 404 permit; the level of NEPA compliance would be uncertain given the substantial amount of environmental impacts.

Alternative 6: Pump water from the west side of Rock Creek; convey water directly to Sulphur; treat water at Sulphur[21]

Description

Water is pumped from a new intake on the West side of the Rock Creek Arm of Lake of the Arbuckles to a new water treatment and storage facility at the southwest corner of Sulphur municipal water system.



Sulphur Pipeline Regional Rural Water Project
Alternative 6

Engineering

Proposed infrastructure includes 5.2 miles of pipe; 1 reservoir pumping plant; 1 reservoir intake tower; 1 booster pumping plant; 1 terminal storage tank; and 1 WTP. Infrastructure components are sized to deliver a peak demand of 3.5 cfs, which includes a 1.25 peaking factor above the 2.75 cfs average flow needed to deliver Sulphur's full contracted amount of 1,997 acre-feet per year.

Effectiveness

- ***Water Delivery*** (Low) – A new reservoir intake tower would not reliably deliver water at all reservoir levels.
- ***Constructability*** (Moderate to Low) – The pipeline alignment is in rocky/hilly terrain so construction would be challenging. A new intake would present many construction challenges. The reservoir pumping station, reservoir intake tower, booster intake tower, and booster pumping station are all located near a reservoir shoreline and would be less favorable for construction because of steeper terrain and rock. The placement of the WTP at Sulphur is favorable due to flatter terrain and less rock.
- ***Serviceability*** (High to Low) – The reservoir intake and pumping station would be relatively remote, making it difficult to access by both operators and utilities. The WTP would be located in Sulphur, making it more accessible.

Efficiency

- ***Annualized life-cycle cost*** (Moderate) –The annualized life-cycle cost of treated water is $1.82, which is more than $1.50 but less than $4.00 per 1,000 gallons.

[21] This Alternative corresponds to Alternative 5 of the *Sulphur Municipal and Industrial Water Supply Facilities, Phase I Preliminary Studies and Investigations Report* (C.H. Guernsey & Company 1986).

Acceptability

- ***Authorities*** (Moderate) – Facilities are placed within lands included as part of the Arbuckle Project's original authorization, so construction likely to be compatible with NPS policy and regulations.
- ***Impacts on Recreation*** (Low) – The pipeline alignment crosses through permanent recreation facilities, including: paved roads, tent and RV spaces, and potable water delivery systems. Recreation users would be impacted during construction and operations.
- ***Impacts on Residents*** (High) – The only potential impacts on residents would occur from the new WTP, but impacts would be mitigated by both the distance to the nearest resident, as well as by the construction of berms to obscure the plant's location.
- ***Impacts on Natural Environment*** (High to Moderate) – Facilities would be constructed in relatively less undisturbed habitat; the pipeline alignment would not cross Rock Creek.
- ***Impacts on Cultural Resources*** (Low) – The pipeline alignment crosses archeological sites; conditions are favorable for additional sites to be encountered.
- ***Impacts on Public Safety*** (Moderate) – A new reservoir intake would create a boater safety hazard.

Completeness

- ***Agency Coordination*** (Low) – A substantial amount of coordination would be required construct facilities through the Chickasaw NRA.
- ***Engineering Uncertainty/Risk*** (Moderate) – Construction of a new reservoir intake would require additional investigations to ensure appropriate location and depth.
- ***Permitting*** (High to Low) – Facilities are placed within lands included as part of the Arbuckle Project's original authorization; easements required for areas where the pipeline crosses residents; A new intake would require an individual Section 404 permit; the level of NEPA compliance would be uncertain given the substantial amount of environmental impacts.

Alternative 7: Pump water from the west side of Rock Creek; convey water directly to Sulphur; treat water near Lake of the Arbuckles[22]

Description

Water is pumped from a new intake on the West side of the Rock Creek Arm of Lake of the Arbuckles to a new treatment facility located near the reservoir. Treated water would then be pumped to a storage facility at the southwest corner of Sulphur municipal water system.

Sulphur Pipeline Regional Rural Water Project
Alternative 7

Engineering

Proposed infrastructure includes 5.2 miles of pipe; 1 reservoir pumping plant; 1 reservoir intake tower; 2 booster pumping plants; 1 terminal storage tank; and 1 WTP. Infrastructure components are sized to deliver a peak demand of 3.5 cfs, which includes a 1.25 peaking factor above the 2.75 cfs average flow needed to deliver Sulphur's full contracted amount of 1,997 acre-feet per year.

Effectiveness

- ***Water Delivery*** (Low) – A new reservoir intake tower would not reliably deliver water at all reservoir levels.
- ***Constructability*** (Low) – The pipeline alignment is in rocky/hilly terrain so construction would be challenging. A new intake would present many construction challenges. The reservoir pumping station, reservoir intake tower, booster intake tower, booster pumping station, and WTP are all located near a reservoir shoreline and would be less favorable for construction because of steeper terrain and rock.
- ***Serviceability*** (Low) – The reservoir intake, pumping station, and WTP would be relatively remote, making it difficult to access by both operators and utilities.

Efficiency

- ***Annualized life-cycle cost*** (Moderate) –The annualized life-cycle cost of treated water is $1.99, which is more than $1.50 but less than $4.00 per 1,000 gallons.

[22] This Alternative corresponds to Alternative 6 of the *Sulphur Municipal and Industrial Water Supply Facilities, Phase I Preliminary Studies and Investigations Report* (C.H. Guernsey & Company 1986).

Acceptability

- ***Authorities*** (Moderate) – Facilities are placed within lands included as part of the Arbuckle Project's original authorization, so construction likely to be compatible with NPS policy and regulations.
- ***Impacts on Recreation*** (Low) – The pipeline alignment crosses through permanent recreation facilities, including: paved roads, tent and RV spaces, and potable water delivery systems. Recreation users would be impacted during construction and operations.
- ***Impacts on Residents*** (High) – The only potential impacts on residents would occur from the new WTP, but impacts would be mitigated by both the distance to the nearest resident, as well as by the construction of berms to obscure the plant's location.
- ***Impacts on Natural Environment*** (High to Moderate) – Facilities would be constructed in relatively less undisturbed habitat; the pipeline alignment would not cross Rock Creek.
- ***Impacts on Cultural Resources*** (Low) – The pipeline alignment crosses archeological sites; conditions are favorable for additional sites to be encountered.
- ***Impacts on Public Safety*** (Moderate) – A new reservoir intake would create a boater safety hazard.

Completeness

- ***Agency Coordination*** (Low) – A substantial amount of coordination would be required construct facilities through the Chickasaw NRA.
- ***Engineering Uncertainty/Risk*** (Moderate) – Construction of a new reservoir intake would require additional investigations to ensure appropriate location and depth.
- ***Permitting*** (High to Low) – Facilities are placed within lands included as part of the Arbuckle Project's original authorization; easements required for areas where the pipeline crosses residents; A new intake would require an individual Section 404 permit; the level of NEPA compliance would be uncertain given the substantial amount of environmental impacts.

Alternative 8: Pump water from Guy Sandy Recreation Area; convey water to Sulphur; treat water at Sulphur

Description

Water is pumped from a new intake on the West side of Lake of the Arbuckles near the Guy Sandy Recreation Area to a new treatment and storage facility at the southwest corner of the City's municipal water system along Chickasaw Trail and Hwy 7.

Sulphur Pipeline Regional Rural Water Project
Alternative 8

Engineering

Proposed infrastructure includes 7.2 miles of pipe; 1 reservoir pumping plant; 1 reservoir intake tower; 1 booster pumping plant; 1 terminal storage tank; and 1 WTP. Infrastructure components are sized to deliver a peak demand of 3.5 cfs, which includes a 1.25 peaking factor above the 2.75 cfs average flow needed to deliver Sulphur's full contracted amount of 1,997 acre-feet per year.

Effectiveness

- ***Water Delivery*** (Low) – A new reservoir intake tower would not reliably deliver water at all reservoir levels.
- ***Constructability*** (High to Low) – The pipeline alignment is in relatively flatter terrain with less rock. A new intake would present many construction challenges. The reservoir pumping station, reservoir intake tower, booster intake tower, and booster pumping station are all located near a reservoir shoreline and would be less favorable for construction because of steeper terrain and rock. The placement of the WTP at Sulphur is favorable due to flatter terrain and less rock.
- ***Serviceability*** (High to Low) – The reservoir intake and pumping station would be relatively remote, making it difficult to access by both operators and utilities. The WTP would be located in Sulphur, making it more accessible.

Efficiency

- ***Annualized life-cycle cost*** (Moderate) –The annualized life-cycle cost of treated water is $1.92, which is more than $1.50 but less than $4.00 per 1,000 gallons.

Acceptability

- ***Authorities*** (Moderate) – Facilities are placed within lands included as part of the Arbuckle Project's original authorization, so construction likely to be compatible with NPS policy and regulations.
- ***Impacts on Recreation*** (High to Low) – The pipeline alignment is not likely to have physical impacts on recreation facilities. Recreation users would be impacted during the construction and operations.
- ***Impacts on Residents*** (High) – The only potential impacts on residents would occur from the new WTP, but impacts would be mitigated by both the distance to the nearest resident, as well as by the construction of berms to obscure the plant's location.
- ***Impacts on Natural Environment*** (High to Moderate) – Facilities would be constructed in relatively less undisturbed habitat; the pipeline alignment would not cross Rock Creek.
- ***Impacts on Cultural Resources*** (Moderate) – The pipeline alignment crosses archeological sites; conditions may not be favorable for additional sites to be encountered.
- ***Impacts on Public Safety*** (Moderate) – A new reservoir intake would create a boater safety hazard.

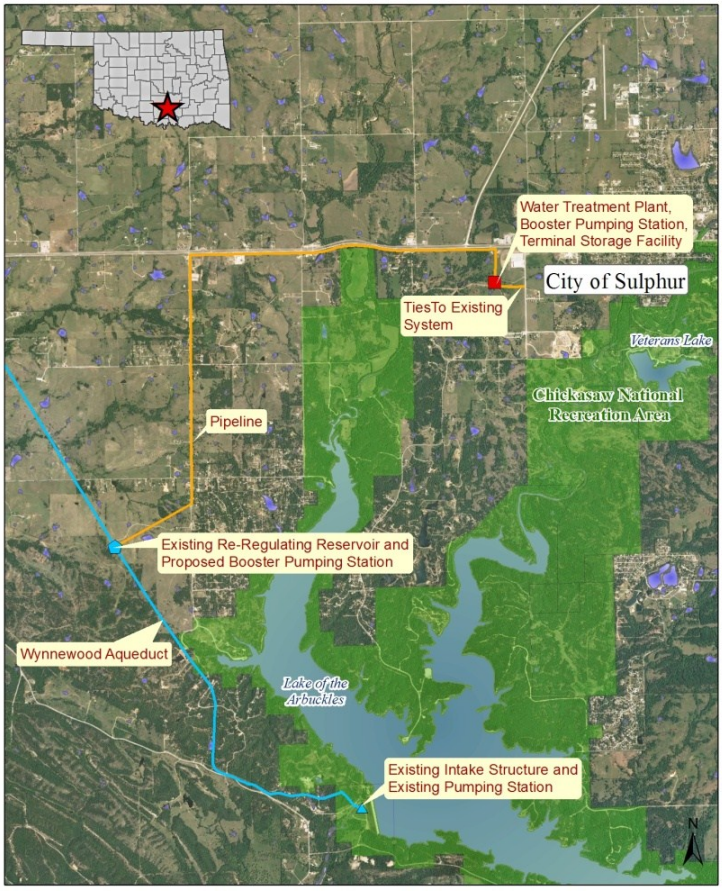
Completeness

- ***Agency Coordination*** (Low) – A substantial amount of coordination efforts needed to connect shared infrastructure between Sulphur and the Arbuckle Master Conservancy District.
- ***Engineering Uncertainty/Risk*** (Moderate) – Construction of a new reservoir intake would require additional investigations to ensure appropriate location and depth.
- ***Permitting*** (High to Low) – Facilities are placed within lands included as part of the Arbuckle Project's original authorization; easements required for areas where the pipeline crosses residents; A new intake would require an individual Section 404 permit; NEPA compliance documentation may be expedited due to less environmental impacts.

Alternative 9: Pump water from existing Lake of the Arbuckles intake; use existing Wynnewood Aqueduct; convey water to Sulphur; treat water at Sulphur

Description

Water is pumped from the existing intake at Lake of the Arbuckles through the existing Wynnewood Aqueduct[23] to the existing regulating reservoir. A new pumping plant at the reservoir pumps the water through a new pipeline to a new treatment and storage facility at the southwest corner of the City's municipal water system along Chickasaw Trail and State Highway 7.



Engineering

Proposed infrastructure includes 6.3 miles of new pipe; new pumps at the existing Arbuckle Reservoir pumping plant; 2 new booster pumping plants; 1 new terminal storage tank; and 1 new WTP. Infrastructure components are sized to deliver a peak demand of 3.5 cfs, which includes a 1.25 peaking factor above the 2.75 cfs average flow needed to deliver Sulphur's full contracted amount of 1,997 acre-feet per year.

Effectiveness

- ***Water Delivery*** (High) – Using the existing reservoir intake ensures that water is reliably delivered at all reservoir levels.
- ***Constructability*** (High) – Using the existing Wynnewood Aqueduct is favorable; the pipeline alignment from the re-regulation reservoir is in relatively flatter terrain with less rock. The placement of the WTP at Sulphur is favorable due to flatter terrain and less rock.
- ***Serviceability*** (High) – The existing reservoir intake shows exceptional performance and requires little maintenance. The WTP would be located in Sulphur, making it more accessible.

Efficiency

- ***Annualized life-cycle cost*** (Moderate) –The annualized life-cycle cost of treated water is $1.91, which is more than $1.50 but less than $4.00 per 1,000 gallons.

[23] A recent review of the capacity of the aqueduct confirmed that the section of the existing Wynnewood Aqueduct from the existing reservoir pumping station to the reregulation reservoir is sized to meet the full water right allocations of the cities of Wynnewood, Davis, *and* Sulphur (Reclamation 2011).

Acceptability

- ***Authorities*** (High) – The pipeline alignment would fall within existing rights-of-way, so construction would not be in conflict with NPS policy and regulations.
- ***Impacts on Recreation*** (High) – Facilities would have no physical impacts on recreation facilities and no temporary or permanent visual and audible impacts to recreation users.
- ***Impacts on Residents*** (High) – The only potential impacts on residents would occur from the new WTP, but impacts would be mitigated by both the distance to the nearest resident, as well as by the construction of berms to obscure the plant's location.
- ***Impacts on Natural Environment*** (High) – Facilities would be constructed in primarily disturbed habitat and along existing rights-of-way.
- ***Impacts on Cultural Resources*** (Moderate) – The pipeline alignment crosses archeological sites; conditions may not be favorable for additional sites to be encountered.
- ***Impacts on Public Safety*** (High) – Using the existing reservoir intake would not create an additional boater safety hazard.

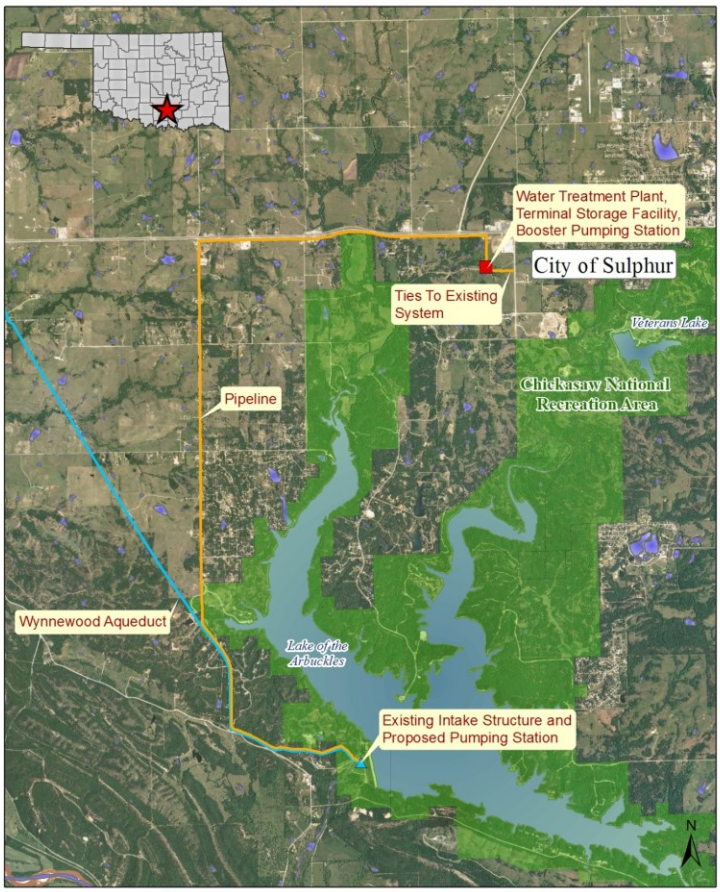
Completeness

- ***Agency Coordination*** (Low) – A substantial amount of coordination efforts needed to connect shared infrastructure between Sulphur and the Arbuckle Master Conservancy District.
- ***Engineering Uncertainty/Risk*** (High) – Using the existing reservoir intake results in less uncertainty and risk.
- ***Permitting*** (High to Moderate) – Facilities are placed within lands included as part of the Arbuckle Project's original authorization; easements required for areas where the pipeline crosses residents; a Section 404 permit would not be required; NEPA compliance documentation would be expedited due to less environmental impacts.

Alternative 10: Pump water from existing Lake of the Arbuckles intake to Sulphur though a new pump station and pipeline; treat water at Sulphur

Description

Water is pumped from Lake of the Arbuckles through a new pump station and pipeline to Sulphur along Chickasaw Trail and State Highway 7. Water is then treated at a new treatment and storage facility at the southwest corner of the City.



Sulphur Pipeline Regional Rural Water Project
Alternative 10

Engineering

Proposed infrastructure includes 9.3 miles of pipe; 1 new reservoir pumping plant; 1 booster pumping plant; 1 terminal storage tank; and 1 WTP. Infrastructure components are sized to deliver a peak demand of 3.5 cfs, which includes a 1.25 peaking factor above the 2.75 cfs average flow needed to deliver Sulphur's full contracted amount of 1,997 acre-feet per year.

Effectiveness

- ***Water Delivery*** (High) – Using the existing reservoir intake ensures that water is reliably delivered at all reservoir levels.
- ***Constructability*** (High) – Construction of a parallel pipeline to the Wynnewood Aqueduct, even though the alignment would be within existing right-of-way and in relatively flatter terrain with less rock, would still present some challenges. The placement of the WTP at Sulphur is favorable due to flatter terrain and less rock.
- ***Serviceability*** (High) – The existing reservoir intake shows exceptional performance and requires little maintenance. The WTP would be located in Sulphur, making it more accessible.

Efficiency

- ***Annualized life-cycle cost*** (Moderate) –The annualized life-cycle cost of treated water is $1.99, which is more than $1.50 but less than $4.00 per 1,000 gallons.

Acceptability

- ***Authorities*** (High) – The pipeline alignment would fall within existing rights-of-way, so construction would not be in conflict with NPS policy and regulations.

- ***Impacts on Recreation*** (High) – Facilities would have no physical impacts on recreation facilities and no temporary or permanent visual and audible impacts to recreation users.
- ***Impacts on Residents*** (High) – The only potential impacts on residents would occur from the new WTP, but impacts would be mitigated by both the distance to the nearest resident, as well as by the construction of berms to obscure the plant's location.
- ***Impacts on Natural Environment*** (High) – Facilities would be constructed in primarily disturbed habitat and along existing rights-of-way.
- ***Impacts on Cultural Resources*** (Moderate) – The pipeline alignment crosses archeological sites; conditions may not be favorable for additional sites to be encountered.
- ***Impacts on Public Safety*** (High) – Using the existing reservoir intake would not create an additional boater safety hazard.

Completeness

- ***Agency Coordination*** (Low) – A substantial amount of coordination efforts needed to connect shared infrastructure between Sulphur and the Arbuckle Master Conservancy District.
- ***Engineering Uncertainty/Risk*** (High) – Using the existing reservoir intake results in less uncertainty and risk.
- ***Permitting*** (High to Moderate) – Facilities are placed within lands included as part of the Arbuckle Project's original authorization; easements required for areas where the pipeline crosses residents; a Section 404 permit would not be required; NEPA compliance documentation would be expedited due to less environmental impacts.

Screening Results

Discussion and Recommendations

Table 2 below provides a summary of the results of the alternatives evaluation. The results are depicted as a percentage of points scored for each of the ten alternatives across the four criteria. Alternatives 1 – 7 scored the lowest of the ten alternatives, scoring only 38 to 44 percent of the total points allowable. These alternatives scored low because they primarily consisted of new infrastructure constructed inside the Chickasaw NRA, which presented a number of issues across the effectiveness, acceptability, and completeness criteria. Alternative 8 scored about 50 percent of the points allowable, which indicates the benefits of avoiding more of the Chickasaw NRA, but was negatively impacted by the costs and risks associated with building a new intake. Alternative 9 and 10 scored the highest of the ten alternatives, scoring about 80 percent of the total points allowable. These alternatives performed relatively well because they use the existing reservoir intake and avoid the Chickasaw NRA. Alternative 9 performed slightly better than Alternative 10 because it maximizes use of existing infrastructure (i.e., the existing Wynnewood Aqueduct).

Table 2. A quantitative comparison of how ten alternatives to convey water from Lake of the Arbuckles to Sulphur perform on four evaluation criteria. Values represent the percentage of total allowable points scored. Details are provided in Appendix A.

	Alternative									
Criterion	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Effectiveness	24.4%	35.5%	35.5%	19.9%	35.5%	35.5%	19.9%	44.9%	99.9%	98.2%
Efficiency	60.0%	60.0%	60.0%	60.0%	60.0%	60.0%	60.0%	60.0%	60.0%	60.0%
Acceptability	46.6%	44.9%	46.6%	46.6%	46.6%	54.9%	54.9%	71.6%	93.3%	93.3%
Completeness	19.9%	19.9%	33.3%	33.3%	33.3%	42.1%	42.1%	46.6%	68.8%	68.8%
Average	**37.7%**	**40.1%**	**43.8%**	**40.0%**	**43.8%**	**48.1%**	**44.3%**	**55.8%**	**80.5%**	**80.1%**

Alternative 9 received the highest scores across all four criteria and is therefore recommended as the only viable, proposed conveyance alternative. Under Alternative 9, 1,997 acre-feet per year would be released through the existing intake structure at Lake of the Arbuckles and pumped through the existing Wynnewood Aqueduct to the existing regulating reservoir, both of which are owned and operated by the Arbuckle Master Conservancy District. Water would then be pumped from a new pumping station through a new pipeline to a new treatment and storage facility at the southwest corner of Sulphur's municipal water system along Chickasaw Trail and State Highway 7. As previously stated at the beginning of this chapter, the proposed conveyance alternative to convey water from Sulphur to Murray County RWD No. 1 is to construct a new pipeline from Sulphur water main to the Murray County RWD No. 1 standpipe. Together, the proposed conveyance alternatives to deliver water from Lake of the Arbuckles to Sulphur and on to Murray County RWD No. 1 comprise the "**Sulphur Pipeline Regional Rural Water Supply Project" (Project)**.

CHAPTER III
APPRAISAL-LEVEL DESIGN AND COSTS

Proposed Alternative

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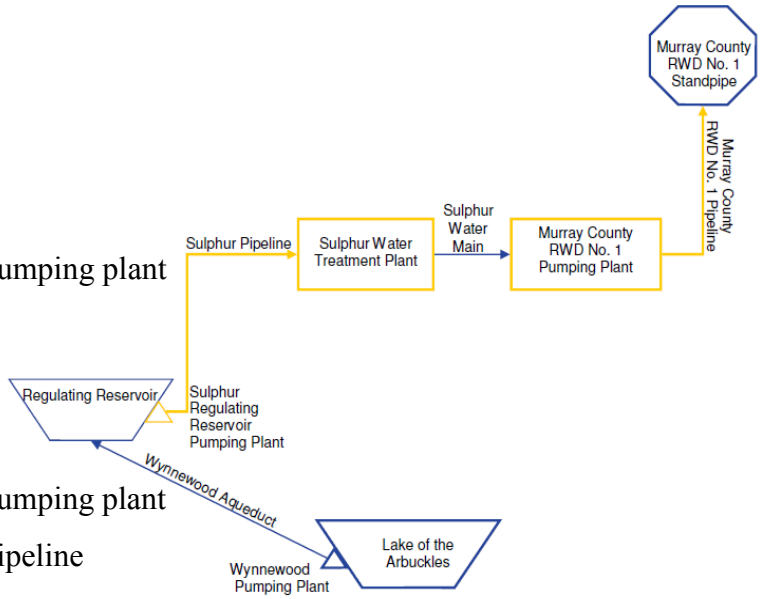
DESIGN NARRATIVES

Detailed design narratives for the proposed alternative, known as the Sulphur Pipeline Regional Rural Water Supply Project (Project) are organized by major project feature and presented in the order by which water would flow from Lake of the Arbuckles to Sulphur and on to Murray County RWD No. 1. For each major project feature, a description of the details, assumptions, risk factors, and additional considerations (as applicable) is provided for the three design components: structural/architectural; mechanical/hydraulic; and electrical. Designs represent state-of-the-art technologies and have incorporated components that reduce energy use and increase energy efficiency where possible[24]. Detailed quantity sheets and a list of preparers are provided in Appendix D.

A list and conceptual illustration of major project features is below. Existing infrastructure is denoted in blue and new infrastructure is denoted in gold:

Project Features

- Existing Wynnewood pumping plant
- Existing Wynnewood Aqueduct
- Existing Regulating reservoir
- Proposed Sulphur regulating reservoir pumping plant
- Proposed Sulphur pipeline
- Proposed Sulphur WTP
- Existing Sulphur water main
- Proposed Murray County RWD No. 1 pumping plant
- Proposed Murray County RWD No. 1 pipeline
- Existing Murray County RWD No. 1 standpipe



Wynnewood Pumping Plant

1. Structural/Architectural Components

   1.1. Details – The existing reinforced concrete pump pedestals would be removed and replaced with new reinforced concrete pedestals that are sized to meet the size requirements of the new pump units furnished.

2. Mechanical/Hydraulic Components

[24] Variable speed vertical turbine pumps were included at the water treatment plant clear well

2.1. Details – The existing pumping plant has three existing duty pumps and one installed standby pump. The pumps are constant speed split case horizontal centrifugal pumps. The control system only allows three pumps to be operated at a time. Each existing pump has a rated capacity of 3.45 cfs at 179 feet of total dynamic head (TDH). Split case horizontal centrifugal pumps were also selected for the replacement pumps. Each new pump is rated for 4.37 cfs at 180 feet of TDH. 125 horsepower motors are required for each pump. Operation and control is anticipated to be the same as the existing pumps. The existing pumping plant discharges into a 27-in pipeline that discharges to an open surge tank at Sta. 13+82.72. Upon a controlled pump shutdown or an uncontrolled pump shutdown due to loss of power, reverse flow is currently controlled by shutting an existing 6-in diameter hydraulically operated gate valve located downstream of each pump. The closure time for each pump discharge valve is 50 to 55 seconds. The pump discharge valve closure time and the surge tank 0.24 miles downstream limit the hydraulic transient from pump shutdown. To install the larger pumps, piping changes within each leg between the suction and discharge manifolds would be required. The suction piping would continue to be 8-in diameter but the existing 6-in discharge piping and valves would be replaced with new 8-in diameter piping and valves. The existing hydraulic fluid power (HPU) unit and piping that operates the valves would also be replaced with a new modern unit operating at a higher pressure. Because there are three duty pumps and one installed standby, the pump station would retain full discharge capacity with the loss of one pump. This configuration would meet state health department regulations for redundant capacity.

2.2. Assumptions - Suction and discharge pipes between the existing suction and discharge manifolds are assumed to require complete replacement due to differences in the existing and replacement pump discharge size and elevation. HPU and hydraulic piping is assumed to require complete replacement since new hydraulically actuated pump discharge valves are required. Additional hydraulic transient mitigation is assumed not to be required.

2.3. Risk Factors - Clearances within pumping plant would be slightly less with the new pumping equipment. Clearance changes cannot be identified until a detailed design layout is completed.

3. Electrical Components

3.1. Details -

- A new 750 kilo Volt-Ampere (kVA) transformer would be required to provide sufficient power for the new 125 HP pumps and the current station service and Chlorination Station loads.
- The existing motor control center (MCC) for the facility would need to be removed and disposed.
- A new MCC would be installed that would be rated for the larger pumps. It would also include the transformers and power panels needed to supply the station service and the Chlorination Station loads.

- The existing 200kW engine generator and support equipment would need to be removed and disposed.
- A new 400 kW engine generator and support systems would need to be installed. Support systems include an above ground fuel tank, spill containment area, double walled tank, double walled fuel piping, and weather protective housing.
- A new Automatic Transfer Switch capable of supplying the facility in normal (Oklahoma Gas & Electric Company (OG&E) power available) and emergency conditions (engine generator) would need to be installed. The switch would need to be service-entrance rated.

3.2. Assumptions -

- Current electrical configuration provides sufficient for three 100 HP pumps to run simultaneously with additional power available for power auxiliary plant equipment and the Chlorination Station. The load list provided would indicate that a 500 kVA transformer is used to power this facility. This transformer and its replacement are supplied by OG&E.
- The existing power cables from the existing OG&E transformer to the facility were installed using the original design criteria. This would allow them to support the additional load of the new pumps.
- Based on the date of the design, the equipment currently installed is of a similar vintage. This would indicate that the existing equipment is either not capable of being retrofitted with newer and larger control units or would require significant maintenance to extend its useful life to ensure long term delivery of water to the region.
- The current control systems are fully functional and capable of performing with the additional changes proposed at the existing regulating reservoir and new WTP.
- The existing 200 kW engine generator and associated automatic transfer switch is only sized to provide power for two 100 HP delivery pumps and other minimum required loads.
- A reduced water delivery in emergency conditions is acceptable therefore allowing for a smaller engine generator to be used. The new 125 HP pumps would require a larger generator to be installed to meet this requirement.

3.3. Risk Factors -

- The current control system for the existing facility could require upgrading to meet the new service requirements.
- The power cables supplying the existing facility could require replacement. Current cables and conduit may be undersized for the new load requirements.
- Delivery requirements in normal and emergency conditions are required to be the same therefore the emergency engine generator size would need to be increased to provide for full operation of the facility.

3.4. Additional Considerations -

- Replacement of the existing MCC would require careful coordination to maintain water delivery capability during construction. This may require the installation of temporary pumps or motor control equipment until the new MCC is fully functional.

Wynnewood Aqueduct

1. Structural/Architectural Components

1.1. Details – There would not be any infrastructure construction for this portion of the existing pipeline. The existing pipeline was constructed to provide water to Davis, Wynnewood, and the refinery at Wynnewood.

1.2. Assumptions – The original construction cost of the aqueduct would be converted to present value and then depreciated by its assumed useful service life based on the performance of the pipeline to date. The proportionate share was determined based on Sulphur's contractual water allocation relative to other member cities (i.e., from the existing reservoir pump station to the existing regulation reservoir). The actual value, based on service life and depreciation, would need to be determined by negotiation between the owner (Arbuckle Master Conservancy District) and Sulphur, and it should be based on performance history, inspection of the current condition of the pipeline, etc.

Regulating Reservoir

1. Structural/Architectural Components

1.1. Details – There would not be any infrastructure construction for the regulating reservoir. A new outlet works would be installed in the embankment of the regulation reservoir, and details of the new outlet works is included in the Sulphur Regulating Reservoir Pumping Plant description below.

1.2. Assumptions – It should be noted that for cost estimation purposes, it was assumed that Sulphur would be required to pay back a proportionate share of original construction costs associated with the portion of the Wynnewood Aqueduct used to convey water to the Sulphur (i.e., from the Wynnewood pumping plant to the regulation reservoir).

Sulphur Regulating Reservoir Pumping Plant

1. Structural/Architectural Components

1.1. Details - Pump Station Intake – A new reinforced concrete regulating reservoir outlet structure would be constructed on the east edge of the existing regulating reservoir adjacent to regulating reservoir overflow structure. It would provide an inlet to the new pump station intake pipeline. The outlet structure would include a trash rack and guardrails on the top deck for safe access to the trash racks.

1.2. Assumptions - Construction of the new outlet structure would require the installation of a new cofferdam and the use of dewatering systems to provide a dry construction area.

1.3. Additional Considerations - The regulating reservoir embankment would be excavated, and portions of the existing reinforced concrete reservoir lining must be removed and replaced for the construction of the outlet structure.

1.4. Details - Pump Station and Service Yard – The new pump station would be located adjacent to the new regulating reservoir service yard to reduce the length of the new intake piping. The service yard would be approximately 85.0 ft by 82.5 ft and would be sloped to allow for surface drainage. The service yard would include 6 in gravel surfacing with perimeter 7-ft chain link fencing with three strands of barbed wire for security and a 20-ft double swing gate.

The Sulphur regulating reservoir pumping plant would be a reinforced concrete substructure, approximately 32 ft 6 in by 28 ft 0 in that would provide space for the pumping units, valves, unit piping and manifold encasements. The new pump station also would include a service bay area for pump controls and pump lay down area for minor pump repairs. An overhead bridge crane would be included to provide for equipment access. The pump station would be enclosed with a pre-engineered metal building that includes insulated metal wall and roof panels, windows for natural lighting, and basic electrical and heating, ventilation, and air conditioning (HVAC) systems.

The new two cylindrical air chambers would be housed in a separate pre-engineered metal building with a reinforced concrete slab on grade foundation. The pumping plant and service yard would be located and sized to provide access into and around the structure to facilitate all the anticipated operation and maintenance requirements for this facility.

1.5. Assumptions - No unique foundation improvements would be anticipated for this structure based on the data provided.

1.6. Additional Considerations - Access roads to the service yard are not included in this estimate and may be considered during final design.

A site plan with the pump station design is included in Appendix B.

2. Mechanical/Hydraulic Components

2.1. Details - A ne*w* reservoir outlet works installed in the embankment of the existing regulating reservoir would be required to deliver water to the new relift pumping plant. The new pumping plant would pump up to 3.5 cfs to the terminal reservoir (tank) at the new Sulphur WTP. The outlet works would include a 14-in by 14-in slide gate and a new 14-in diameter pipeline to feed a new 14-in diameter suction manifold within the new pumping station. The selected pumps would be constant speed split case horizontal centrifugal pumps, each with a design flow rate of 1.75 cfs at 140 feet TDH. 50 horsepower motors would be required for each pump. Two pumps would be duty pumps and one would be installed standby. The control system would be required to alternate starts between the three pumps and prevent more than two pumps from operating. With

one pump off line, the two remaining pumps would produce the full design capacity of the pumping plant thereby meeting state requirements for redundant capacity. Each suction pipe would contain an 8-in diameter isolation valve and a dismantling coupling. Each pump discharge pipe would contain an 8-in diameter isolation valve, dampened check valve, dismantling coupling, and pump control valve. The control valve would be utilized for controlled pump starts and stops. A new 14-in diameter discharge manifold would connect the pumping plant to the new Sulphur pipeline. Hydraulic transients would be mitigated by two air chambers located in a separate structure adjacent to the pumping plant. The air chamber sizes were assumed using engineering judgment. A hydraulic transient analysis using computer software to develop a model would be required to determine the actual size of the air chambers during the design phase of the project.

2.2. Assumptions - Existing regulating reservoir would have sufficient storage to serve a new pump station without modifying the existing control system of the existing Wynnewood Aqueduct.

2.3. Risk Factors – Existing control system for the existing Wynnewood Aqueduct would not operate well with the new control system of the new Sulphur pipeline. The existing regulating reservoir storage capacity may prove to be inadequate for stable control.

2.4. Additional Considerations - Bladder style air chamber should be considered as an alternative to conventional air chambers. Bladder style air chambers do not require a dedicated compressor and a complicated control system to keep the air to water ratio within the prescribed limits.

3. Electrical Components

3.1. Details -

- A new 225 kVA 480 volts 3 Phase transformer would be required and be provided by OG&E.
- A new integrated MCC would be installed that would be rated for the pumps and station service loads. Unit is to contain motor controllers, panelboards, and transformers.
- New cable and conduit would be installed to provide power from the new MCC and panelboard to all station loads.
- A new 200 kW engine generator and support systems would be installed. Support systems would include: above ground fuel tank, spill containment area, double walled tank, double walled fuel piping, and weather protective housing.
- A new Automatic Transfer Switch would be installed that is capable of supplying the facility in normal (OG&E power available) and emergency conditions (engine generator). The new switch would be service entrance rated.
- New lighting would be provided for both the interior and exterior of the facility.
- New wiring devises such as 120 volt receptacles, switches, and a 480 volt power receptacle would be installed.

- A new grounding system would be installed and connected to the service equipment and electrical loads.
- A new fire detection and alarm system would be installed to notify local officials in the event of an issue at the facility.

3.2. Assumptions -

- Power availability at the existing regulating reservoir would be limited to 240 volts 50 amps, and thus would not be sufficient to power the new equipment at the new pumping plant. A minimum of 480 volts 200 amps would be required. OG&E would provide service required for the new facility.
- A backup source of power to maintain pumping capability would be required.

3.3. Risk Factors -

- Costs associated with extending OG&E may be excessive. Alternate sources may be needed.

3.4. Additional Considerations -

- Potential exists for supplementing power for this new facility by alternative energy sources. The viability of alternative energy sources is explored in the next section.
- The engine generator currently in use at the existing Wynnewood pumping plant may be suitable for this facility.

Sulphur Pipeline

1. Structural/Architectural Components

1.1. Details – The Sulphur portion of the new pipeline would connect the new Sulphur regulating reservoir pumping plant to the new terminal storage tank at the new Sulphur WTP. The new Sulphur pipeline consists of 6.3 miles of 14-in High Density Poly Ethylene pipe. The new pipeline would require air valves, blowoffs, county road crossings, and a stream crossing.

1.2. Assumptions -

- Pipeline was sized to meet a peak demand of 3.5 cfs. This represents a 1.25 peaking factor above the average flow of 2.75 cfs needed to deliver the full contracted amount of 1,997 acre-feet per year.
- Excavation for the new pipe would have vertical sides and a width equal to the inside diameter of the pipe plus two feet. The total volume of backfill equals the total volume of excavation.
- A USGS topographic map was correlated to local utility company subsurface exploration experience in the area and was generalized to three areas with the following rock percentages: 10 percent rock for alignments parallel to U.S. Hwy 7; 50 percent rock for alignments parallel to Chickasha Trail; and 80 percent rock for alignments in the Chickasaw NRA.
- County road crossings would be made by open cutting, compacting backfill about the pipe, and restoring the road surface. Highway road crossings would be made through borehole drilling. Stream crossings would be made by open cutting; the stream cross section would be restored as close as possible to its original section and protection would be provided as required.
- Blow-off structures would exist to drain the new pipe at all low points in the pipeline; air inlet/release valve structures with an isolating gate valve would exist at all high points in the pipeline.
- Easement costs would be $14,000 per mile. This was based on indexing actual costs for easements associated with the Wynnewood aqueduct and a generalized land price of $2,500 per acre.
- The pipeline terminal point is a new concrete storage structure, which would provide water to the new WTP.

1.3. Risk Factors -

- The amount of rock encountered during excavation for the new pipeline alignment might be greater than expected

Sulphur Water Treatment Plant

1. Structural/Architectural Components

1.1. Details – The new Sulphur WTP structure would be a steel frame building approximately 110 ft by 80 ft. The foundation for the new WTP building foundation would consist of a reinforced cast in place concrete slab, trenches, walls, stem walls, and footings to accommodate the superstructure frame, water treatment equipment, equipment access, piping, and other building services. The structure also would house the control room, offices, laboratory, restrooms, and equipment and chemical storage. The floor slab would be sized to support a 500 pounds per square ft live load.

The superstructure would consist of a welded steel rigid frame that has been sized to provide a full building width span. An efficient design of the steel frame for this width of the building may require the use of interior columns. If the water treatment equipment is arranged such that the use of interior columns would interfere with the equipment layout and a full open building area is required, the building frame may be designed to support the full width of the building roof. However, this would significantly increase the size of the structural steel members, resulting in an increase in costs. The eave height of the superstructure would be approximately 25 ft. The roof pitch would be approximately 1:12 and the total height of the rigid frame at the peak would be approximately 28 ft. The rigid frames would be spaced at 20 ft center to center. Platforms suspended from the center of the roof would provide area for HVAC equipment. A 10-ton bridge crane would be included with the crane girders and crane rails attached to the rigid frames.

The roof and exterior walls would be constructed with insulated steel wall panels and the interior walls would be constructed with cold formed light gage steel studs and joists with a gypsum board finish. 10 ft wide and 16 ft wide overhead doors would be provided for equipment access into and out of the building.

The service yard would have six inches of gravel surfacing (except where paved bituminous surfacing is provided, see below) and would be secured with a 7 ft high chain link fence and 20 ft wide, double swing gates. The service yard would include outdoor security lighting. The site would be sloped to allow surface water drainage flow away from the structures.

Other features included within the service yard area would be the regulating tank, backwash waste holding tank, clearwell, air chamber building, and space available for drying beds.

The new WTP and service yard would be sized to provide access into and around the structures to facilitate all the anticipated operation and maintenance requirements for this facility. In addition, employee and visitor parking would be provided outside of the main water treatment building. Also, the parking area and east building access area

would be paved with a suitable graded road base material and 3-in bituminous pavement.

A site plan with the WTP design is included in Appendix B.

1.2. Assumptions - No unique foundation improvements would be anticipated for this structure based on the data provided. However, the treatment plant foundation may be placed upon compacted free draining engineered fill material if required.

2. Mechanical/Hydraulic Components

2.1. Details - Terminal Storage Tank Pumping Plant - The new pumping plant would pump up to 3.5 cfs from a 200,000 gallon terminal reservoir (tank) at the new Sulphur WTP to the mixed media filtration tanks. A 14-in diameter tank outlet and pipeline would be required to feed a 14-in diameter suction manifold within the new WTP pumping station. The new pumps would be constant speed split case horizontal centrifugal pumps, each with a design flow rate of 1.75 cfs at 25 feet TDH. 7.5 horsepower motors would be required for each pump. Two pumps would be duty pumps and one would be installed standby. A new control system would be required to alternate starts between the three pumps and prevent more than two pumps from operating. With one pump off line, the two remaining pumps would produce the full design capacity of the pumping plant thereby meeting state requirements for redundant capacity. Each new suction pipe would contain an 8-in diameter isolation valve and a new dismantling coupling. Each new pump discharge pipe would contain an 8-in diameter isolation valve, dampened check valve, dismantling coupling, and pump control valve. The new control valve would be utilized for controlled pump starts and stops. A new 14-in diameter discharge manifold would connect the new pumping plant to the new filtration tanks. Hydraulic transients would not be a concern for this pumping plant with normal valve opening and closing times since the suction lines and discharge lines are hydraulically short.

2.2. Assumptions - TDH of pumps are based on assumed elevations of Sulphur Pipeline Terminal Tank and filtration tanks.

2.3. Risk Factors - Control systems of existing Wynnewood pumping plant, new Sulphur regulating reservoir pumping plant and new Sulphur WTP must be sufficiently coordinated to allow reliable operation.

2.4. Details –Clear Well Pumping Plant - The new pumping plant would pump from 1.0 to 3.5 cfs from the new WTP clear well to Sulphur's existing water distribution system. The new selected pumps would be variable speed vertical turbine pumps, each with a design flow rate of 1.75 cfs at 130 feet TDH. New 40 horsepower motors would be required for each pump. Two pumps would be duty pumps and one would be installed standby. A new control system would be required to alternate starts between the three pumps and prevent more than two pumps from operating. With one pump off line, the two remaining pumps would produce the full design capacity of the pumping plant thereby meeting state requirements for redundant capacity. Each new pump discharge pipe would contain an 8-in diameter isolation valve, dampened check valve, dismantling coupling, and pump control valve. The new control valve would be utilized for

controlled pump starts and stops. A new 14-in diameter discharge manifold would connect the pumping plant to the distribution system pipeline. Hydraulic transients would be mitigated by two air chambers located in a separate structure adjacent to the clear well. The air chamber sizes were assumed using engineering judgment. A hydraulic transient analysis using computer software to develop a model would be required to determine the actual size of the air chambers during the design phase of the project. The hydraulic transient model must include the City's distribution system and terminal boundaries such as an elevated storage tank.

2.5. A***ssumptions -*** Air chambers sizes shown on preliminary drawings are assumed.

2.6. Risk Factors - Control systems of existing Wynnewood pumping plant, new Sulphur regulating reservoir pumping plant and new Sulphur WTP must be sufficiently coordinated to allow reliable operation.

2.7. Additional Considerations - Bladder style air chamber should be considered as an alternative to conventional air chambers. Bladder style air chambers do not require a dedicated compressor and a complicated control system to keep the air to water ratio within the prescribed limits.

3. Electrical Components

3.1. Details -

- A new 500 kVA 480 volts 3 Phase transformer is to be provided by OG&E.
- A new integrated MCC would be installed. The unit would contain new variable frequency drive motor controllers for feed and clear well pumps as well as feeder breakers to supply other facility loads
- A new dry type transformer would be installed, and would be rated for 480-208/120 volts with sufficient capacity to power all 208/120 volt equipment.
- A new 208/120 volt 200 amp distribution panelboard would be installed.
- New cable would be installed to provide power to all station distribution equipment and loads.
- New conduit, cable tray, and wireway would be installed to provide flexible routing of power and instrumentation cable between electrical equipment, power and control systems.
- A new 500kW engine generator and support systems would be installed. Support systems would include: above ground fuel tank, spill containment area, double walled tank, double walled fuel piping, and weather protective housing.
- A new Automatic Transfer Switch capable of supplying the facility in normal (OG&E power available) and emergency conditions (engine generator) would be installed. The switch would be service-entrance rated.
- New lighting would be provided for both the interior and exterior of the new facility. Lighting control would be provided by a programmable control system to optimize power consumption.

- New wiring devises such as 120 volt receptacles, switches, and 480 volt power receptacles would be installed.
- A new grounding system would be installed and connected to the service equipment and electrical loads.
- A new fire detection and alarm system would be installed to notify local officials in the event of an issue at the facility.

3.2. Assumptions -

- OG&E would provide service required for the new facility.
- A backup source of power to maintain pumping capability would be required.
- Variable frequency drives would be utilized to provide flexibility to water delivery. The use of these drives can also improve power consumption through power factor management.

3.3. Risk Factors -

- The use of variable frequency drives for supply and delivery pumps may not be needed.

3.4. Additional Considerations -

- Potential exists for supplementing power for this facility by alternative energy sources. The viability of alternative energy sources is explored in the next section.

4. Water Treatment Components

4.1. Details - The treatment process would begin after the new Terminal Storage Tank when water is pumped to the new packaged treatment system consisting of a new adsorption clarifier and mixed media filter. Powdered activated carbon (PAC) would be added to the adsorption clarifier feed to reduce total organic carbon (TOC) and taste and odor components. PAC is useful during high TOC events such as spring runoff. The new adsorption clarifier unit would be designed to use alum and polymer to lower turbidity levels. The new mixed media filtration unit would be designed for the removal of organic and biological constituents. The filtered water would flow to the new clearwell where free chlorine would be introduced for contact time with water for biological inactivation and disinfection. Backwash Waste streams from the clarifier and mixed media filter would flow to the new Backwash Waste Tank. Settled solids would be pumped to the belt press for dewatering and disposal. Decanted water would be pumped to the new Terminal Storage Tank to mix with the incoming raw water for treatment. A treatment process schematic is shown in Figure 7. Appendix C contains the process flow diagram which shows flow rates and equipment sizing criteria.

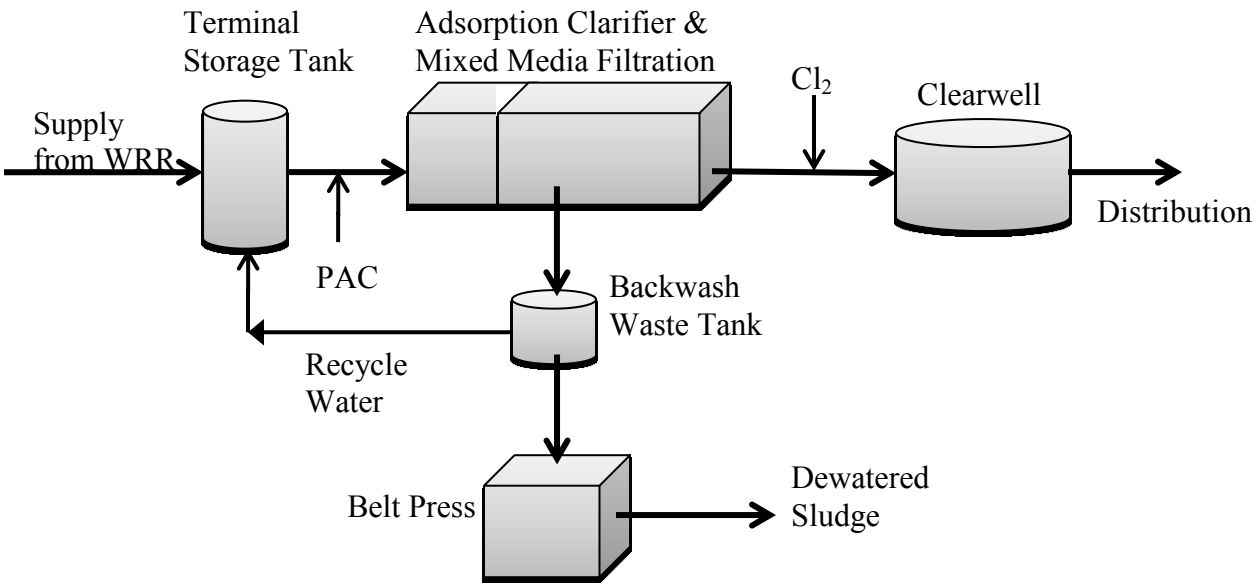


Figure 7. Water treatment process schematic.

The new Terminal Storage Tank would be used between the new regulating reservoir supply and the initial treatment unit. This tank would allow for a stable feed flow of 3.5cfs (2.26 mgd).

In cases of high TOC in the raw water, such as during spring runoff, it would be necessary to remove TOC to prevent the formation of DBPs. Removal of TOC can be accomplished with the addition of activated carbon, which can either be used in a powdered or granular form. Since there was limited TOC data provided in the water quality data, PAC is recommended for seasonal applications because it is less costly than granular activated carbon and there is no carbon regeneration stage. The PAC system lends itself to use as part of the treatment process only when necessary. The PAC system along with a bulk bag holder hoist is about 9 ft long by 6 ft wide and is comprised of the following: volumetric feeder; liquid mix tank; tank cover; mixer motor; shaft; feeder support stand; electrical control panel; and bulk bag holder hoist.

The new PAC would be fed through the volumetric feeder at precisely controlled rates into the liquid mix tank to create a slurry solution, which would then be injected into the main process flow before the feed enters the package treatment system.

The new adsorption clarifier and mixed media filtration packaged unit would treat the biological constituents and reduce turbidity in the water. The unit recommended would be an advanced packaged unit that reduces the footprint when compared to separate, customized water treatment processes. The unit would come with an adsorption clarifier which does not require formation of a settle-able flocculation. This would eliminate the need for tube settlers and would reduce the amount of coagulant and polymer chemicals used.

The water would pass from the adsorption clarifier to the mixed media filtration chamber, which is the second section of the packaged unit. The mixed media filter would use three or more granular materials of differing size and specific gravity layered to produce a filter that is coarse

near the top and becomes progressively finer toward the bottom. Figure 8 is a picture of a packaged adsorption clarifier and mixed media filtration unit from Siemens Water Technologies.

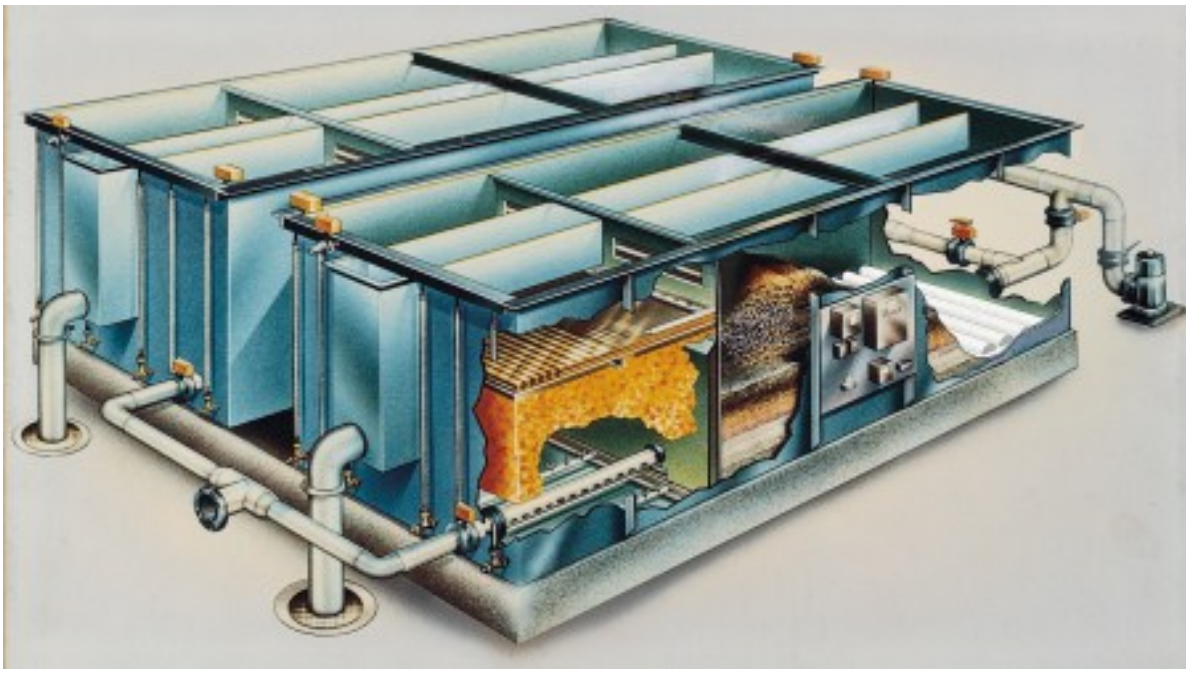


Figure 8. Siemens Trident® Package Treatment Unit.

One unit would be comprised of two chambers housed in one tank with dimensions of 27 ft long by 8 ft wide and treats a design flow of 700 gallons per minute (gpm). Three units would be needed to meet the peak demand of 1650 gpm. The packaged unit also comes with a controller that monitors filter effluent quality and continually evaluates and changes chemical feed to maintain the desired water quality parameters.

Disinfection is the process used to inactivate or destroy pathogenic microbes. Free chlorine would be applied to the water prior to the clearwell to allow for the required contact time for effective disinfection. Due to the potential of free chlorine to form DBPs, it is recommended that the raw water be sampled and tested for both total and dissolved organic carbon prior to the final selection of a disinfectant.

Backwash waste from the new package treatment system would flow by gravity to the new Backwash Waste Storage Tank located outside the building. Backwashed solids would settle in this tank while the clarified water would be pumped back to the new Terminal Storage Tank for reprocessing. The settled solids would be periodically pumped to the belt press system for dewatering and disposal.

A belt press is recommended to dewater the settled solids from the Backwash Waste Tank. The Siemens PressPack system is a complete skid mounted dewatering system which contains the following: progressive cavity feed pump; venturi style polymer/sludge mixer; flocculation tank; belt press; polymer system; air compressor; control panel; skid with integral drain pan; and interconnecting wiring and piping.

The settled solids from the new Backwash Waste Tank would be pumped to the belt press system and enter the mixing tank where polymers would be added to enable flocculation. After flocculation, the waste would flow to the belt press where the majority of the water would be removed by gravity. Once sludge enters the belt press, two belts gently squeeze and remove the remaining water before a series of rollers increases the pressure and completes the dewatering process. The removed water would then flow by gravity to the Backwash Waste Tank to be recycled to the Terminal Storage Tank for reprocessing.

Figure 9 shows a process flow schematic of the Siemens PressPack system. Figure 10 is a picture of the Siemens PressPack system.

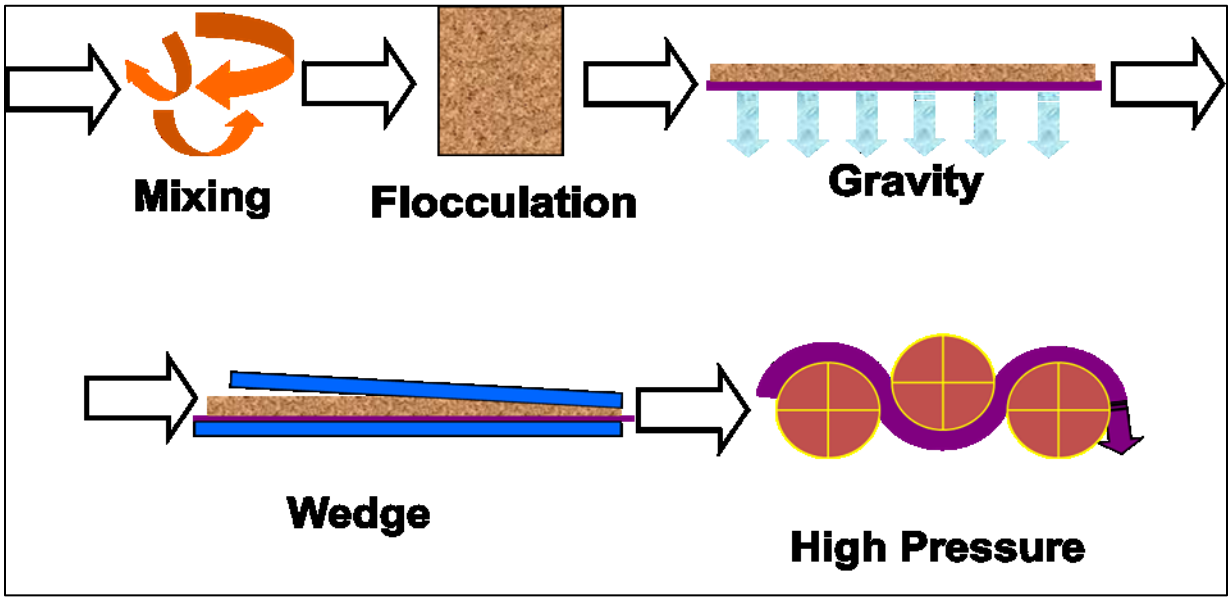


Figure 9. Process flow of Siemens PressPack dewatering system.

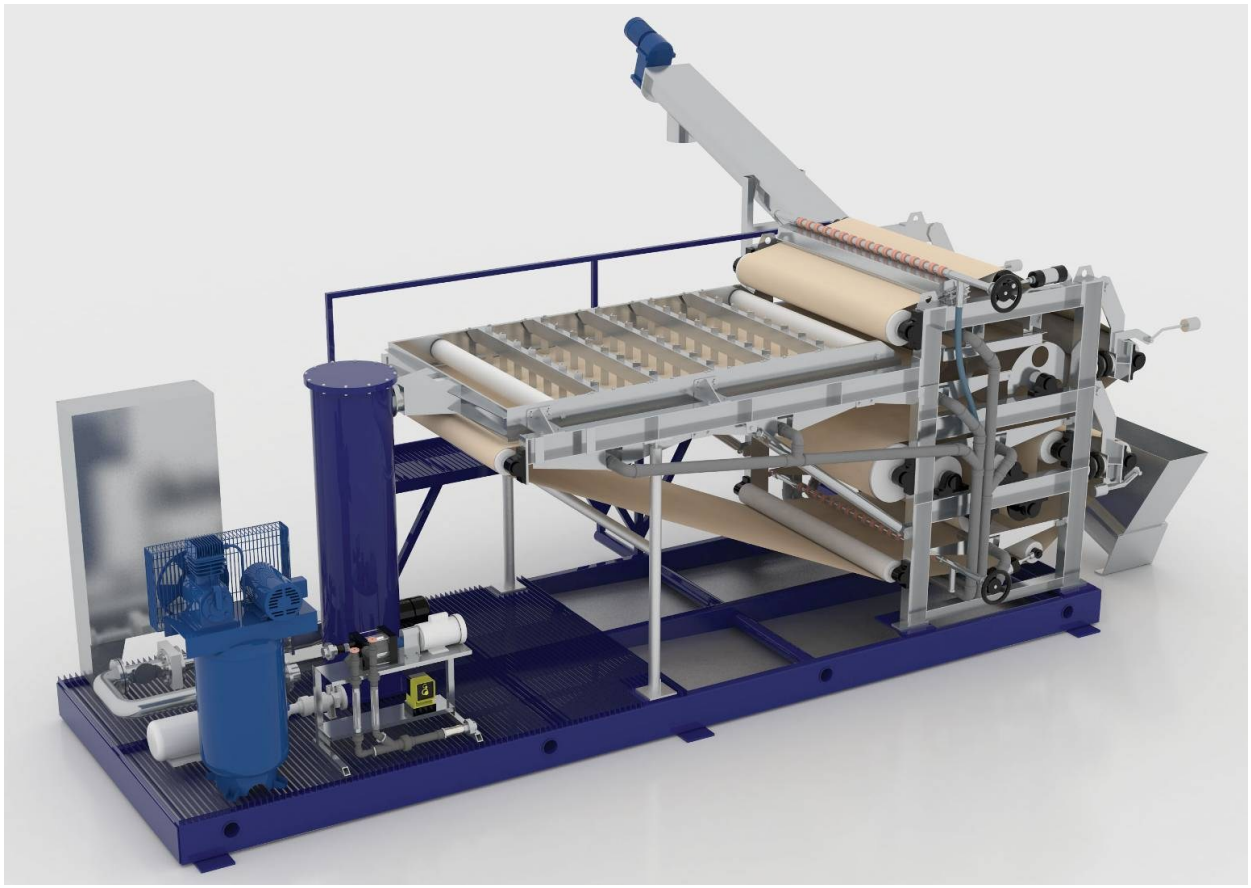


Figure 10. Siemens PressPack.

4.2. Assumptions - The treatment process was designed to treat a peak flow of 3.5 cfs delivered from the new Wynnewood Regulating Reservoir to the new Terminal Storage Tank.

4.3. Risk Factors - OSHA regulations require that explosion-proof controls must be in place when powdered activated carbon is used. If granular activated carbon is used, this regulation would not apply.

4.4. Additional Considerations - A peak flow of 3.5 cfs was used for the design of the new WTP. The manufacturers mentioned in this section were used in the appraisal investigation for the design of the WTP and to determine capital and operation and maintenance costs. Reclamation does not endorse or claim preference toward the specific manufacturers listed in this report. Furthermore, in later stages of design (i.e. Feasibility or Final Design), Sulphur should refine the treatment process equipment recommendations.

Sulphur Water Main

1. Structural/Architectural Components

1.1. Details – Minor modifications would be required to connect the Sulphur WTP to the existing Sulphur water main.

1.2. Assumptions – It should be noted that for cost estimation purposes, minor modifications are considered a design contingency.

Murray County RWD No. 1 Pumping Plant

1. Structural/Architectural Components

1.1. Details – From the new WTP, a new pumping plant would be installed to pump the treated water through the existing Sulphur 16-in water main to the City's existing WTP on the east side of the city.

1.2. Assumptions –

- The new pumping plant would consist of two new horizontal split case pumps (one primary; one standby) with a service capacity of 2.0 cfs each. This represents a 1.25 peaking factor above the average flow of 1.6 cfs needed to deliver the 2060 water demand for Murray Co. RWD No. 1, Dougherty, and Buckhorn RWD of 1,220 acre-feet per year. This volume includes the existing RWD temporary permit volume of 76 acre-feet per year which would remain in place.
- The existing electrical configuration would provide sufficient power for the pumps and auxiliary plant equipment. Potential exists for supplementing power for this facility by alternative energy sources. The viability of alternative energy sources is explored in the next section.
- A new backup source of power to maintain pumping capability would be required.

Murray County RWD No. 1 Pipeline

1. Structural/Architectural Components

1.1. Details – From the existing Sulphur WTP, a new 10-in HPDE pipeline would be constructed to convey water approximately 2.3 miles to the existing Standpipe for RWD No. 1.

1.2. Assumptions –

- The new pipeline alignment would fall within existing rights-of-way. The pipeline alignment from the existing Sulphur WTP to the existing RWD No. 1 standpipe parallels a major roadway and is in relatively flatter terrain with less rock.

- New facilities would be constructed in primarily disturbed habitat and along existing rights-of-way.

Murray County RWD No. 1 Standpipe

1. Structural/Architectural Components

1.1. Details – Minor modifications would be required to connect the new pipeline to the existing standpipe.

1.2. Assumptions – It should be noted that for cost estimation purposes, minor modifications are considered a design contingency.

RENEWABLE ENERGY OPPORTUNITIES

Reclamation's Rural Water Directives and Standards (D&S) require consideration of measures to either use or produce renewable energy as part of alternatives deemed viable for further analysis. Wind, solar, and geothermal sources were briefly investigated. Oklahoma Gas and Electric Company (OG&E), a major commercial electricity provider in the area, was also investigated as a potential provider of clean energy applications. Three major components of the project as previously described could potentially utilize or supplement power by alternative energy sources:

- Sulphur Regulating Reservoir Pumping Plant;
- Sulphur Water Treatment Plant; and
- Murray County RWD No. 1 Pumping Plant.

Wind, solar, and geothermal energy were all found to be applicable for the three components as described below.

Wind Resources

The U.S. Department of Energy (DOE) published a guide for seeking wind energy in the state of Oklahoma titled Small Wind Electric Systems. This guide provides consumers with information to help them determine viability of wind energy. Figure 11 illustrates that the investigation area in Murray County (black circle) would not be ideal for wind energy due to its proximity to the Arbuckle Mountains.

The OG&E currently operates electric transmission and distribution systems which generate about 6,800 megawatts of electricity from natural gas, coal, and wind. In 2003, OG&E became the first electric utility in Oklahoma to offer wind power as a choice for its retail customers. OG&E generated 10 percent of their power supply through wind. The OG&E currently operates seven wind farms with 780 megawatts of capacity. Through OG&E's renewable energy program, the option to purchase wind power for 25, 50 or 100 percent of usage is available with no new equipment required. A 16,000 kWh monthly wind energy cap currently exists for municipal pumping customers; therefore, this could supplement only a portion of the energy

consumption needed for any of the three components (Table 3). Table 3 also provides the uncapped additional costs associated with the estimated power needed per each component.

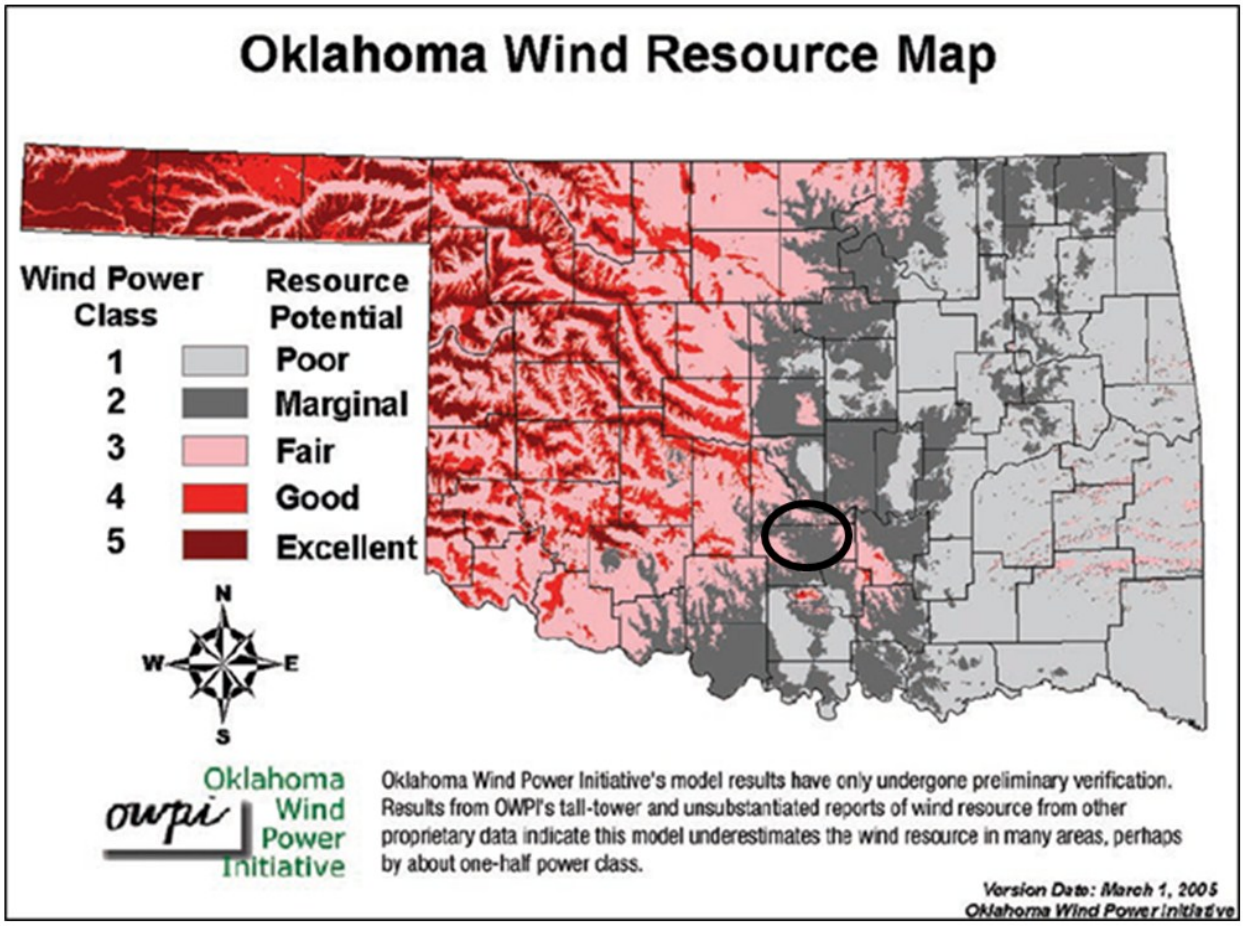


Figure 11. Oklahoma Wind Resources as prepared by USDE.

Table 3. Wind energy potential and associated additional costs.

Component:	Maximum percent of energy provided by wind[1]	Additional costs per month of wind energy for capped power consumption [2]	Additional costs per month of wind energy for uncapped power consumption [3]
Sulphur Regulating Reservoir Pumping Plant	48	$620	$1,300
Sulphur Water Treatment Plant	56	$620	$1,100
Murray County RWD No. 1 Pumping Plant	100	$280	$280

[1] Assumes a 16,000 kWh cap for each component.
[2] Cost based on OG&E's wind selection charge of $0.039 per kWh with a maximum supply of 16,000 kWh (OG&E 2012).
[3] Cost based on OG&E's wind selection charge of $0.039 per kWh assuming no cap on wind energy consumption (OG&E 2012).

Solar Resources

Solar cells, also called photovoltaic cells, convert sunlight directly into electricity. The DOE recommends about 100 ft^2 of unshaded south-facing roof or yard space for every kilowatt of electricity produced for maximum performance (DOE, 2009). Based on square footage estimates assumed at the new water treatment plant, outputs range from 10 to 300 Watts; this limited range of output may supplement a portion of the energy needs of various project components and therefore should be explored further in a more detailed investigation.

Geothermal Resources

Geothermal energy is energy generated and stored in the earth. Using geothermal heat pumps, energy can be tapped to heat and cool buildings, such as the proposed new Sulphur WTP. Geothermal heat pumps are more efficient than conventional heat pumps or HVAC that use the outdoor air because the ground or groundwater located a few feet below the earth's surface remains relatively constant throughout the year (U.S. Energy Information Administration, 2012). Geothermal heat pumps are generally more expensive to install than outside air heat pumps; however, depending on the location of geothermal heat pumps, energy consumption and emissions can be much less relative to high-efficiency outside air heat pumps. Overall, it could be a renewable alternative to providing HVAC in the WTP and could be investigated further in a more detailed investigation.

PROPOSED ALTERNATIVE PROJECT COST ESTIMATES

Construction Costs

Cost Summary

Table 4 below provides a summary of project cost estimates. Cost information, sources, and assumptions are provided below. Detailed quantity estimates for each project feature and totals are provided in Appendix D.

Table 4. Summary of appraisal-level cost estimates for the Sulphur Pipeline Regional Rural Water Supply Project. Costs are provided for conveying water from Lake of the Arbuckles to Sulphur (i.e., "Lake to Sulphur) and from Sulphur to Murray County Rural Water District No. 1 (i.e., "Regional Connection").

Components	Infrastructure Totals		
	Lake to Sulphur	Regional Connection	Total
Wynnewood Pumping Plant	$1,050,000	$ -	$1,050,000
Wynnewood Pumping Plant and Pipeline (Proportionate Share)	$480,000	$ -	$480,000
Regulating Reservoir Outlet Structure and Pumping Station	$1,100,000	$ -	$1,100,000
Pipeline (pipe, earthwork, and structures)	$1,900,000	$430,000	$2,330,000
Sulphur Water Treatment Plant	$5,800,000	$ -	$5,800,000
Murray County RWD No. 1Pumping Plant	$ -	$530,000	$530,000
Land Cost	$70,000	$30,000	$100,000
Subtotal	*$10,400,000*	*$990,000*	*$11,390,000*
Contract Costs[1]	$2,700,000	$260,000	$2,960,000
Construction Contingencies	$3,300,000	$310,000	$3,610,000
Non-Contract Costs[2]	$2,500,000	$240,000	$2,740,000
Total Construction Cost	**$18,900,000**	**$1,800,000**	**$20,700,000**
Annual O&M Cost	**$410,000**	**$16,000**	**$426,000**
Lifecycle O&M Cost	$20,500,000	$800,000	$21,300,000
Annualized Construction Cost per 1000 gallons	$1.30	$0.20	$1.50
Annual O&M Cost per 1000 gallons	$0.63	$0.04	$0.67
Annualized Life-Cycle Cost per 1000 gallons	$1.93	$0.24	$2.17

[1] Contract costs includes: Mobilization, Design Contingencies, and Allowance for Procurement Strategies
[2] Non Contract costs includes: Feasibility Study, Environmental Compliance, Engineering Designs, and Construction Management

Origin and Source of the Cost Estimates

Reclamation has established requirements and procedures for developing cost estimates. These are set forth in D&S Project Planning and Facility Operations, Maintenance, and Rehabilitation (FAC) 09-01, *Cost Estimating* and D&S FAC 09-02, *Construction Cost Estimates and Project Cost Estimates*, and FAC 09-03, *Representation and Referencing of Cost Estimates*.

Preparers and Reviewers

Cost estimates for the replacement pumps, intake/pump station, and WTP/booster pump station were prepared and reviewed by Reclamation's Technical Service Center Estimating Group (86-68170) in Denver, Colorado. Cost estimates for structural and mechanical components were prepared by Ian Bailey, Civil Engineer; checked by Ngoc Dam; and peer reviewed by Thomas Hanke, Civil Engineer. Cost estimates for electrical components were prepared by Ngoc Dam, Electrical Engineer (86-68430); checked by Ian Bailey, and peer reviewed by Loran Zlomke, Electrical Engineer (86-68170).

Cost estimates for the conveyance pipeline and appurtenances were prepared by Matt Warren, Supervisory Civil Engineer, checked by Anna Hoag, Civil Engineer, and reviewed by James Allard, Deputy Area Manager, all from Reclamation's Oklahoma-Texas Area Office.

The names of preparers and reviewers for all cost estimates, as well as associated quanitites, can be found within the quantity worksheets provided in Table 5 and Appendix D.

Table 5. Summary of the project cost estimators

Components	Quantities			Prices		
	Prepared	Checked	Reviewed	Prepared	Checked	Reviewed
Wynnewood Pumping Plant						
Structural	B. K. Goplen[1]	B. D. Van Otterloo[1]	B. D. Van Otterloo	Ian Bailey[2]	Ngoc Dam[2]	T. Hanke[2]
	Jerry R. Waugh[4]	Toby Turnage[4]	Toby Turnage	Ian Bailey	Ngoc Dam	T. Hanke
Electrical	D. Liscomb[5]	M. Schuh[5]	M. Schuh	Ngoc Dam	Ian Bailey	L. Zlomke[2]
Regulating Reservoir Outlet Structure and Pump Station						
Structural	B. K. Goplen	B. D. Van Otterloo	B. D. Van Otterloo	Ian Bailey	Ngoc Dam	T. Hanke
	B. D. Van Otterloo	B. K. Goplen	B. K. Goplen	Ian Bailey	Ngoc Dam	T. Hanke
Mechanical	Jerry R. Waugh	Toby Turnage	Toby Turnage	Ian Bailey	Ngoc Dam	T. Hanke
Electrical	D. Liscomb	M. Schuh	M. Schuh	Ngoc Dam	Ian Bailey	L. Zlomke
Water Treatment Plant						
Structural	B. D. Van Otterloo	B. K. Goplen	B. K. Goplen	Ian Bailey	Ngoc Dam	T. Hanke
Mechanical	Jerry R. Waugh	Toby Turnage	Toby Turnage	Ian Bailey	Ngoc Dam	T. Hanke
Electrical	D. Liscomb	M. Schuh	M. Schuh	Ngoc Dam	Ian Bailey	L. Zlomke
Treatment	John L. Walp[3]	R. A. Jurenka[1]	R. A. Jurenka	Ian Bailey	Ngoc Dam	T. Hanke
Pipeline						
Structural	M. Warren[7]	A. Hoag[8]	J. Allard[6]	M. Warren	A. Hoag	J. Allard

[1] TSC-86-68120 Plant Structures Group
[2] TSC-86-68170 Estimating, Specificiations, and Construction Management Group
[3] TSC-86-68410 Mechanical Equipment Group
[4] TSC-86-68420 Hydraulic Equipment Group
[5] TSC-86-68430 Electrical Design Group
[6] OTAO-6H-10000 Deputy Area Manager
[7] OTAO-6H-40000 Facility Operations Group
[8] OTAO-6H-50000 Planning and Environmental Group

Purpose and Intended Use of the Cost Estimates

The cost estimates are considered "appraisal-level", as defined by D&S FAC 09-01, which states: "appraisal cost estimates are used in appraisal reports to determine whether more detailed investigations of a potential project are justified. These estimates may be prepared from cost graphs, simple sketches, or rough general designs which use the available site-specific design data". Appraisal-level costs estimates are developed at an early stage of project development and are therefore not suitable for requesting project authorization or construction fund appropriations from Congress. Table 6 below identifies the project development timeline and level of cost estimates produced.

Table 6. Types of cost estimates produced for each project planning stage (D&S FAC 09-01).

PROJECT STATUS	PROJECT STAGE	LEVEL OF COST ESTIMATE PRODUCED
Planning	Planning	Preliminary
		Appraisal
		Feasibility
Construction	Design	Percent Design [Updated feasibility]
		Prevalidation of Funds
	Solicitation	Independent Government Cost Estimate [Award]
	Construction	Independent Government Cost Estimate for Contract Modifications
Operation and Maintenance	Operations	One or more of the previously identified estimates

Basis of Cost Estimate

The unit prices are based on historical, bid, and industry reference costing data. Due to the effect of current material pricing, manufacturer quotes were obtained on the following significant cost drivers: Sludge Belt press Dewatering System; Packaged Water Treatment System; and Hydraulic Transient Mitigation System – bladder style air chamber. Assumptions and uncertainties described in the design narratives above and are included in the special allowances section below.

Price Level

All costs are in July 2012 dollars.

Basic Scope and Special Allowances

The cost estimates are divided into the following key elements:

Field Costs: capital costs of project features from award to construction closeout. The field cost is broken down into the contract costs and construction contingencies.

- Contract Costs: estimated cost of the contract at the time of bid or award.
    - Mobilization: A value of 5 +/- percent was utilized for mobilization. This includes costs of contractor bonds, and mobilizing contractor personnel and equipment to the project site during initial project start-up. The assumed 5 +/- percent value in the cost estimate is based upon past experience of similar projects.
    - Design Contingency: A value of 15 +/- percent was utilized for (i) unlisted items, (ii) design and scope changes; and (iii) cost estimating refinements.
    - Allowance for Procurement Strategies: A value of 5 +/- percent was utilized for procurement strategies to account for potential additional costs when the solicitation is advertised and awarded under other than full and open bid competition. These include solicitations that will be set aside under socio-economic programs, along with solicitations that may limit competition or allow award to other than the lowest bid or proposal. This estimate assumes a Request for Proposals from qualified contractors

with selection based on a combination of Project approach, contractor experience and the proposed price.

- Construction Contingency: A value of 25 +/- percent was utilized for construction contingencies based upon the completeness and reliability of: the engineering design data, geological information, projected quantities, and the general knowledge of the conditions at the site. It covers minor differences in actual and estimated quantities, unforeseeable difficulties at the site, changed site conditions, possible minor changes in plans, and other uncertainties.

Non-Contract Costs: A value of 15 +/- percent was utilized for work or services provided in support of the project that are broad or non-specific in nature or otherwise attributed to the project as a whole. These include:

- Feasibility Study: A value of 6 +/- percent was utilized for undertaking a feasibility study and associated investigations and surveys. This estimate was developed based on costs of other studies of similar scope.
- Environmental Compliance: A value of 1 +/- percent was utilized for environmental compliance documentation and mitigation pursuant to the National Environmental Policy Act (NEPA).
- Designs and Specifications: A value of 4 +/- percent was utilized for the preparation and review of final designs, construction drawings, specifications, construction cost estimates, etc.
- Service Facilities and Other Costs: A value of 2 +/- percent was used for items in support of construction including camps, roads, trails, utility systems, transportation equipment, etc. It also includes other costs associated with office salaries, supplies and expenses, general transportation expenses, security, environmental oversight, legal services, etc.
- Construction Management: A value of 2 +/- percent was utilized for construction management, including engineering administration, management, coordination, and control of construction.

Escalations

There are two distinct periods of time that must be considered with escalation: (1) the time from when the estimate is prepared until notice to proceed; and (2) the duration of the construction contract. An allowance for escalation from the July 2012 price level to the Notice to Proceed milestone was not included in the estimate, nor was an escalation amount estimated for the duration of construction. For projects which are to be developed over an extended period of time, or at some distant time in the future, it is prudent that some consideration of the time value of money be incorporated.

Operations and Maintenance Costs

The O&M of basic features such as the pumping plant, pipeline, and terminal storage facility were derived, in part, from actual O&M of the existing Wynnewood Aqueduct by the Arbuckle Master Conservancy District over the past three years. Actual O&M costs would vary depending on negotiated rates and quality of constructed features. The following assumptions were made:

- An annual O&M proportionate share for the existing Wynnewood pumping plant was estimated to be $50,000.
- An annual O&M proportionate share for the existing Wynnewood Aqueduct was estimated to be $50,000.
- Annual O&M costs for the new Sulphur and RWD pipelines were estimated to be $2,600 per mile.
- Annual O&M costs for the new terminal storage facility were estimated to be $10,000.

Annual O&M costs for the new Sulphur regulating reservoir pumping plant and the new RWD pumping plant were based on cost curves documented in the *Desalting Handbook for Planners, 3rd Edition*. The cost curves recommend a percent per year of the total capital costs for spare parts and repairs.

- Annual O&M costs for the new Sulphur regulating reservoir pumping plant were estimated to be $10,940.
- Annual O&M costs for the new RWD pumping plant were estimated to be $5,290 per mile.

Annual O&M costs for the new WTP were estimated from a cost curve showing annual O&M cost versus plant capacity for conventional WTPs (Kawamura, 2000). The O&M cost is based on the projected average annual flow of 2.8 cfs (1.8 mgd) through the treatment plant. The cost obtained from the cost curve was then indexed to an August 2012 value by using the *Engineering News-Record* Construction Cost Index, resulting in an estimated annual O&M cost of approximately $211,500. This cost includes labor, chemicals, power, maintenance and repair, and miscellaneous supplies and services.

Annual power costs associated with pumping were estimated by first calculating the energy required to lift the annual quantity of water supplied by the new WTP over the assumed design head for each pumping facility. Pump and motor efficiencies were then applied to this energy requirement based on the equipment selected in the appraisal level design. A power cost of $0.0511 per kilowatt-hour was used based on the average year to date power cost for the industrial sector in Oklahoma (USEIA, 2012). These calculations resulted in an estimated annual power cost of approximately $62,600 for the Wynnewood pumping plant, the Sulphur regulating reservoir pumping plant, and the clearwell pumping plant and $4,460 for the RWD pumping plant.

Assumptions

The cost curve used to estimate the annual WTP O&M cost was developed assuming a “basic, conventional WTP processing raw water of fairly good quality with no significant buildup of

scale in the pumping facilities". These assumptions seem reasonable given the water quality data available for this appraisal investigation.

The power costs associated with pumping from the Wynnewood pumping plant only account for the incremental water flow associated with new water deliveries to Sulphur and Murray County RWD No. 1 (1,997 acre-feet per year). Separate energy estimates were not prepared for the WTP, as power is included in the treatment plant cost estimate detailed above. For the pumping plants, estimates were developed only for power costs associated with pumping and do not include power requirements for items such as lighting, controls, etc.

Separate repair and spare parts estimates were not prepared for the WTP and clearwell pumping plant, as these items are included in the treatment plant cost estimate detailed above.

It was assumed that upgrading the pumps at the existing Wynnewood pumping plant would not require a staffing increase at that facility. The reregulating pumping plant is designed as an unmanned facility, and it was assumed that any labor requirements would be performed by the operators at the WTP.

Risk Factors

- The cost curve used to estimate the annual WTP O&M cost does not account for local factors such as environmental considerations, labor rates, regulations, etc.
- Power costs are estimated using the average power cost in Oklahoma for industrial customers. Local power costs could vary from the state average.

Additional Considerations

- Future studies can further refine the WTP O&M cost estimates by incorporating the local factors described above. Special attention should be paid to the local labor rate, as labor costs mostly likely be the largest component of the WTP O&M costs. Input from water treatment equipment vendors can also be used to further refine the water treatment O&M cost estimate.
- Annual power cost estimates can be further refined once alignment and profiles are finalized for the new pipeline segments associated with this project.
- Coordination with the current operators of the Wynnewood pumping plant could help to refine the cost estimate for the incremental repair and spare parts cost associated with upgrading the existing pumps.

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CHAPTER IV
ECONOMICS AND BENEFITS ANALYSIS

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ECONOMICS AND BENEFITS ANALYSIS

Introduction

43 CFR §404.44 requires appraisal investigations to evaluate the cost-effectiveness of the Project and the extent to which the project could yield net economic benefits. The Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies (P&Gs) provide general standards for estimating municipal and industrial (M&I) water supply benefits (U.S. Water Resources Council, 1983). However, the P&Gs do not provide a discussion of the specific methodologies that can be used to estimate M&I water supply benefits. M&I water supply benefits can be measured using a variety of approaches that differ in complexity, accuracy, and data requirements. Benefit estimation approaches include:

1. Stated preference approach – Based on the use of survey techniques to directly estimate benefits based on the willingness to pay for an improved water supply as stated by water users.
2. Revealed preference approach - Based on actual observed behavior in market situations. The basic idea is that markets reveal the preferences of an individual through prices paid for and quantities purchased of a good or service. Market prices can be used to estimate willingness to pay functions from which benefits can be estimated.
3. Use of price elasticity estimates – Estimates of the price elasticity of demand for water supplies can be combined with current quantities and prices in the market to estimate a municipal water demand relationship. This demand relationship can then be used to estimate benefits.
4. Benefits transfer approach – Use of results from previously completed studies to estimate benefits, including willingness to pay, at the study site under consideration.
5. Cost of No Action (i.e., future without the project) – Using the resource cost of the water supply alternative that would be implemented in the absence of the project under consideration as an estimate of benefits. This approach is an approximation of water supply benefits only when the level of service provided is equivalent for each alternative.

The latter two methods, No. 4 and 5 were used to quantify benefits associated with the Projects.

Cost of No Action (Future Without the Project)

When evaluating the proposed alternative, it is important to identify costs that would be expended to meet water supply needs if the proposed alternative was not implemented. This avoided cost can be considered as a benefit of the alternative because it is a resource cost saved that would be available for use elsewhere (a reduced opportunity cost). In the absence of the proposed alternative, some type of water conservation/restriction measures would be required as well as acquisition of additional groundwater water rights. Preliminary investigations indicate that water conservation alone would not bridge the full 1,439 acre-foot gap between supply and demand that is projected by the year 2060 in the service area. Even with water conservation, a deficit of 847 acre-feet per year would result in 2060.

The acquisition of additional groundwater rights may be affected by numerous factors, and a detailed assessment is beyond the scope of this investigation. For the purposes of this appraisal

level analysis, it was assumed that acquisition of groundwater rights would be obtained either directly through purchase/leasing of water rights or indirectly through purchasing/leasing land. It is assumed that the water pumped from the aquifer is equal to a factor of 0.2 acre-feet per acre per year. Due to uncertainties regarding the spatial distribution of future groundwater development, this investigation also assumes that lands which are purchased/leased for groundwater rights could be "dedicated" but not developed, meaning that existing infrastructure (i.e., well fields, pumps, pipes, etc.) located elsewhere could be used to develop groundwater in areas where infrastructure currently exists rather than building new infrastructure[25]. Direct purchase of water rights was assumed to cost $300 per acre[26]. Regarding purchasing/leasing lands, the Oklahoma State University Agricultural Economics Extension (2012) website provides estimates of Oklahoma agricultural land values by county which can be used as a proxy for the value of land that would need to be purchased for groundwater. The three-year 2009 to 2011 weighted average agricultural land value for Murray County Oklahoma was $1,620 per acre and the average value of agricultural land in 2011 was $1,504 per acre. According to the Oklahoma State University Agricultural Economics Extension, pastureland values were consistently lower than cropland values up to 1999, but from 2000 to 2011 Oklahoma pastureland values exceeded cropland values. Not all of the land purchased for obtaining groundwater for future needs would be agricultural land. For the purposes of this analysis, the higher value of $1,620 per acre was used. It is important to note that this value is preliminary; the cost of obtaining the land necessary to meet future water needs cannot be estimated precisely due to variation in land values over time and limited land purchase information available at this time.

The amount of land needed to secure 1,439 acre-feet per year of water rights in 2060 was estimated to be 7,195 acres, and the amount of land needed to secure 847 acre-feet per year of water rights in 2060 was estimated to be 4,235 acres. As presented in Table 7, the present land value was calculated using a planning rate of 3.75 percent under the assumption that Sulphur and Murray County RWD No. 1 would purchase enough land to meet their projected deficits that may occur each decade, as denoted in Chapter I, Table 1. For example, in 2013 Murray County RWD No. 1 would need to purchase 4,038 acres of land to meet the projected 2020 water deficit of 808 acre-feet.

[25] It is not known at this time how the taking and use of groundwater will be addressed in the permitting process.
[26] An entity in southeastern Oklahoma is known to have recently purchased Arbuckle-Simpson groundwater rights for $300 per acre. Details of this contract are not known at this time.

Table 7. Present value of avoided land acquisition and water right costs under the No Action (Future Without the Project) Alternative.

	2060 Supply Deficit		2060 Acres Needed[1]		Water Rights Purchase Present Value ($300/acre)		Land Acquistion Present Value ($1620/acre)	
	Low[2]	High[3]	Low	High	Low	High	Low	High
Sulphur	-	295	-	1,477	N/A[4]	$165,000	N/A	$900,000
Murray County RWD No. 1[5]	1,009	1,144	5,045	5,718	$1,250,000	$1,400,000	$6,900,000	$7,400,000
Total	847	1,439	4,235	7,195	$1,100,000[6]	$1,600,000	$6,000,000[4]	$8,500,000

[1] Based on amount of land needed assuming a 0.2 acre-feet per acre equal proportionate share
[2] Assumes future with conservation measures, as well as the lowest estimated cost per water right.
[3] Assumes future without conservation measures, as well as the highest estimated cost per water right.
[4] With water conservation measures in place, a water surplus of 162 acre-feet per year in 2060 is expected for the City of Sulphur, so project benefits associated with acquisition of land for water rights are not applicable.
[5] Murray County RWD No. 1 includes Buckhorn and Dougherty.
[6] Sulphur's expected 2060 water supply surplus with conservation would decrease the overall project benefits associated with acquisition of land for water rights when combined with Murray County RWD No. 1.

Willingness to Pay – Benefits Transfer Approach

Section VII, part 1.7.2 of the P&G's indicate that the general measurement standard for valuing goods and services is the willingness of users to pay for each increment of output from a plan. Willingness to pay can be defined as the dollar amount that an individual or firm is willing to give up or pay to acquire a good or service. This measurement standard is applied to all water related resources, including M&I water supplies.

The benefits transfer approach was used in this analysis to estimate the water supply improvement benefits for the Sulphur Pipeline Rural Water Supply Project proposed alternative. This approach was chosen because existing, secondary data are generally only required for an appraisal-level investigation. Application of the benefit transfer method assumes that the relationship between a resource improvement and economic value in one area can be estimated and applied to another geographic area or resource. The accuracy of benefits transfer based estimates is dependent on the similarity of the site where the original detailed analysis was completed and the site of interest where the transferred benefits are applied. Similarity can be defined in terms of economic conditions, population characteristics, resources within an area, or other characteristics.

The source of information used to estimate the domestic water supply benefits of the Sulphur Pipeline Regional Rural Water Supply Project is a previously completed study of the benefits associated with the a proposed northwest Oklahoma Water Supply Project (Piper and Martin, 1997). The northwest Oklahoma study is based on the results from a 1992 survey of northwest Oklahoma households conducted by the OWRB. The survey was mailed to 1,000 households with 486 responses. The survey asked for the willingness of households to pay for a water supply system that would reduce groundwater overdraft in the region. Recognizing that differences certainly exist between northwest and south-central Oklahoma (our current investigation area), the survey represents the best available known data for this approach, so the

project concept generally could be used to represent the groundwater overdraft situation in the Sulphur area. The exact wording of the willingness to pay question for the northwest Oklahoma study is shown on the next page.

Question asked in the Northwest Oklahoma rural water survey

Most of the water used for domestic purposes in northwest Oklahoma comes from underground sources (aquifers). The quality of these aquifers varies, with water treatment necessary in certain areas. In addition, these aquifers are being overdrawn in some areas due to heavy use. Concerns have therefore arisen as to whether these aquifers can meet northwest Oklahoma's future water supply needs.

Water planners believe domestic water supplies must be provided by dependable sources. They suggest consideration of a water supply system for the counties of Beaver, Cimarron, Dewey, Ellis Harper, Texas, Woods, and Woodward. Such a system could involve underground and surface water sources with the following options being reviewed: well systems, water transfer from other regions, pipelines for local water transfer, and improved water treatment.

The Oklahoma Water Resources Board is interested in determining the value of regional water users would place on a water system as measured by willingness to pay. Assume that an overall unwillingness to pay will result in the system not being constructed. Without the system, water will continue to be provided primarily by underground sources, possibly creating further declines in both quality and quantity in certain areas.

Given this scenario, would you be willing to pay an additional $___ for this system on a monthly basis through increases in your water bill? Your individual responses will not be reported, nor do they infer a monetary obligation on your part. Your responses will be used to develop an overall indicator of willingness to pay.

1 YES
2 NO

To better define your willingness to pay, what is the maximum amount you would be willing to pay for this system on a monthly basis? _____ / month. This amount is a total willingness to pay, not an amount added to your existing cost.
$___ Additional Dollars Each Month

The average willingness to pay from the northwest Oklahoma survey ranged from $3.89 to $5.29 per household per month. The Piper and Martin study (1997) estimated a model of willingness to pay based on the northwest Oklahoma data. The modeling resulted in estimated willingness to pay ranging from $7.68 to $11.37 per household per month. It is important to point out that this range represents the measure of the benefit of water, and are representative of the benefit above and beyond the actual amount currently being paid for water.

The survey approach used to estimate northwest Oklahoma water supply benefits represents a stated preference valuation approach. It is important to point out that an accurate measurement of benefits using this approach is contingent upon the survey respondent understanding the proposed improvement and their ability to place a value on the improvement described in the survey. For example, the benefits to water users of converting from groundwater to surface water supplies could be estimated by asking users their willingness to pay for a surface water project. However, water users must understand how the conversion to surface water would

affect water quality and reliability and the water users must be able place a monetary value on the change in terms of what water users are willing to give up (opportunity cost) to get the water supply change. Furthermore, survey respondents must be familiar with proposed change in related resources. Survey respondents in the Sulphur area, for instance, must have some understanding of environmental and recreational benefits associated with a water supply change. Overall, stated preference based estimates are likely to provide representative benefit estimates for municipal and industrial water supply improvements compared to some other resource types because of the familiarity of water users with water supply problems and the familiarity with potential solutions to these problems such as pipelines and water treatment facilities.

For the purposes of this appraisal-level analysis, the range of willingness to pay for the northwest Oklahoma study (i.e., $7.68 to 11.37 per household per month) was used to estimate the domestic water supply benefits of the Sulphur Pipeline Regional Rural Water Supply Project. The willingness to pay estimates were converted from 1992 dollars to 2nd quarter 2012 dollars using Bureau of Economic Analysis price indices for personal consumption expenditures, housing and utilities. Willingness to pay in 2012 dollars was estimated to range from $13.14 per month ($157.68 per year) to $19.45 per month ($233.44 per year). For the purposes of this analysis, annual benefits per household were estimated to range from $158 to $233 annually. Because the Sulphur area will be subject to pumping restrictions in the future to avoid a fairly drastic result of continued groundwater drawdown, the high end of the range of benefits may be the most appropriate level of benefit. Again, it is important to point out that these values represent the measure of the benefit of water, and are representative of the benefit *above and beyond the actual amount currently being paid for water*.

The indexed annual benefits described above are expressed as benefits per household in the potential service area. Therefore, in order to estimate the benefits of the Sulphur Pipeline Regional Rural Water Supply Project, the current and projected future service area households must be estimated. The service populations in 2010 and projected to 2060 for Sulphur, Murray County RWD No.1, and Buckhorn RWD were obtained from the OWRB, OCWP Lower Washita Watershed Planning Region Report (2012). The number of households served was estimated by dividing the population by the average household size estimated in the American Community Survey for the years 2006 to 2010 (U.S. Census Bureau, 2012). The average household size for Murray County RWD No. 1 was based on the average for Census Tracts 7906 and 7908 and the household size for Buckhorn RWD was based on the average household size for Census Tract 7906. Service population and estimated households served are shown in Table 8.

Table 8. Population and households served by Sulphur Pipeline Regional Rural Water Project.

Year	Population served				Estimated households served			
	Sulphur	Murray County RWD No. 1	Buckhorn RWD	Dougherty	Sulphur	Murray County RWD No. 1	Buckhorn RWD	Dougherty
2010	5,135	4,521	925	230	2,096	1,787	354	88
2020	5,586	4,909	1,004	258	2,280	1,940	384	99
2030	6,105	5,372	1,099	278	2,492	2,123	421	107
2040	6,586	5,801	1,187	297	2,688	2,292	454	114
2050	7,144	6,289	1,286	325	2,916	2,486	492	125
2060	7,703	6,778	1,386	354	3,144	2,679	530	136

The number of households served in each year was assumed to increase linearly over each 10-year interval for which projections are available. The benefits per household in each year in the future were discounted to a present value using the current planning rate of 3.75 percent assuming benefits begin at the end of the first year the project is completed. The present values of benefits associated with each service area population and for the total potential service area are shown in Table 9. A summary of total quantified project benefits for both avoided land costs from the No Action Alternative and from domestic benefits associated with willingness to pay is provided in Table 10 below.

Table 9. Present value range of domestic water supply benefits over 50 years, Sulphur Pipeline Regional Rural Water Supply Project.

Entity	Low	High
Sulphur	$9,100,000	$13,500,000
Murray County RWD No. 1	$9,800,000	$14,500,000
Total	**$18,900,000**	**$27,000,000**

Table 10. Present value range of total project benefits over 50 years, Sulphur Pipeline Regional Rural Water Supply Project.

Entity	No Action; Future without Project[1]		Domestic Benefits		Total Quantified Benefits[4]	
	Low[2]	High[3]	Low	High	Low	High
Sulphur	N/A[5]	$900,000	$9,100,000	$13,500,000	$9,100,000	$14,500,000
Murray County RWD No. 1[6]	$1,250,000	$7,400,000	$9,800,000	$14,500,000	$11,000,000	$22,000,000
Total	$1,100,000[7]	$8,500,000	$18,900,000	$27,000,000	$20,000,000	$36,000,000

[1] Based on amount of land needed assuming a 0.2 acre-feet per acre equal proportionate share
[2] Assumes future with conservation measures, as well as the lowest estimated cost per water right.
[3] Assumes future without conservation measures, as well as the highest estimated cost per water right.
[4] Small difference in total due to rounding.
[5] With water conservation measures in place, a water surplus of 162 acre-feet per year in 2060 is expected for the City of Sulphur, so project benefits associated with acquisition of land for water rights are not applicable.
[6] Murray County RWD No. 1 includes Buckhorn and Dougherty.
[7] Sulphur's expected 2060 water supply surplus with conservation would decrease the overall project benefits associated with acquisition of land for water rights when combined with Murray County RWD No. 1.

Recreation/Environmental Benefits – Benefits Transfer Approach

The direct benefits estimated above for households in the project service areas are likely to include recreational and/or environmental components resulting from a desire to prevent future groundwater drawdown. However, potential future lost benefits resulting from the effect of continued groundwater withdrawal on springs and other nearby resources are not included in the above estimates. It cannot be estimated with any degree certainty what these future benefits may be, and it is beyond the scope of this investigation to perform a detailed, localized assessment. For the purposes of this investigation, project-related benefits are considered "unquantified". However, the current level of recreation use at the Chickasaw NRA along with the value of that use, may provide a measure of the magnitude and importance of recreation and environmental resources in the area that could ultimately be affected by continued groundwater drawdown and associated impacts on springs and other resources.

Visitation data for the Chickasaw NRA obtained from the NPS visitor-use statistics website (National Park Service, 2012), combined with estimates of representative recreation values and expenditures, can be used to estimate the value of recreation and the importance of visitation on the local economy. Table 11 shows annual visitation at the Chickasaw NRA between 2009 and 2011. The most recent data available are from 2011.

Table 11. Visitation at Chickasaw NRA

Activity	2009	2010	2011	Average
Non-Recreation	1,489,028	1,331,940	1,425,414	1,415,461
Recreation	1,238,484	1,253,637	1,212,139	1,234,753
• Camping	72,332	66,127	73,956	70,805
• Boaters and boats	39,351	46,037	28,242	37,877

Non-recreation visitors include through traffic, trades-people with business in the Recreation Area, and government personnel (not including NPS personnel) with business in the NRA. Non-recreation visitation is not included in the estimated value of activity in the NRA. For the benefits transfer approach, two sources of information were used to estimate the range of Chickasaw NRA benefits. The 2005 Updated Outdoor Recreation Use Values on National Forests and Other Public Lands provides estimates of average consumer surplus (benefits) per day for a variety of recreation activities in different regions of the United States (Loomis, 2005). The addendum to the 2006 National Survey of Fishing, Hunting, and Wildlife-Related Recreation provides net economic values per day of wildlife-related recreation (U.S. Fish and Wildlife Service, 2009). The Loomis (2005) study estimated southeastern U.S. region values per day in 2004 dollars of $42.77 for general recreation, $25.79 for camping, $58.92 for motor-boating, $40.10 for wildlife viewing, and $46.06 for sightseeing. The U.S. Fish and Wildlife 2009 addendum estimated values in 2006 dollars of $33.00 for wildlife watching and $58.00 per day for bass fishing for state residents.

The visitation estimates presented in Table 11 represent visits and must be converted into recreation days in order to estimate recreation benefits. A 1990 analysis of net economic values for recreation in Forest Service regions provides estimates of the number of days per trip for various types of recreation activities (McCollum et. al, 1990). The southeastern region, which

includes Oklahoma, 1.85 days per trip for general recreation, 2.21 to 5.42 days per trip for camping, and 1.73 days per trip for sightseeing.

The values used to estimate the benefits associated with Chickasaw NRA recreation are indexed to 2012 using the Bureau of Labor Statistics Consumer Price Index. The indexed 2012 values are $37.88 to $52.39 per day for general recreation, $66.58 to $72.18 per day for boating, and $31.59 per day for camping. The estimated total economic value of recreation at the Chickasaw NRA is shown in Table 12.

Table 12. Visitation and estimated economic value of recreation at Chickasaw NRA

Recreation activity	Average 2009 to 2011 Visitation	Estimated Recreation Days	Value Per Day 2012 Dollars		Total annual recreational value in 2012 dollars	
			Low	High	Low	High
Camping	70,805	270,120	$32		$8,600,000	$8,600,000
Boaters and boats	37,877	70,070	$67	$72	$4,700,000	$5,000,000
Other recreation	1,126,071	2,083,230	$38	$52	$79,200,000	$108,300,000
Total	**1,234,753**	**2,423,420**	**-**	**-**	**$92,500,000**	**$121,900,000**

Based on the values presented in Table 12, it appears that an impact on resources that translates into a change in visitation at the Chickasaw NRA will result in approximately a $1.0 million impact on recreational value each year for each one percent of visitation change. It should be noted that this analysis is preliminary and based on the benefits transfer approach that assumes recreation values based on broad regional surveys. A more accurate estimate of recreation and environmental values would entail a more localized analysis and a survey of resources in the study area.

Even though quantifying the resources that could potentially be adversely impacted by continued groundwater pumping is beyond the scope of this investigation, preliminary calculations were made on the cumulative volume of groundwater that would be pumped from the Arbuckle-Simpson Aquifer under three different implementation scenarios described below, summarized in Table 13, and illustrated in Figures 12 –15. It is important to point out that these calculations are for comparative purposes only. A more meaningful assessment of impacts should entail groundwater and surface water modeling of more precise pumping scenarios that vary in space and time.

1. ***Scenario 1 - No Action (Future without the Project):*** This scenario assumes that once permit restrictions are in place, Sulphur and Murray County RWD No. 1 would purchase or lease land to acquire additional groundwater rights to meet current and future demands.
2. ***Scenario 2 - Prioritized use of Groundwater over Surface Water:*** This scenario assumes that once permit restrictions are in place, Sulphur and Murray County RWD No. 1 would continue to use their prior groundwater rights to meet demands to the extent they are able to do so, but would use surface water from Lake of the Arbuckles to meet additional demands in lieu of acquiring additional groundwater rights.
3. ***Scenario 3 - Prioritized use of Surface Water over Groundwater:*** This scenario assumes that once permit restrictions are in place, Sulphur and Murray County RWD No. 1 would stop pumping groundwater altogether in the near term, and use surface water from Lake of the Arbuckles to meet current and future demands. Note that under this scenario, in the year 2024 (2043 with conservation), demands would exceed available surface water supplies, so groundwater would be utilized to meet remaining demands.

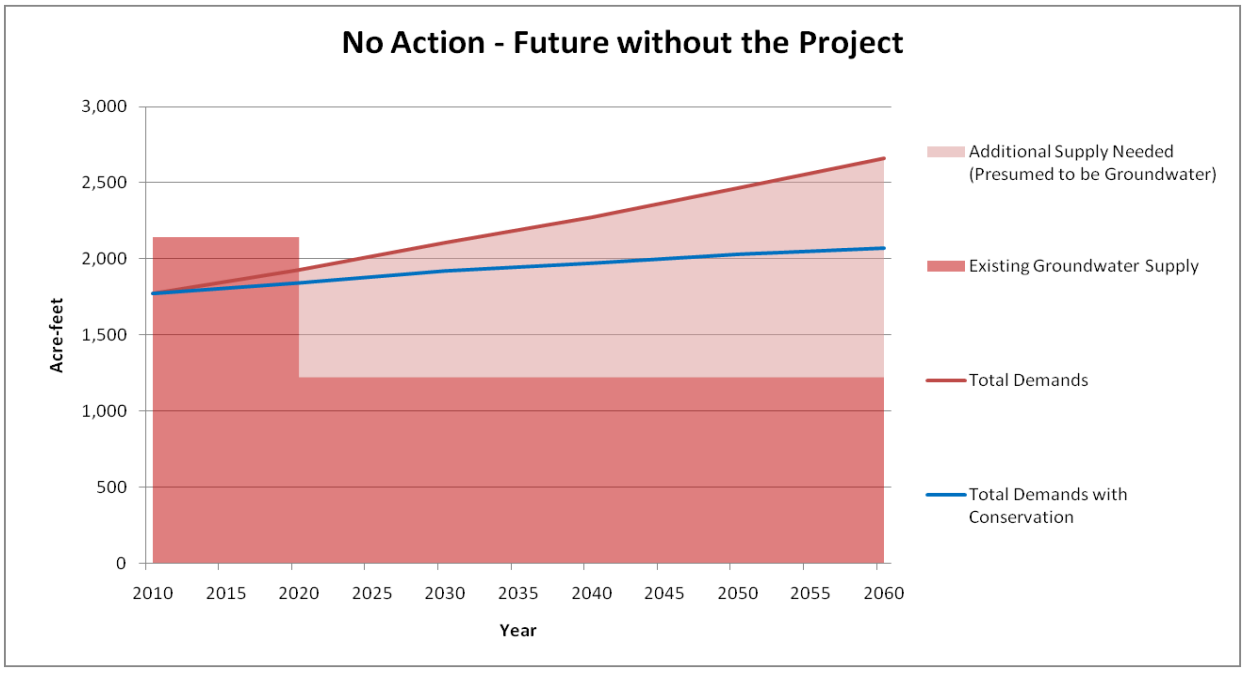

Figure 12. Illustration of implementation Scenario 1 – No Action, with and without water conservation.

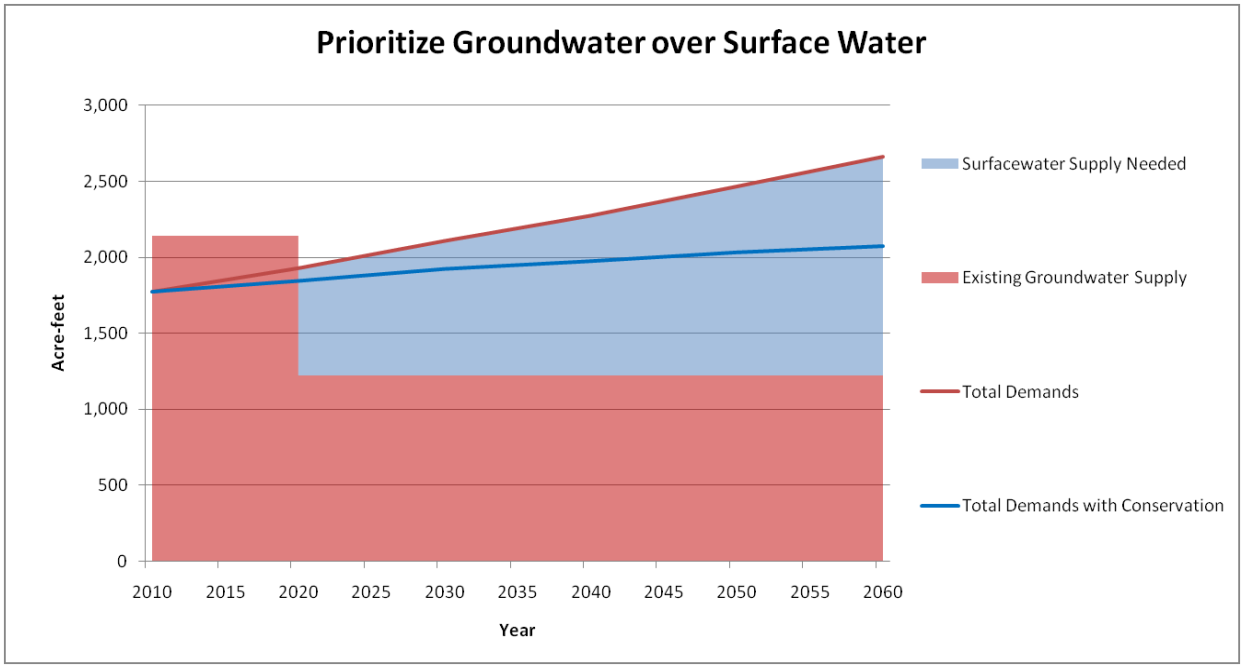

Figure 13. Illustration of implementation Scenario 2 – Prioritized use of Groundwater over Surface Water, with and without water conservation.

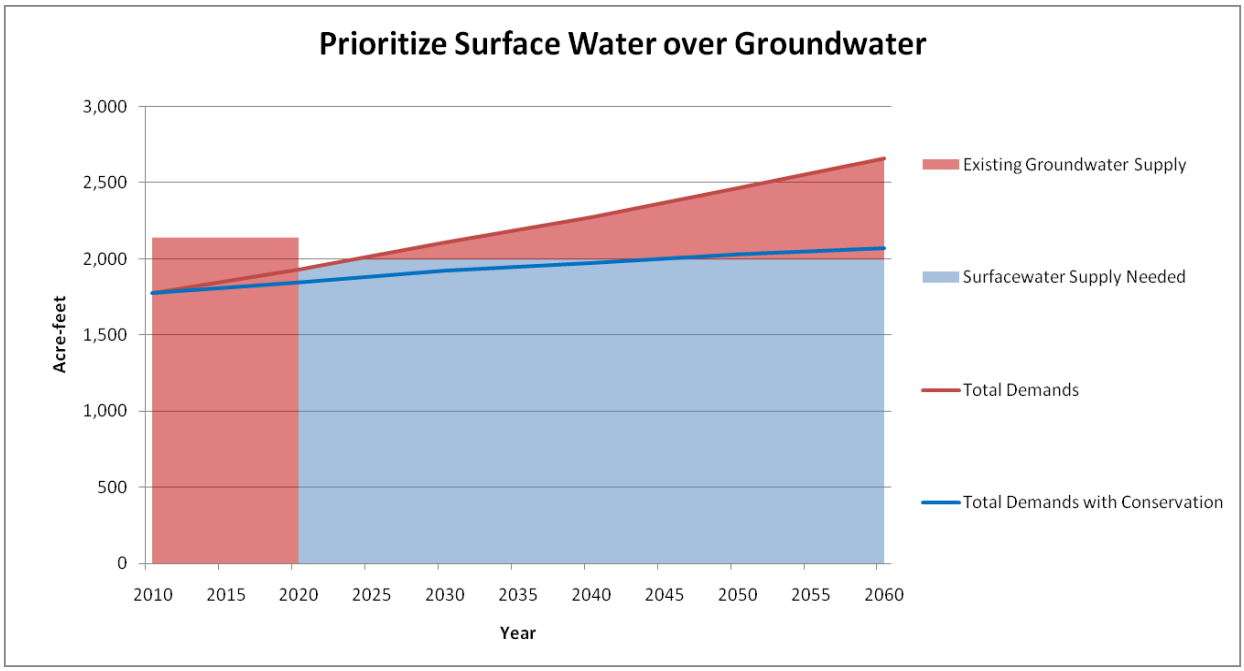

Figure 14. Illustration of implementation Scenario 3 – Prioritized use of Surface Water over Groundwater, with and without water conservation.

Table 13. Summary of cumulative pumping volumes between 2010 and 2060 under three implementation scenarios, both with and without water conservation measures.

Cumulative Groundwater Pumping Needed to Meet Demands (Acre-Feet)						
Year	Scenario 1		Scenario 2		Scenario 3	
	No Action	No Action with Conservation	Prioritize Groundwater over Surface Water	Prioritize Groundwater over Surface Water with Conservation	Prioritize Surface over Groundwater	Prioritize Surface over Groundwater with Conservation
2010	1,774	1,774	1,774	1,774	1,774	1,774
2020	20,367	19,909	19,660	19,286	18,438	18,064
2030	40,641	38,790	31,840	31,507	18,839	18,466
2040	62,634	58,302	44,020	43,728	20,862	20,489
2050	86,430	78,359	56,200	55,948	24,688	24,315
2060	112,163	98,897	68,380	68,169	30,450	30,077

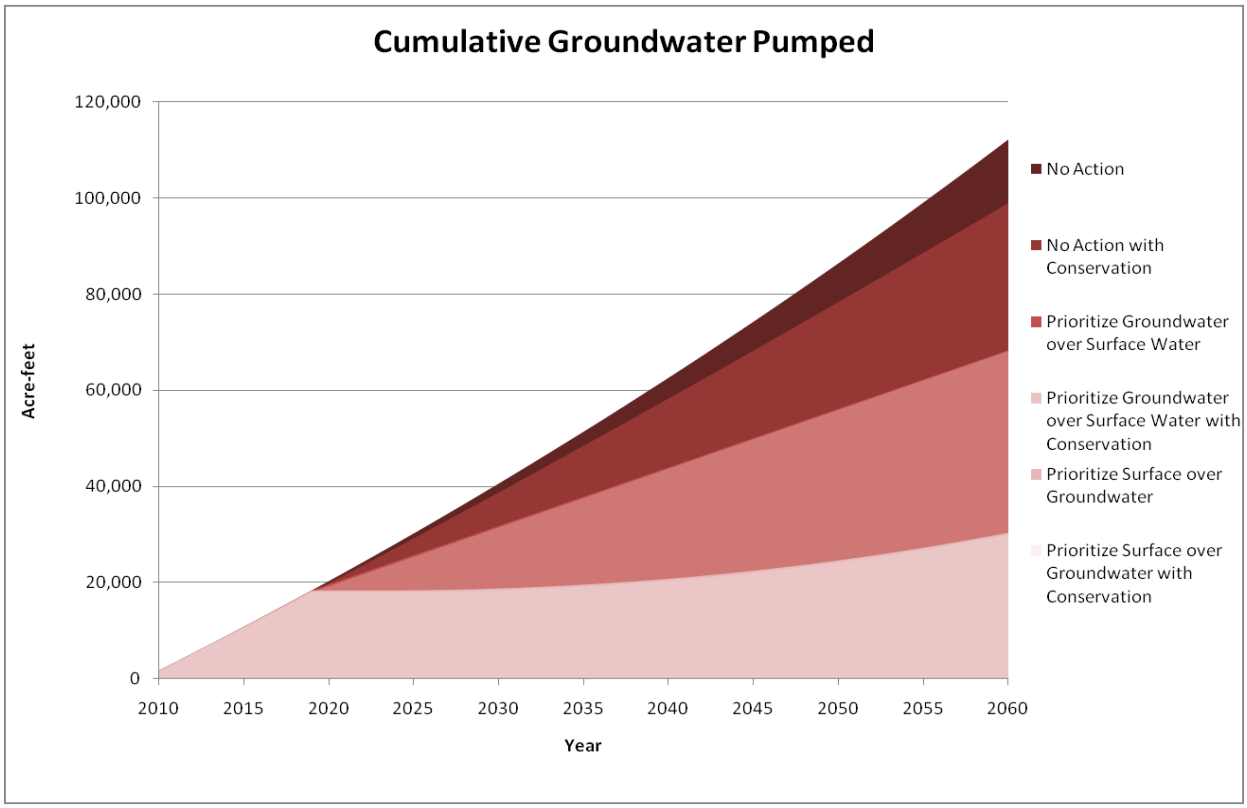

Figure 15. Illustration of cumulative pumping volumes between 2010 and 2060 under three implementation scenarios, both with and without water conservation measures.

Project Costs

The appraisal-level capital and O&M costs for the Sulpur Pipeline Regional Rural Water Supply Project are presented in detail within Chapter III.

The $410,000 annual O&M cost for Sulphur and $16,000 annual O&M cost for Murray County RWD No. 1 were converted to a present value of $9.5 million and $400,000 respectively based on a 50-year period and a project planning rate of 3.75 percent. The present value of O&M costs can then be added to construction costs to estimate total project costs. Interest during construction (IDC) also needs to be calculated and added to the project costs. The IDC accounts for costs incurred when project construction begins until the project is brought into service. The IDC represents a resource cost because funds must be disbursed for construction and are not available for use elsewhere. The IDC calculation begins at the beginning of project construction and ends when the project is substantially complete. A three year construction period was assumed and the fiscal year 2013 planning rate of 3.75 percent was applied. The estimated IDC was $1.10 million for the Sulphur portion of construction costs and $100,000 for the RWD's portion of costs, totaling $1.20 million. Total Sulphur Pipeline Regional Rural Water Supply Project Construction, O&M, and IDC costs are shown in Table 14.

Table 14. Total Sulphur Pipeline Rural Water Supply Project Costs. Costs are provided for conveying water from Lake of the Arbuckles to Sulphur (i.e., "Lake to Sulphur) and from Sulphur to Murray County Rural Water District No. 1 (i.e., "Regional Connection").

Category of Cost	Lake to Sulphur	Regional Connection	Total
Construction cost	$18,900,000	$1,800,000	$20,700,000
Present value of annual O&M costs	$9,500,000	$400,000	$9,900,000
Interest during construction	$1,100,000	$100,000	$1,200,000
Total project cost	**$29,500,000**	**$2,300,000**	**$31,800,000**

Benefits and Costs Comparison

The present value of total project costs stated above is estimated to be $31.8 million. The present value of total quantified project benefits associated with avoided land costs and willingness to pay range from $20.0 million to $36.0 million. These values alone correspond to net positive economic benefits when considering the higher range of project benefits. Additional benefits also may exist that are associated with reducing future groundwater withdrawals and subsequent potential impacts to recreation and environmental resources. The value of recreation and environmental resources at the Chickasaw NRA were estimated to range from $92.5 to $121.9 million annually, which correspond to a present value of about $2 billion over the 50 year period of analysis. Quantifying the project benefits associated with those values was beyond the scope of this investigation. However, even a one percent benefit on the value of recreation would bring the net project benefits well above project costs.

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CHAPTER V
FINANCIAL CAPABILITY ANALYSIS

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FINANCIAL CAPABILITY ANALYSIS

Introduction

The capability of water users to pay for M&I water supplies can be defined as the maximum amount water users can pay for water after accounting for household income, business revenues, and household or business expenses. Although there is no universally accepted method for measuring payment capability or affordability for domestic water supplies, two general approaches have been used to estimate capability to pay. One common technique involves the use of an affordability threshold, which is measured as a percentage of median household income. Using this technique, threshold percentages of household income are applied to households in the study area to determine total water payment affordability. A second approach is based on an evaluation of a range of actual water payments made by households and businesses relative to household income after accounting for necessary expenses, and taking the upper end of the relative payment range. These approaches are described in a technical memorandum titled, Evaluating Economic and Financial Feasibility of Municipal and Industrial Water Projects (Piper, 2009).

Affordability Thresholds

The U.S. Environmental Protection Agency (EPA) and various rural development agencies have established threshold water payments percentages for determining affordability (payment capability). The EPA (1980) looked at the consumer cost for complying with federal drinking water regulations. Agency economists concluded that annual household water service costs ranging from 1.5 percent to 2.5 percent of median annual income raised questions about affordability. Rates over 2.5 percent of median household income were labeled unaffordable. The EPA established affordability criteria for drinking water systems as a result of 1996 Amendments to the Safe Drinking Water Act. These Amendments allowed small public water supply systems to use less extensive water treatment technology if the most effective technology was not considered affordable. Therefore, EPA was required to define affordability in the context of household bills for sewer and drinking water service. As a result, EPA established a 4.0 percent of household income benchmark for affordability (2.0 percent for wastewater treatment and 2.0 percent for drinking water supplies). This was later amended to 4.5 percent to allow 2.5 percent for drinking water expenses. The EPA affordability threshold is not a true measure of affordability, but is instead based on acceptability of fee increases by lending institutions and the cost of other utilities.

The Department of Housing and Urban Development (HUD) established an affordability threshold for water and sewer payments, respectively, of 1.3 percent and 1.4 percent (total of 2.7 percent) of annual median income (EPA, 2006). An independent study by the National Consumer Law Center (NCLC, 1991) supported an affordability threshold for combined water and sewer bills of 2.0 percent. The United States Department of Agriculture, Rural Development Act set grant eligibility at 0.5 percent of median annual income, if annual income in the region is less than 80 percent of the state median.

For this Sulphur Pipeline Regional Rural Water Supply Project investigation, the EPA threshold of 2.5 percent of median household income is used as one measure of payment capability, which

is only one of the thresholds used by various government agencies to evaluate affordability. It is a commonly used general measure that is applicable across many regulatory and financial programs.

Another approach that can be used to estimate the capability of water users to pay for water supplies is to evaluate actual observed water payments for municipalities and other water suppliers relative to household income or business revenues after accounting for necessary expenses. The resulting payment ratios can then be used to approximate payment capability by taking the upper end of the range to estimate payment capability. The payment capability ratios represent the proportion of discretionary income that households served by various utilities must spend for domestic water supplies. Therefore, they are a measure of dollars spent on water service per dollar of discretionary household income. These ratios represent actual payments made by households for water. Therefore, the higher ratios are likely to be the best estimate of maximum ability to pay. This methodology provides an estimate of ability to pay that accounts for variation in household income, household expenses, and costs of living that are not considered when using set percentages of household income.

For the Sulphur Pipeline Regional Rural Water Supply Project investigation, along with the EPA threshold, data from previously completed ability to pay analyses were used to estimate a range of ability to pay for the Sulphur Pipeline Regional Rural Water Supply Project. Data from an assessment of the Lewis and Clark Rural Water System (Piper and Martin, 1999), the Eastern New Mexico Rural Water System (Smith Engineering Company, 2003), and the Equus Beds Aquifer Storage Recharge and Recovery Project (Bureau of Reclamation, 2009) are used to estimate a range of payment capability ratios that are applied to the Sulphur Pipeline Rural Water Supply Project. It should be noted that the past studies of payment capability with the exception of the Lewis and Clark analysis are based on median household income. The Lewis and Clark analysis calculated payment capability using average household income and slightly different categories of expenses. The range of ability to pay percentages are shown in Table 15.

Table 15. Payment capability percentages used to estimate Sulphur Pipeline Rural Water Supply Project payment capability

Source of estimate	Ability to Pay Percentage	Type of Income
U.S. EPA	2.5	Median household income
Equus Beds (low)	5.53	Discretionary median household income
Equus Beds (high)	13.09	Discretionary median household income
Eastern New Mexico	5.9	Discretionary median household income
Lewis and Clark (low)	3.21	Discretionary mean household income
Lewis and Clark (high)	4.0	Discretionary mean household income

Discretionary Income Calculations

Discretionary income for the Sulphur Pipeline Regional Rural Water Supply Project water users was estimated using median or average household income data obtained from the U.S. Census Bureau American Consumer Survey 5 year data for 2006 to 2010. Economic and demographic data for the investigation area are presented in Table 16.

Table 16. Economic and demographic data for the Sulphur Pipeline Regional Rural Water Supply Project investigation area.

Measure	Census Tract 7906[1]	Census Tract 7907[1]	Census Tract 7908[1]	Dougherty	Sulphur
Median household income	$47,392	$40,775	$38,588	$38,333	$37,806
Mean household income	$72,225	$47,074	$47,509	$42,371	$41,042
Unemployment Percent	0.0	4.8	6.8	10.9	7.7
Educational Attainment[2] Percent	18.0	12.7	12.4	18.1	8.3
Median age	43.0	41.2	40.4	36.6	38.5
Household size (2010)	2.61	2.43	2.45	2.59	2.45
Population (2010)	2,035	5,313	6,140	215	4,929

[1] Census Tract 7906, 7907, and 7908 includes the rural populations for Murray County.
[2] Educational attainment is defined as those people 25 years of age or older that have a bachelors degree or higher.

Household expenditure data were obtained from the U.S. Bureau of Labor Statistics, Consumer Expenditure Survey (CES) data (U.S. Bureau of Labor Statistics, 2012). The U.S. Bureau of Labor Statistics provides detailed household expenditure data by region in the CES. Expenditures in the CES are broken down into specific household categories. CES data for the South region, which includes Oklahoma (for 2010 – 2011), were used to estimate the percentage of income before taxes that is spent on necessary goods and services. These necessary goods and services include food, housing, apparel, transportation, healthcare, and personal insurance and pensions. These percentages were then applied to the median and mean household income estimates in the investigation area to estimate average discretionary income per household for each water supplier. The discretionary income results are shown below in Table 17 for the four water entities related to this investigation.

Table 17. Median and mean household income, discretionary income after accounting for expenses, and estimated households used to calculate payment capability of the Sulphur Pipeline Regional Rural Water Supply Project users.

Municipality/County	Median household income	Average household income	Estimated household discretionary income	Estimated households in 2010	Estimated households in 2060
Sulphur	$37,806	$41,042	$13,230 - $14,360	2,096	3,144
Murray County RWD No. 1	$42,990	$59,867	$15,050 - $20,950	1,787	2,679
Buckhorn RWD	$47,392	$72,225	$16,590 - $25,280	354	530
Dougherty	$38,333	$42,371	$13,420 - $14,830	230	354

Estimated Payment Capability

The next step was to calculate the payment capability by applying the percentages presented in Table 15 to the discretionary income projections developed in Table 17. The range of estimated annual payment capability for the Sulphur Pipeline Regional Rural Water Project water users is presented in Table 18. As discussed above, these estimates are based on actual payments so the high range of estimates are likely to be the best representation of maximum payment capability.

Table 18. Average annual payment capability for users of the Sulphur Pipeline Regional Rural Water Supply Project over the 50 year period of analysis (Lowest, Highest, and Average).

Entity	EPA	Lowest Estimate[1]	Highest Estimate[2]	Average Estimate[3]
Sulphur	$2,500,000	$1,200,000	$4,500,000	$2,300,000
Murray County RWD No. 1	$2,400,000	$1,500,000	$4,400,000	$2,300,000
Buckhorn RWD	$520,000	$360,000	$960,000	$520,000
Dougherty	$280,000	$140,000	$510,000	$260,000
Total	**$5,700,000**	**$3,200,000**	**$10,500,000**	**$5,400,000**

[1] The lowest estimate represents the 3.21 percent threshold of discretionary income, which is the low end of the Lewis and Clark Project.
[2] The highest estimate represents the 13.09 percent threshold of discretionary income, which is the high end of the Equus Beds Project.
[3] The average estimate represents an average of all six percentages included in Table 15.

Affordability - Payment Capability Compared to Project Costs

To evaluate affordability of the Sulphur Pipeline Regional Rural Water Supply Project, the estimated annual payment capability must be compared to the combined annual costs of construction and O&M of the project when added to the cost of existing service. Two options were analyzed: Option 1 assumes that the project would be constructed to deliver water only to Sulphur and would be funded solely by Sulphur without a cost-share from Murray County RWD No. 1; Murray County RWD No. 1 would acquire and fund groundwater rights instead. Option 2 assumes that the project would be constructed to deliver water to both Sulphur and Murray County RWD No. 1 and would be funded in partnership between Sulphur and Murray County RWD No. 1.

Option 1 – Conveyance infrastructure constructed from Lake of the Arbuckles to Sulphur only and funded solely by Sulphur; RWDs acquire and fund groundwater rights independently

Under Option 1, assuming a repayment period of 20 years and a 3.75 percent interest rate (the current project planning rate), the annual costs to Sulphur would be approximately $1.44 million for construction and $410,000 for O&M. The combined annual costs equal $1.85 million for Sulphur. Under Option 1, Murray County RWD No. 1 is assumed to make up their projected water deficit though acquisition of additional groundwater rights, as proposed under the No Action. The annual costs of both construction and O&M for Murray County RWD No. 1 are estimated to be approximately $1.25 million and would be funded solely by Murray County RWD No. 1.

This next step is to add the estimated annual costs of new service associated with the proposed conveyance infrastructure to the estimated annual cost of water that users pay for their existing service (i.e., baseline service). The current estimated water cost per household per month for Sulphur equals $41.28 based on monthly use of 10,000 gallons and 2009 water rates, or $495 per year. Similarly, the estimated water cost in 2009 based on 10,000 gallon use per household per month for Murray County RWD No. 1 and its customers include: $30.00 for Murray County RWD No. 1 $58.00 for Buckhorn RWD, and $60,00 for Dougherty. Assuming this is a representative cost of water for existing service in the future, the total cost of water for Sulphur is $1.04 million annually for 2010 and would increase to $1.56 million annually by 2060. The total cost for Murray County RWD No. 1 is $954,000 annually for 2010 and would increase to $1.43 million by 2060.

For Sulphur, the combined costs of new service from the Project with existing, baseline service in 2060 is estimated to be about $3.41 million annually[27]. This cost would increase the estimated water cost per household, based on monthly use of 10,000 gallons, for Sulphur from $41.28 currently to $90.31 per month in 2060. It is important to point out that this cost does not reflect or imply the actual water rates customers would have to pay if the Project is brought into service. Furthermore, it should be noted that assuming the highest cost of water in 2060 for existing service could significantly overstate the cost of water.

For Murray County RWD No. 1, the combined costs of new service from additional groundwater rights with existing, baseline service in 2060 is estimated to be about $2.68 million annually[28]. This cost would increase the estimated water cost per household, based on monthly use of 10,000 gallons, for Sulphur from $41.28 currently to $90.31 per month in 2060.

Option 2 – Conveyance infrastructure constructed from Lake of the Arbuckles to Sulphur, as well as to RWDs; funded in partnership between Sulphur and RWDs

Under Option 2, the following assumptions were made regarding the cost-share of new service associated with the Sulphur Regional Rural Water Supply Project: (1) The infrastructure to deliver water from Lake of the Arbuckles to Sulphur would be cost-shared assuming a proportionate distribution of costs between Sulphur and Murray County RWD No. 1 based on total volume of demands in 2060[29]; (2) The infrastructure to deliver water from Sulphur to Murray County RWD No. 1 would be paid 100 percent by Murray County RWD No. 1. Under Option 2, the cost-share provided by Murray County RWD No. 1 would reduce annual costs for new service from $1.85 million to $1.00 million for Sulphur and from $1.25 million to $1.00 million for Murray County RWD No. 1. The combined annual costs of new service with existing service in 2060 would be $2.56 million for Sulphur and $2.43 million for Murray County RWD No. 1.

[27] Equals $1.85 million, the annual cost of new service from the project, plus $1.56 million, the maximum future annual cost for existing, baseline service.

[28] Equals $1.25 million, the annual cost of new service from the project, plus $1.43 million, the maximum future annual cost for existing, baseline service.

[29] Sulphur demands in 2060 are projected to be 1,441 acre-feet per year (54 percent); Demands of Murray County RWD No. 1 are projected to be 1,220 acre-feet per year in 2060 (46 percent).

These costs would increase the estimated water cost per household, based on monthly use of 10,000 gallons, for Sulphur from $41.28 currently to $67.83 per month in 2060. The proportionate share of Murray County RWD No. 1 and its customers would increase the monthly cost from current costs to 2060 costs by the following: Murray County RWD No. 1 from $30.00 to $52.03; Buckhorn RWD: from $58.00 to $95.09; and Dougherty: from $60.00 to $94.52. It is important to point out that these costs were calculated based on assumptions made for the purposes of this preliminary analysis; more accurate annual costs would be determined based on a number of factors, including the actual costs of construction/O&M, as well as the results of potential negotiated contracts between Sulphur, Murray County RWD No. 1, Buckhorn, and Dougherty.

Affordability Conclusions

Figure 16 provides an illustration summarizing the affordability results. A comparison of annual project costs to payment capability indicates that under Option 1, where only the Sulphur portion of the project is constructed, Sulphur has sufficient payment capability to afford 100 percent of the construction/O&M of the project based on the highest annual payment capability threshold ($3.41 million cost versus $4.50 million capability, respectively). Similarly, the Murray County RWD No. 1 has sufficient payment capability to afford 100 percent of the construction/O&M associated with acquisition of groundwater rights under all but the lowest financial capability threshold ($2.68 million cost versus $2.00 million capability). However, Under Option 2, if the full project is constructed to deliver water to both Sulphur and Murray County RWD No. 1, then Sulphur, along with the Murray County RWD No. 1, would both have sufficient payment capability to afford construction/O&M regardless of the financial capability threshold used.

Under the Rural Water Supply Act, Reclamation has the authority to pay up to 75 percent of construction costs, dependent on financial capability of the project sponsor. Furthermore, 43 CFR §404.44 requires appraisal investigations to analyze whether the project sponsor has the capability to pay 100 percent of the costs associated with O&M. The results above indicate that project sponsors could afford both 25 percent of construction costs and 100 percent of O&M costs.

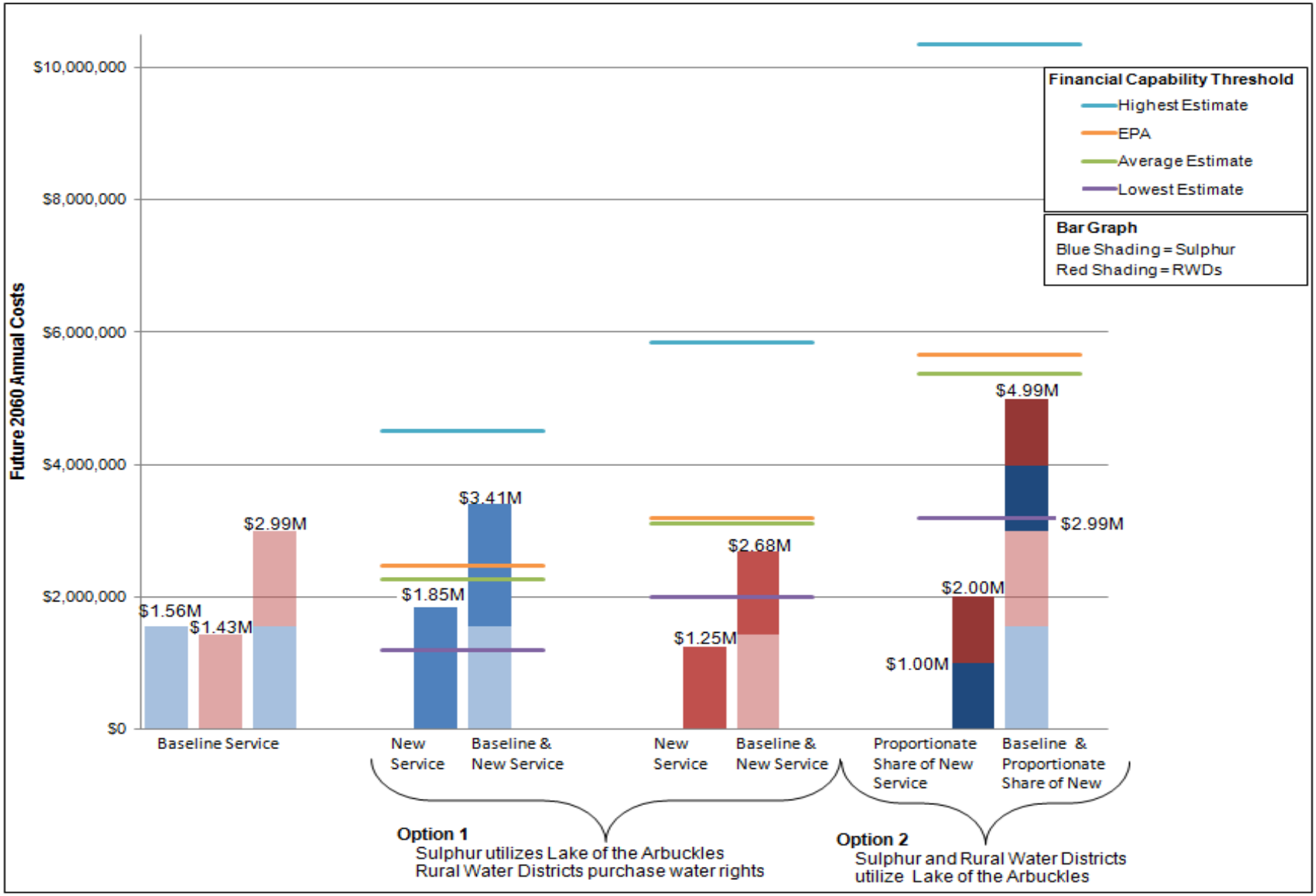

Figure 16. A comparison of annual project costs (2060) versus financial capability under two implementation options, Sulphur Pipeline Regional Rural Water Supply Project

Funding Sources and Options

Study sponsors may seek funding for project implementation from a variety of sources both within and outside Reclamation. A detailed financing assessment is beyond the scope of this investigation, but a summary is provided below.

Funding under Reclamation's Rural Water Program – Title I (P.L. 109-451)

It is not certain whether future Federal appropriations will be made to this program, so the extent to which funding may be available for additional investigations (i.e., a feasibility study) and/or construction remains uncertain; funding for construction is contingent upon the project receiving Congressional authorization, which in and of itself is a complex outcome to achieve.

Funding under the existing Arbuckle Project authority (P.L. 87-594)

Project sponsors also have the option of seeking Federal appropriations for construction under the existing Arbuckle Project authority (P.L. 87-594). However, it is important to note that: (1) while the existing Arbuckle Project authority clearly allows for construction of a conveyance system from the reservoir to Sulphur, there is some question as to whether the existing authority is broad enough to allow for construction of a water treatment plant and/or a rural water conveyance system; and (2) any appropriations provided under the existing Arbuckle Project authority would be subject to conditions of a repayment contract which would require Sulphur to repay 100 percent of construction costs (with interest) within 50 years of the date of water delivery.

Funding options outside Reclamation

Reclamation policy also requires appraisal investigations to make efforts to explore funding sources outside Reclamation so that resources could be leveraged to the maximum extent possible to avoid programmatic overlap. Project sponsors have already begun contacting entities that have programs that could potentially provide planning or construction assistance on this project. Each entity was successfully contacted, and additional follow-up will be conducted as needed during future planning phases of this project. A synopsis of those outreach attempts and potential funding sources are described below:

1. OWRB-administered State Revenue Bond Issue (1985) is a low-interest public water and sewer loan Revenue Bond Loan Program that offers a variable interest rate with a fixed rate conversion option.
2. OWRB-administered Clean Water State Revolving Fund (CWSRF) loan program was established by the 1987 Clean Water Act amendments to provide a renewable financing source for statewide wastewater infrastructure and polluted runoff control needs while protecting the State's surface and ground waters. The CWSRF is funded by EPA capitalization grants, State matching funds, and bonds. During fiscal year 2013, the OWRB will continue offering financing at approximately 40 percent below market rate.
3. OWRB-administered Drinking Water State Revolving Fund loan program (1997) is funded by EPA capitalization grants, State matching funds, loan repayments, investment earnings, and bonds. The low-interest loan program is administered cooperatively by OWRB and ODEQ to assist communities with public water supply infrastructure construction projects.

4. OWRB-administered Rural Economic Action Plan (REAP) Grants (1996) is a point-based program designed to assist smaller communities that lack sufficient fiscal capacity. REAP grants are match-free with a maximum grant amount of $150,000. Cities, towns, and municipalities with a population less than 7,000 can apply, but populations less than 1,750 are given priority.
5. U.S. Department of Agriculture (USDA) Water and Wastewater Disposal Systems for Rural Communities offers grants and loans for communities and tribes with a population less than 10,000. According to the 2005-2009 census, Sulphur had a population of 4,806. This may be a source of funding and will be explored further.
6. USDA Technical Assistance and Training Grants may be a source of funding if a private non-profit organization with expertise in water and wastewater issues is willing to work on the project.
7. USDA Emergency Community Water Assistance Grants are probably not a good source of funding because Sulphur has not experienced a significant, emergency decline in water quantity or quality.
8. USDA Rural Development Grants are probably not a good source of funding since they deal primarily with emerging businesses with fewer than 50 employees.
9. USDA Water and Waste Disposal Loans and Grants provide water and waste disposal to residents in counties where the per capita income does not exceed 70 percent of the national average. The per capita income of Sulphur (in 2009 inflation-adjusted dollars) was $16,886, whereas the national average was $27,041. Therefore, the per capita income for Sulphur is 62.4 percent of the national average; therefore, this grant could be a potential source of funding.
10. USDA Rural Housing Site Loans provide affordable housing for low income individuals in towns of 10,000 or less. This project does not relate with housing; therefore, this program is not considered as a viable funding source.
11. USDA Very Low House Repair Loans and Grants provide home repairs and repairs to water and wastewater disposal systems to homeowners with incomes less than $23,000. Because this project is for a municipality and not an individual property owner, this program is probably not a viable funding source.
12. Housing and Urban Development (HUD) Community Development Block Grant (CBDG), Small Cities Program provides funding for housing, water and wastewater in low income areas excluding those areas in large cities. Sulphur may qualify because 22 percent of the population is below poverty level (national average is 13.5 percent).
13. HUD States Program provides funding to the states to distribute to low and moderate income communities to develop housing including water and wastewater. Sulphur may qualify since 22 percent of the population is below poverty level (national average is 13.5 percent).
14. HUD Indian Community Development Block Grant Program provides grants to develop water and wastewater in low and moderate income families. This funding is strictly for tribal projects; therefore, this program is not considered a viable funding source.
15. U.S. Environmental Protection Agency (EPA) State Revolving Loan Program provides construction funds for municipal wastewater treatment facilities. Because this project

involves potable water transmission and treatment, this funding is probably not a viable source.

16. Economic Development Administration (EDA) Public Works and Development has funding available for construction of public works facilities to create development opportunities in areas experiencing severe economic distress. Because Sulphur is not experiencing severe economic distress, this program is not a viable source of funding.
17. Department of Indian Health Services provides funding for water supply and sewage treatment facilities for Indian Tribes. Because the Native Indian population in Sulphur is only estimated to be about 6.4 percent, this is probably not a viable source of funding.
18. U.S. Army Corps of Engineers (USACE) assists in the design and construction of water and wastewater facilities on a reimbursable basis. The USACE could be considered for future planning phases and construction.
19. U.S. Department of Interior, Bureau of Indian Affairs, Rural Water Projects: funding to construct and maintain rural water systems on Indian Reservations. This project would not qualify for funds from this program.
20. U. S. Department of Interior, Bureau of Indian Affairs ,Water Management, Planning and Pre-Development Program: provides funding to Indian tribes for technical research and studies associated with adjudicated and decreed water rights, or water that is otherwise appurtenant to Indian trust lands, including public domain allotments. This may occur through coordination with governmental entities by obtaining information describing the quantity and quality of water through surface and ground water assessments, inventories, monitoring, modeling and gauging. This program does not fund construction but could be considered for future planning phases.

CHAPTER VI
ENVIRONMENTAL CONSIDERATIONS

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ENVIRONMENTAL CONSIDERATIONS

Reclamation's Directives and Standards CMP 09-03 requires a preliminary analysis of potential environmental, cultural, and social impacts that could affect the potential for further study and project implementation. This analysis was completed by assessing the extent to which the proposed alternative would meet any of the "extraordinary circumstances" listed below in Section 40 CFR Part 46, which are used to determine whether an action can be categorically excluded from further review under the NEPA process, or if a more detailed analysis is warranted. The assessment provided below is preliminary in nature. The information does not represent a conclusion of fact or "finding" under NEPA. If this appraisal investigation is advanced to the feasibility-level investigation, then a more in depth analysis under NEPA would be completed. The extraordinary circumstances are as follows - does the project:

1. *Have a significant effect on the quality of the human or natural environment?* The pipeline alignment would primarily fall within existing rights-of-way, so facilities would have no physical impacts on recreation facilities and no temporary or permanent visual and audible impacts to recreation users. The only potential impacts on residents would occur from the new WTP, but impacts would be mitigated by both the distance to the nearest resident, as well as by the construction of berms to obscure the plant's location.

   Regarding impacts to the natural environment, infrastructure would be constructed primarily within disturbed habitat and primarily within existing rights-of-way, so impacts on terrestrial wildlife would be limited. Impacts on Lake of the Arbuckle's aquatic communities may occur as a result of operations associated with delivery of Sulphur's contracted amount of 1,997 acre-feet per year. A preliminary evaluation was conducted using 80 years of records and an area capacity curve based on year 2060 sediment accumulation. Generally under "wetter" years, little to no affect on reservoir volume and elevation would be observed. Generally under relatively "dryer" years, the maximum amount of water the reservoir can store without flood releases, also known as the top of conservation pool, is 65,378 acre-feet (elevation 872.0 mean sea level (msl)). If 1,997 acre-feet per year is delivered under these conditions, then the reservoir storage volume would be reduced to 63,381 acre-feet (elevation 871.1 msl). This represents approximately a 3.1 percent reduction in volume and less than one foot drop in elevation. Under the most extreme drought conditions (i.e., similar to the 1957 drought of record), if the full contracted amount of water is delivered to existing M&I customers, *excluding* Sulphur, then the reservoir's storage volume would be 10,107 acre-feet (elevation 832.3 msl). If Sulphur's contracted amount of 1,997 acre-feet per year is withdrawn, then the reservoir storage volume would be reduced to 6,955 acre-feet (elevation of 827.0 msl). This would represent approximately a 31 percent reduction in volume and a 5.3 foot drop in elevation. It is important to point out that such an extreme drought is very rare (occurring only one year in the last 80 years on record), and it is uncertain whether such conditions would ever be repeated in the future, especially considering the likely water conservation/rationing triggers associated with low reservoir levels.

   On the other hand, the Project may result in benefits to the natural environment, to the extent that reduced aquifer withdrawals may impact spring flows in the Chickasaw NRA. This type of an analysis was beyond the scope of this investigation.

2. *Have significant impacts on public health or safety?* Using the existing reservoir intake results in a low safety risk, and it would not create an additional boater safety hazard.

3. *Have significant impacts on such natural resources and unique geographic characteristics as historic or cultural resources; park, recreation or refuge lands; wilderness areas; wild or scenic rivers; national natural landmarks; sole or principal drinking water aquifers; prime farmlands; wetlands; floodplains; national monuments; migratory birds; and other ecologically significant or critical areas?* The pipeline alignment would fall primarily within existing rights-of-way, so construction would not be in conflict with NPS policy and regulations. As well, construction would not likely affect significant natural resource lands. Facilities would have no physical impacts on recreation facilities and no temporary or permanent visual and audible impacts to recreation users. Operational impacts would be dependent on the extent to which Project implementation results in reduced aquifer drawdown versus reduced reservoir levels.

4. *Have highly uncertain and potentially significant environmental effects or involve unresolved conflicts concerning alternative uses of available resources?* Facilities would be constructed primarily in disturbed habitat and along existing rights-of-way, where no such conflicts are known to exist.

5. *Establish a precedent for future action or represent a decision in principle about future actions with potentially significant environmental effects?* There is no departure from current Reclamation principles in place for siting the project, such as avoiding disturbance to natural and cultural resources.

6. *Have a direct relationship to other actions with individually insignificant but cumulatively significant environmental effects?* The proposed alternative is specific to the Sulphur Pipeline Regional Rural Water Supply Project, and it is not related to any other activities.

7. *Have significant impacts on properties listed or eligible for listing on the National Register of Historic Places?* The pipeline alignment crosses archeological sites; conditions may not be favorable for additional sites to be encountered. The likelihood may be reduced in areas where existing rights-of-way are used. Nevertheless, consultation with the State Historical Preservation Officer would be undertaken as part of the NEPA analysis.

8. *Have significant impacts on species listed, or proposed to be listed, on the List of Endangered or Threatened Species, or have significant impacts on designated Critical Habitat for these species?* Three listed species could potentially occur within the project area: piping plover, least tern, and whooping crane. The project is not expected to affect any of the three species.

9. *Violate a Federal law, or a State, local, or tribal law or requirement imposed for the protection of the environment?* The pipeline alignment would fall within existing rights-of-way, so construction would not be in conflict with NPS policy and regulations. Violations of other Federal, State, or local laws are unlikely. Although no violation of tribal law is expected, this cannot be addressed with finality until tribal authorities are consulted during the NEPA process.

10. *Have a disproportionately high or adverse effect on low income or minority populations?* The only potential impacts on residents would occur from the new WTP, but impacts would be

mitigated by both the distance to the nearest resident, as well as by the construction of berms to obscure the plant's location.

11. *Affect Indian Trust Assets (ITAs)?* No known ITAs occur within the project area.

12. *Limit access to and ceremonial use of Indian sacred sites on Federal lands by Indian religious practitioners or significantly adversely affect the physical integrity of such sacred sites?* The use of such sites would not be affected by the proposed alternative.

13. *Contribute to the introduction, continued existence, or spread of noxious weeds or non-native invasive species known to occur in the area or actions that may promote the introduction, growth, or expansion of the range of such species?* Best management practices, such as reseeding disturbed vegetation, would help mitigate potential impacts.

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CHAPTER VII
CONCLUSIONS AND RECOMMENDATIONS

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CONCLUSIONS

Interim Final Rule 43 CFR §404.44 establishes several criteria that Reclamation must apply to determine whether it is appropriate to recommend that a feasibility study be conducted under the Rural Water Supply Program.

Whether a reasonable range of alternatives have been formulated and evaluated.

Yes, a reasonable range of alternatives were formulated and evaluated based on their ability to meet the planning objective of reducing long-term pumping of the Arbuckle-Simpson Aquifer through development of a surface water supply alternative that conveys water to Sulphur and provides at least 707 acre-feet per year of water to Sulphur and Murray Co. RWD No. 1 by 2020, and at least 1,439 acre-feet per year of water by 2060. Chapter II provides a detailed assessment of alternatives, which include the No Action (Future without the Project), as well as four supply source alternatives, including Lake of the Arbuckles, Washita River, Veterans Lake, and Water Reuse and Recycling. The Washita River and Veterans Lake were eliminated from further consideration. Water Reuse and Recycling was eliminated in this investigation due to not meeting the full 2060 deficit, but was considered viable as a supplemental water supply option. Lake of the Arbuckles was selected as the preferred source alternative that could provide the full 2060 water supply deficit.

Ten conveyance alternatives were formulated and evaluated to deliver water from Lake of the Arbuckles to Sulphur. Alternative 9 was selected as the proposed alternative. Under Alternative 9, 1,997 acre-feet per year would be released through the existing intake structure at Lake of the Arbuckles and pumped through the existing Wynnewood Aqueduct to the existing regulating reservoir, both of which are owned and operated by the Arbuckle Master Conservancy District. Water would then be pumped through a new pipeline to a new Water Treatment Plant and storage facility at the southwest corner of Sulphur's municipal water system along Chickasaw Trail and State Highway 7.

Two conveyance alternatives were formulated to deliver water from Sulphur to Murray County RWD No. 1. Alternative 1 was eliminated from consideration. Alternative 2 was selected as the proposed alternative and entails construction of a new pipeline from Sulphur water main to the Murray County RWD No. 1 standpipe.

For each alternative considered in the investigation, whether the alternative:

1. *Identifies viable water supplies and water rights sufficient to supply the proposed service area, including all practicable water sources such as lower quality waters, non-potable waters, and water reuse based water supplies.*

   The proposed alternative identified above is considered viable and would provide 1,997 acre-feet per year of treated water to meet long-term water supply needs of the service area. This water has already been allocated to Sulphur by the Arbuckle Master Conservancy District, the water right owner. All practicable water supply sources, including marginal quality (i.e., Washita River) and water reuse, were evaluated and eliminated from further consideration in this investigation. The Washita River was eliminated due to poor water quality and anticipated conveyance and treatment costs. Water reuse was eliminated from consideration in this investigation because preliminary estimates showed that water reuse alone could not

bridge the full water supply deficit, even with water conservation (609 acre-feet per year supply availability from reuse versus 847 acre-feet per year deficit with conservation). A more detailed feasibility study should also explore the merits of developing the Washita River and water reuse as a means to alleviate potential impacts associated with reduced aquifer and reservoir levels. A more detailed study should examine the role that water conservation would play in offsetting water supply deficits and associated infrastructure needs in the future with-project alternatives and without-project alternatives, including the acquisition of additional groundwater rights.

2. *Has a positive effect on public health and safety.*
No adverse public health or safety effects are anticipated for the proposed alternative. Using the existing reservoir intake results in a low safety risk and would not create an additional boater safety hazard.

3. *Will meet water demand, including projected future needs.*
The delivery of 1,997 acre-feet of water per year, the full amount that can be contracted, would fully meet the 2060 demands and beyond for all water users in the study area. Detailed information on water supplies and demands are provided in Chapter I. A more detailed study should evaluate opportunities to provide water to others outside the study area, especially if Sulphur and Murray County RWD No. 1 were to implement water conservation measures and/or water reuse.

4. *Provides environmental benefits, including source water protection.*
The analysis presented in Chapter IV indicates that the Project may result in recreational and environmental benefits associated with the Chickasaw NRA due to a potential reduction in withdrawals on the Arbuckle-Simpson Aquifer. A more detailed study should consider the need to quantify recreational and environmental benefits associated with various supply alternatives, including a balance of those which result from reduced aquifer drawdown versus those associated with maintaining reservoir levels in Lake of the Arbuckles.

5. *Applies a regional or watershed perspective and promotes benefits in the region in which the project is carried out.*
The proposed alternative has the potential to provide the potable water supply needs in the study area, including Sulphur, RWDs, Dougherty, and potentially others outside the study area. The extent to which regional benefits could be provided is partly dependent on whether Sulphur and others implement water conservation measures and/or water reuse, as well as the benefit/costs associated with maintaining aquifer versus reservoir levels.

6. *Implements an integrated water resources management approach.*
The recent groundwater pumping restrictions has created a unique opportunity for Sulphur to collaborate with other stakeholders in the region on an integrated water resources management approach that meets the immediate and long-term water supply needs of the area, while at the same time reducing the economic, recreational, historic, cultural, and natural resources associated with the Arbuckle-Simpson Aquifer.

7. *Enhances water management flexibility, including providing for local control of water supplies and, where applicable, encouraging participation in water banking and markets.*
Water users in the study area are currently utilizing groundwater as their sole water supply source. Augmentation and/or replacement of groundwater with a new surface water supply source from the proposed alternative would diversify their water supply portfolio, thereby providing more local control and flexibility while ensuring a reliable water supply source

well into the future. Inclusion of water conservation and/or reuse as cost-effective components in alternatives considered in a feasibility study may also provide the opportunity for Sulphur to serve the needs of other customers outside the study area and further enhance regional benefits.

8. *Promotes long-term protection of water supplies.*
The Project promotes the long-term protection of water supplies. The water supply outlook for the area depends on different implementation scenarios with regards to prioritization of water use. As presented in Chapter IV, once permit restrictions are in place by 2020[30], if Sulphur and RWDs were to stop pumping groundwater altogether in the near term and use surface water from Lake of the Arbuckles to meet current and future demands instead, they would still have enough water to meet their needs until year 2024 (2043 with conservation). After that point, demands would exceed available surface water supplies, so additional supplies such as groundwater would be required to meet remaining demands. However, if groundwater is prioritized over surface water, then the Project would provide enough water to meet the needs of the service area to beyond 2060, although this option may come at the cost of offsetting environmental and recreation benefits. A more detailed study should evaluate how different implementation scenarios affect benefit/costs to the extent practical.

9. *Includes preliminary cost estimates that are reasonable and supported.*
Preliminary design and cost estimates were developed as one of many factors to screen conveyance options included in Chapter II. Results showed that preliminary-level costs had no bearing on selection of a conveyance option due to the low level of expected accuracy in the costs. Chapter III presents more detailed, appraisal-level designs and cost estimates of the Project. The cost estimates are reasonable and well supported as shown in Chapter III and the Appendices. A more detailed study should include geotechnical investigations, among others, to refine and develop feasibility-level project cost estimates.

10. *Is cost-effective and generates national net economic benefits.*
The present value of total project costs stated in Chapter IV is estimated to be $31.8 million. The present value of total quantified project benefits associated with avoided land costs and willingness to pay range from $20.0 million to $36.0 million. These values alone correspond to net positive economic benefits when considering the higher range of project benefits. When consideration is given to additional benefits associated with recreation and environmental resources, the Project has the potential to generate even greater net benefits. A more detailed feasibility study should refine the cost/benefits analysis by (1) Evaluating how water conservation and reuse affect projected supply deficits and avoided land costs; (2) Evaluating the net benefits associated with maintaining aquifer levels versus reservoir levels; (3) Urging project sponsors to conduct a localized survey in the study area on willingness to pay; (4) Potentially quantifying the benefits to recreational and environmental resources.

11. *Whether the project sponsor has the capability to pay 100 percent of the operations, maintenance, and replacement costs.*
A comparison of annual project costs to payment capability estimates indicates that if only the Sulphur portion of the project is constructed, Sulphur has sufficient payment capability to

[30] A Final Order on the Determination of the Maximum Annual Yield of the Arbuckle Simpson-Aquifer was issued on October 23, 2013; although the order does not establish an implementation timeframe, the year 2020 was assumed for this investigation.

afford 100 percent of the construction and O&M of the project based on the highest annual payment capability estimate. However, if the full project is constructed to deliver water to both Sulphur and Murray County RWD No. 1, then Sulphur, along with Murray County RWD No. 1, would both have sufficient payment capability to afford 100 percent of construction and O&M regardless of the cost estimate used. Given the uncertainty in financial capability associated with the range in payment capabilities, a detailed study should more closely examine financial capability of project sponsors through an analysis on bond rating/issuer credit rating, debt service coverage ratio, and socioeconomic indicators.

RECOMMENDATIONS

Based on this Appraisal Investigation, Reclamation finds that the Sulphur Pipeline Regional Rural Water Supply Project is viable and appropriate for more detailed analysis in a feasibility study. This study also should include a more detailed evaluation on the role of water conservation, acquisition of groundwater rights, and water reuse in meeting supply deficits.

CONSULTATION AND COORDINATION

This Report and Investigation were carried out in coordination with several Federal, State, tribal, and local stakeholders to: (1) Ensure that resources were leveraged and that duplicative efforts, as applicable, were avoided; (2) Maintain transparency and accountability for methods and approaches employed throughout the planning process; and (3) Improve the credibility and value of Reclamation's findings and recommendations. The following stakeholders were identified and consulted with throughout this investigation: (1) Arbuckle Master Conservancy District; (2) National Park Service; (3) Chickasaw Nation; (4) Oklahoma Water Resources Board; (5) Oklahoma Department of Wildlife Conservation; (6) Murray County RWD No. 1; (7) Buckhorn RWD; and (8) Citizens for the Protection of the Arbuckle Simpson Aquifer. Consultation with representatives from U.S. House Representative Tom Cole (R - 4th District) also occurred throughout the process.

The following stakeholder meetings were held:

1. August 18, 2011: A kick-off meeting with stakeholders was held to provide an overview and solicit feedback about Reclamation's Rural Water Supply Program (discussed below), the draft scope of work for the investigation, and on expectations regarding roles, responsibilities, information sharing, and timeframes.
2. October 25, 2011: Assess Murray County RWD No. 1 and Buckhorn RWD's need and/or interest in having its supplies and demands evaluated in this investigation.
3. January 26, 2012: A meeting with stakeholders was held to discuss and solicit feedback on the methods and results of Reclamation's preliminary screening analysis and alternatives evaluation.
4. April 30, 2013: A meeting with stakeholders was held to discuss and solicit feedback on the results of investigation, including selection of a preferred conveyance alternative, costs, benefits, and financial capability. Also discussed were options moving forward in terms of scoping and financing a feasibility-level investigation.

In an effort to inform the general public about the investigation, Reclamation hosted a public meeting at Sulphur's City Hall on August 12, 2013 and presented an overview on the results of the appraisal investigation and solicited feedback on the findings and recommendations. Public comments were documented and will be considered as additional planning studies are undertaken in the future.

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CHAPTER VIII
REFERENCES

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REFERENCES

C.H. Guernsey & Company. (1986). Sulphur Municipal and Industrial Water Supply Facilities, Phase I Preliminary Studies and Investigations. Prepared for the Bureau of Reclamation. Oklahoma City, OK.

Kawamura, S. (2000). Integrated Design and Operation of Water Treatment Facilities (2nd ed.). John Wiley & Sons, Inc. New York City, NY.

Loomis, J. (2005). Updated Outdoor Recreation Use Values on National Forests and Other Public Lands. General Technical Report PNW-GTR-658. USDA Forest Service, Pacific Northwest Research Station, Portland, OR.

McCollum, Daniel W., G.L. Peterson, J. R. Arnold, D.C. Markstrom, and D.M. Hellerstein. (1990). The Net Economic Value of Recreation on the National Forests: Twelve Types of Primary Activity Trips Across Nine Forest Service Regions. Research Paper RM-289. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO.

National Consumer Law Center. (1991). The Poor and the Elderly - Drowning in the High Cost of Water, Special report. Boston, MA.

National Park Service. (2012, November 6). NPS Stats, National Park Service Visitor Use Statistics. Retrieved from https://irma.nps.gov/Stats/Reports/ReportList.

Oklahoma Department of Environmental Quality. 2012. Final 2012 Bacteria Total Maximum Daily Loads for the Water River, Oklahoma. Oklahoma City, Oklahoma.

Oklahoma Gas and Electric Company. (2012, September 17). Retrieved from http://www.oge.com/.

Oklahoma State University, Agricultural Economics Extension Home. (2012, October 29). Oklahoma Agricultural Land Values. Retrieved from http://agecon.okstate.edu/oklandvalues/index.asp.

Oklahoma Water Resources Board. (2011). Beneficial 2010-2011 Oklahoma Streams Report. Oklahoma City, Oklahoma.

Oklahoma Water Resources Board. (2012). Oklahoma Comprehensive Water Plan Lower Washita Watershed Planning Region Report. Oklahoma City, Oklahoma.

Oklahoma Gas and Electric Company. (2012, July 19). Standard Pricing Schedule: Green Power Wind Rider. Oklahoma City, Oklahoma.

Oklahoma Water Resources Board and U.S. Geological Survey. (2011). Hydrogeology and Simulation of Groundwater Flow in the Arbuckle-Simpson Aquifer, South-Central Oklahoma. Scientific Investigations Report 2011-5029. Reston, Virginia.

Oklahoma Water Resources Board. (2013). Final Determination of Maximum Annual Yield of Groundwater from the Arbuckle-Simpson Groundwater Basin, revised. Oklahoma City, Oklahoma.

Piper, Steven and Martin, Wade E. (1997). Household willingness to pay for improved rural water supplies: A comparison of four sites. Water Resources Research, Vol. 33, No. 9.

Piper, Steven. (2009). Evaluating Economic and Financial Feasibility of Municipal and Industrial Water Projects. U.S. Bureau of Reclamation, Denver Technical Service Center, Technical Memorandum Number EC-2009-02.

Smith Engineering Company. (2003). Eastern New Mexico Rural Water System: Conceptual Design Report. Albuquerque, NM.

U.S. Bureau of Labor Statistics. (2012, November, 7). Consumer Expenditure Survey Data Table for the South Region and Metropolitan Areas. Table 23. Retrieved from http://www.bls.gov/ro3/cetablesouth.htm.

U.S. Bureau of Reclamation. (2003). Desalting Handbook for Planners, 3rd Edition, Desalination and Water Purification Research and Development Report #72. Water Treatment Engineering and Research Group. Denver, CO.

U.S. Bureau of Reclamation. (2009). Equus Beds Aquifer Storage Recharge and Recovery Project, Final Environmental Impact Statement. Equus Beds Division, Wichita Project, Kansas.

U.S. Bureau of Reclamation. (2010). Water Treatment Primer for Communities in Need, Desalination and Water Purification Research and Development Report #68. Water Treatment Engineering and Research Group. Denver, CO.

U.S. Bureau of Reclamation. (2011). Wynnewood Aqueduct Capacity Evaluation – Sulphur, OK. Technical Services Center. Denver, CO.

U.S. Census Bureau. (2012, November 8). American Fact Finder. Retrieved from http://factfinder2.census.gov/faces/nav/jsf/pages/index.xhtml.

U.S. Department of Energy. (2009). Own Your Power! A Consumer Guide to Solar Electricity for the Home. U.S. Department of Energy, the Office of Energy Efficiency and Renewable Energy. Washington, DC.

U.S. Energy Information Administration. (2012). Electric Power Monthly, with Data for May 2012. Retrieved from http://www.eia.gov/electricity/monthly/current_year/july2012.pdf. Table 5.6.B. Washington, DC.

U.S. Energy Information Administration. (2012). In Energy Information Glossary for Geothermal Heat Pump Energy. Retrieved from http://www.eia.gov/. Washington, DC.

U.S. Environmental Protection Agency. (1980). Water Utility Financing Study. Office of Drinking Water, Washington, D.C.

U.S. Environmental Protection Agency. (2005). Technologies and Costs Document for the Final Long Term 2 Enhanced Surface Water Treatment Rule and Final Stage 2 Disinfectants and Disinfection Byproducts Rule. Washington D.C.

U.S. Environmental Protection Agency. (2012, October 29). Information for States on Developing Affordability Criteria for Drinking Water. Appendix E. Affordability Measures and Thresholds: Selected Studies. Retrieved from http://www.epa.gov/docs/ogwdw000/smallsys/affapp-e.html.

U.S. Fish & Wildlife Service. (2012). 2011 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation, State Overview. Preliminary Estimates. Shepherdstown, West Virginia.

U.S. Fish & Wildlife Service. (2009). Net Economic Values of Wildlife-Related Recreation in 2006. Addendum to the 2006 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation. Report 2006-5. Shepherdstown, West Virginia.

U.S. Water Resources Council. (1983). Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies. Government Printing Office, Washington, DC.

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APPENDICES

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Appendix A: Alternatives Screening Results

Table A1. A quantitative comparison of how ten alternatives to convey water from Lake of the Arbuckles to Sulphur perform on the Effectiveness criterion.

Effectiveness	Maximum Points	Alternative									
Category		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
1. Water Delivery	Subtotal	1	1	1	1	1	1	1	1	5	5
High Effectiveness	5										
Low Effectiveness	1										
2. Constructability	Subtotal	1	2	2	1	2	2	1	2.75	5	4.75
High Effectiveness	5										
i. Pipeline	*1.25*									1.25	
ii. Pump plant	*1.25*									1.25	1.25
iii. Treatment plant	*1.25*		1.25	1.25		1.25	1.25		1.25	1.25	1.25
iv. No intake	*1.25*									1.25	1.25
Moderate Effectiveness	3										
i. Pipeline	*1*								1		1
ii. Pump plant	*1*										
iii. Treatment plant	*1*										
Low Effectiveness	1										
i. Pipeline	*0.25*	*0.25*	*0.25*	*0.25*	*0.25*	*0.25*	*0.25*	*0.25*			
ii. Pump plant	*0.25*	*0.25*	*0.25*	*0.25*	*0.25*	*0.25*	*0.25*	*0.25*	*0.25*		
iii. Treatment plant	*0.25*	*0.25*			*0.25*			*0.25*			
iv. Yes intake	*0.25*	*0.25*	*0.25*	*0.25*	*0.25*	*0.25*	*0.25*	*0.25*	*0.25*		
3. Serviceability	Subtotal	1.66	2.32	2.32	0.99	2.32	2.32	0.99	2.99	4.98	4.98
High Effectiveness	5										
i. Intake	*1.66*									*1.66*	*1.66*
ii. Pump plant	*1.66*									*1.66*	*1.66*
iii. Treatment plant	*1.66*		*1.66*	*1.66*		*1.66*	*1.66*		*1.66*	*1.66*	*1.66*
Moderate Effectiveness	3										
i. Intake	*1*										
ii. Pump plant	*1*								*1*		
iii. Treatment plant	*1*	*1*									
Low Effectiveness	1										
i. Intake	*0.33*	*0.33*	*0.33*	*0.33*	*0.33*	*0.33*	*0.33*	*0.33*	*0.33*		
ii. Pump plant	*0.33*	*0.33*	*0.33*	*0.33*	*0.33*	*0.33*	*0.33*	*0.33*			
iii. Treatment plant	*0.33*				*0.33*			*0.33*			
Total		3.66	5.32	5.32	2.99	5.32	5.32	2.99	6.74	14.98	14.73
Max points = 15		15	15	15	15	15	15	15	15	15	15
Percentage of Points Scored		**24.4%**	**35.5%**	**35.5%**	**19.9%**	**35.5%**	**35.5%**	**19.9%**	**44.9%**	**99.9%**	**98.2%**

Table A2. A quantitative comparison of how ten alternatives to convey water from Lake of the Arbuckles to Sulphur perform on the Efficiency criterion.

Efficiency	Maximum Points	Alternative									
Category		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Annualized Life-Cycle Cost											
High Efficiency	5										
Moderate Efficiency	3	3	3	3	3	3	3	3	3	3	3
Low Efficiency	1										
Total		3	3	3	3	3	3	3	3	3	3
Max points = 5		5	5	5	5	5	5	5	5	5	5
Percentage of Points Scored		**60.0%**	**60.0%**	**60.0%**	**60.0%**	**60.0%**	**60.0%**	**60.0%**	**60.0%**	**60.0%**	**60.0%**

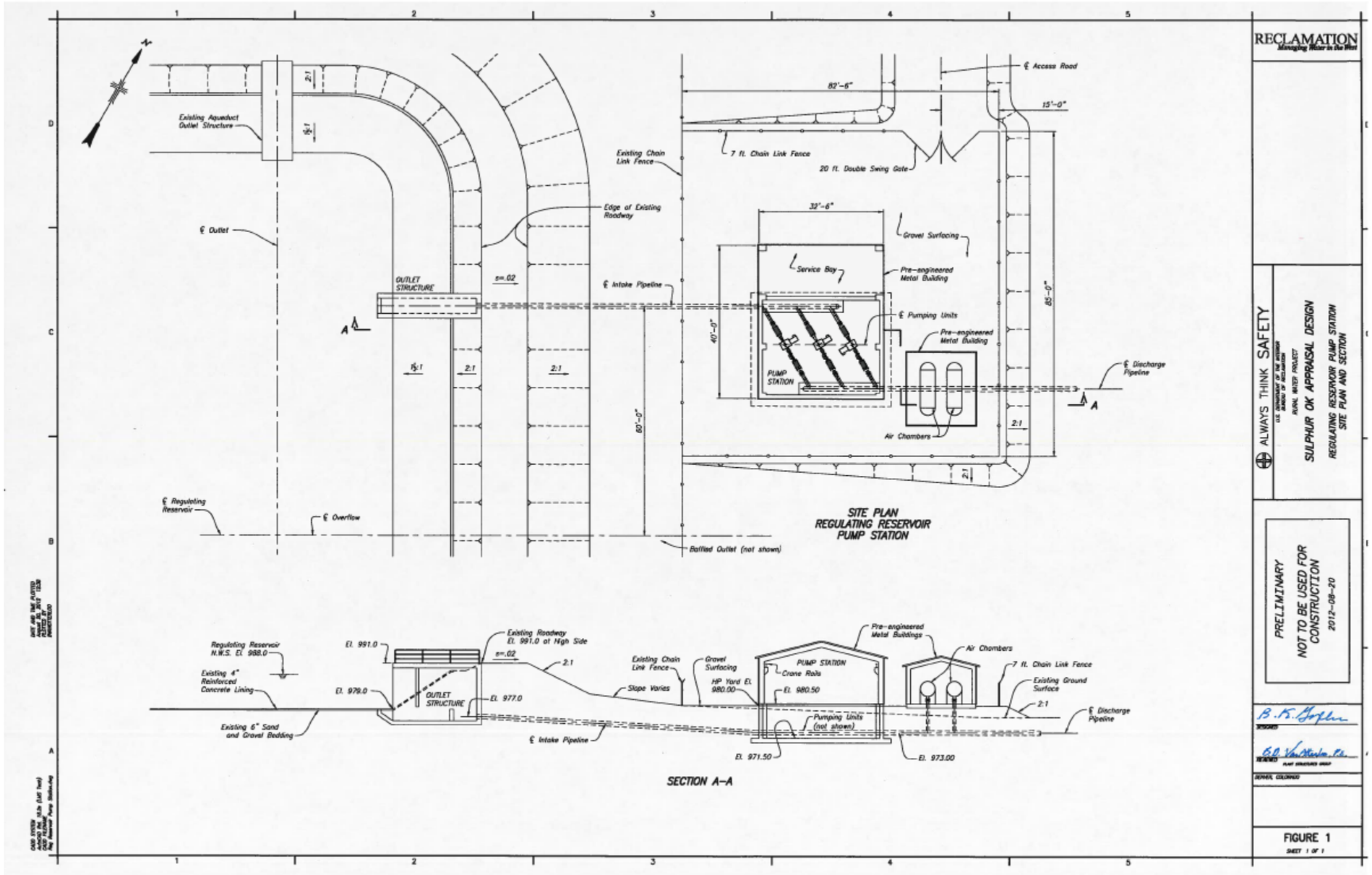
Table A3. A quantitative comparison of how ten alternatives to convey water from Lake of the Arbuckles to Sulphur perform on the Acceptability criterion.

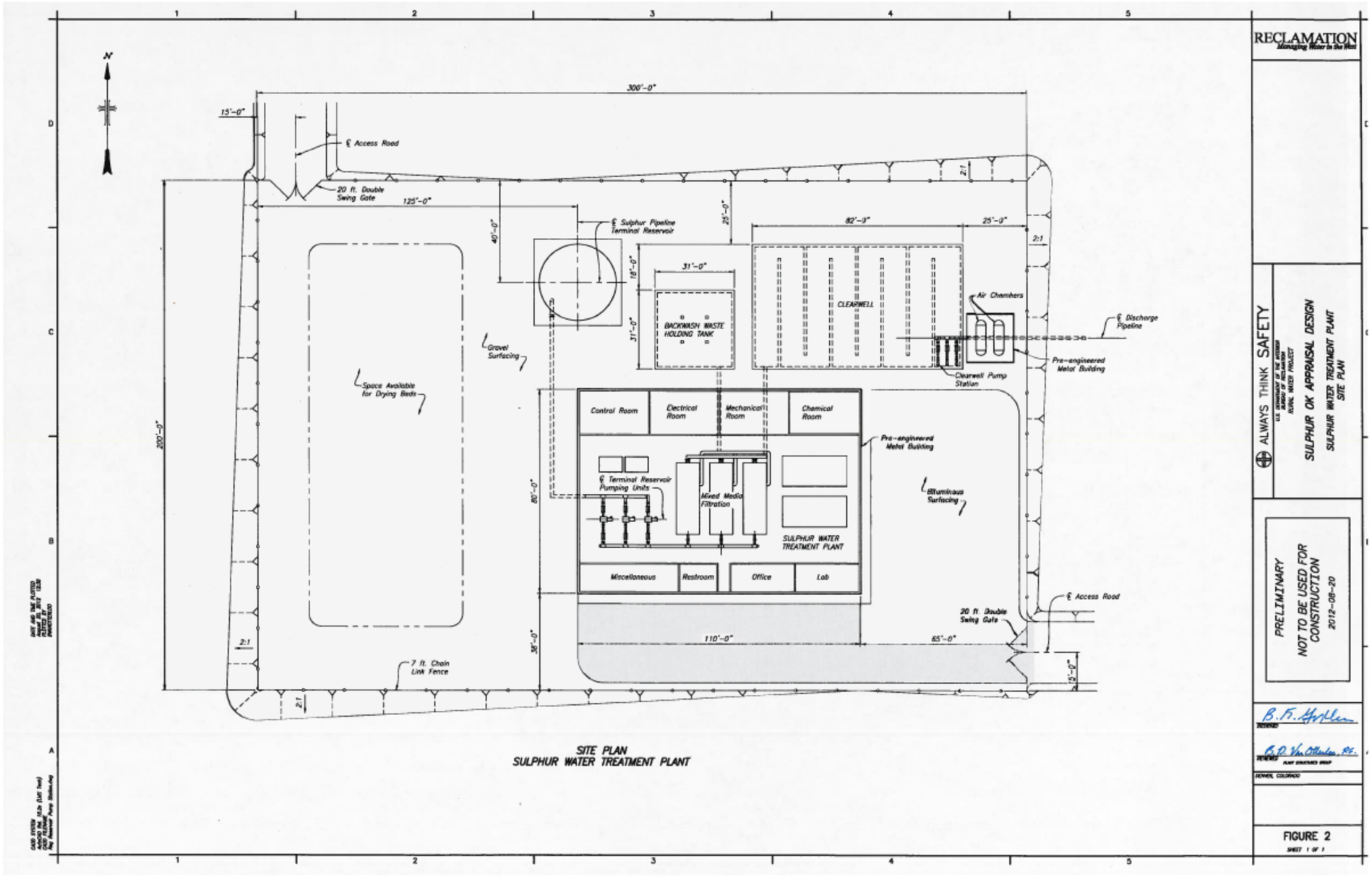
Acceptability	**Maximum Points**	**Alternative**									
Category		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
1. Authorities/Policies	Subtotal	1	1	1	1	1	3	3	3	5	5
High	5									*5*	*5*
Moderate	3						*3*	*3*	*3*		
Low	1	*1*	*1*	*1*	*1*	*1*					
2. Impacts on Recreation	Subtotal	2	2	2	2	2	1	1	3	5	5
High Acceptability	5										
i. Facilities	*2.5*								*2.5*	*2.5*	*2.5*
ii. Users	*2.5*									*2.5*	*2.5*
Moderate Acceptability	3										
i. Facilities	*1.5*	*1.5*	*1.5*	*1.5*	*1.5*	*1.5*					
ii. Users	*1.5*										
Low Acceptability	1										
i. Facilities	*0.5*						*0.5*	*0.5*			
ii. Users	*0.5*	*0.5*	*0.5*	*0.5*	*0.5*	*0.5*	*0.5*	*0.5*	*0.5*		
3. Impacts on Residents	Subtotal	4.98	4.98	4.98	4.98	4.98	4.98	4.98	4.98	4.98	4.98
High Acceptability	5										
i. Pumping plant	*1.66*	*1.66*	*1.66*	*1.66*	*1.66*	*1.66*	*1.66*	*1.66*	*1.66*	*1.66*	*1.66*
ii. Pipeline	*1.66*	*1.66*	*1.66*	*1.66*	*1.66*	*1.66*	*1.66*	*1.66*	*1.66*	*1.66*	*1.66*
iii. Treatment plant	*1.66*	*1.66*	*1.66*	*1.66*	*1.66*	*1.66*	*1.66*	*1.66*	*1.66*	*1.66*	*1.66*
Moderate Acceptability	3										
i. Pumping plant	*1*										
ii. Pipeline	*1*										
iii. Treatment plant	*1*										
Low Acceptability	1										
i. Pumping plant	*0.33*										
ii. Pipeline	*0.33*										
iii. Treatment plant	*0.33*										
4. Impacts on Natural Env.	Subtotal	2	1.5	2	2	2	3.5	3.5	4.5	5	5
High Acceptability	5										
i. Disturbed Areas?	*1.25*								*1.25*	*1.25*	*1.25*
ii. Fish & Wildlife Habitat	*1.25*								*1.25*	*1.25*	*1.25*
iii. Sensitive species	*1.25*									*1.25*	*1.25*
iv. Sensitive habitat	*1.25*						*1.25*	*1.25*	*1.25*	*1.25*	*1.25*
Moderate Acceptability	3										
i. Disturbed Areas?	*0.75*						*0.75*	*0.75*			
ii. Fish & Wildlife Habitat	*0.75*	*0.75*		*0.75*	*0.75*	*0.75*	*0.75*	*0.75*			
iii. Sensitive species	*0.75*	*0.75*	*0.75*	*0.75*	*0.75*	*0.75*	*0.75*	*0.75*	*0.75*		
iv. Sensitive habitat	*0.75*										
Low Acceptability	1										
i. Disturbed Areas?	*0.25*	*0.25*	*0.25*	*0.25*	*0.25*	*0.25*					
ii. Fish & Wildlife Habitat	*0.25*		*0.25*								
iii. Sensitive species	*0.25*										
iv. Sensitive habitat	*0.25*	*0.25*	*0.25*	*0.25*	*0.25*	*0.25*					
5. Impacts on Cultural Res.	Subtotal	1	1	1	1	1	1	1	3	3	3
High Acceptability	5										
Moderate Acceptability	3								3	3	3
Low Acceptability	1	1	1	1	1	1	1	1			
6. Impacts on Public Safety	Subtotal	3	3	3	3	3	3	3	3	5	5
High Acceptability	5									5	5
Moderate Acceptability	3	3	3	3	3	3	3	3	3		
Low Acceptability	1										
Total		13.98	13.48	13.98	13.98	13.98	16.48	16.48	21.48	27.98	27.98
Max points = 30		30	30	30	30	30	30	30	30	30	30
Percentage of Points Scored		**46.6%**	**44.9%**	**46.6%**	**46.6%**	**46.6%**	**54.9%**	**54.9%**	**71.6%**	**93.3%**	**93.3%**

Table A4. A quantitative comparison of how ten alternatives to convey water from Lake of the Arbuckles to Sulphur perform on the Completeness criterion.

Completeness	**Maximum Points**	**Alternative**									
Category		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
1. Agency Coordination	Subtotal	1	1	1	1	1	1	1	1	1	1
High Completeness	5										
Moderate Completeness	3										
Low Completeness	1	1	1	1	1	1	1	1	1	1	1
2. Engineering Uncertainty/Risk	Subtotal	1	1	3	3	3	3	3	3	5	5
High Completeness	5									5	5
Moderate Completeness	3			3	3	3	3	3	3		
Low Completeness	1	1	1								
3. Permits/Risk	Subtotal	0.99	0.99	0.99	0.99	0.99	2.32	2.32	2.99	4.32	4.32
High Completeness	5										
i. ROW easements	*1.66*						*1.66*	*1.66*	*1.66*	*1.66*	*1.66*
ii. Env. Permits	*1.66*									*1.66*	*1.66*
iii. Cultural clearance	*1.66*										
Moderate Completeness	3										
i. ROW easements	*1*										
ii. Env. Permits	*1*										
iii. Cultural clearance	*1*								*1*	*1*	*1*
Low Completeness	1										
i. ROW easements	*0.33*	*0.33*	*0.33*	*0.33*	*0.33*	*0.33*					
ii. Env. Permits	*0.33*	*0.33*	*0.33*	*0.33*	*0.33*	*0.33*	*0.33*	*0.33*	*0.33*		
iii. Cultural clearance	*0.33*	*0.33*	*0.33*	*0.33*	*0.33*	*0.33*	*0.33*	*0.33*			
Total		2.99	2.99	4.99	4.99	4.99	6.32	6.32	6.99	10.32	10.32
Max points = 15		15	15	15	15	15	15	15	15	15	15
Percentage of Points Scored		**19.9%**	**19.9%**	**33.3%**	**33.3%**	**33.3%**	**42.1%**	**42.1%**	**46.6%**	**68.8%**	**68.8%**

Appendix B: Regulation Reservoir Pumping Plant & Water Treatment Plant Site Plans





SITE PLAN
SULPHUR WATER TREATMENT PLANT

RECLAMATION
Managing Water in the West

ALWAYS THINK SAFETY

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
RURAL WATER PROJECT

SULPHUR OK APPRAISAL DESIGN
SULPHUR WATER TREATMENT PLANT
SITE PLAN

PRELIMINARY
NOT TO BE USED FOR CONSTRUCTION
2012-08-20

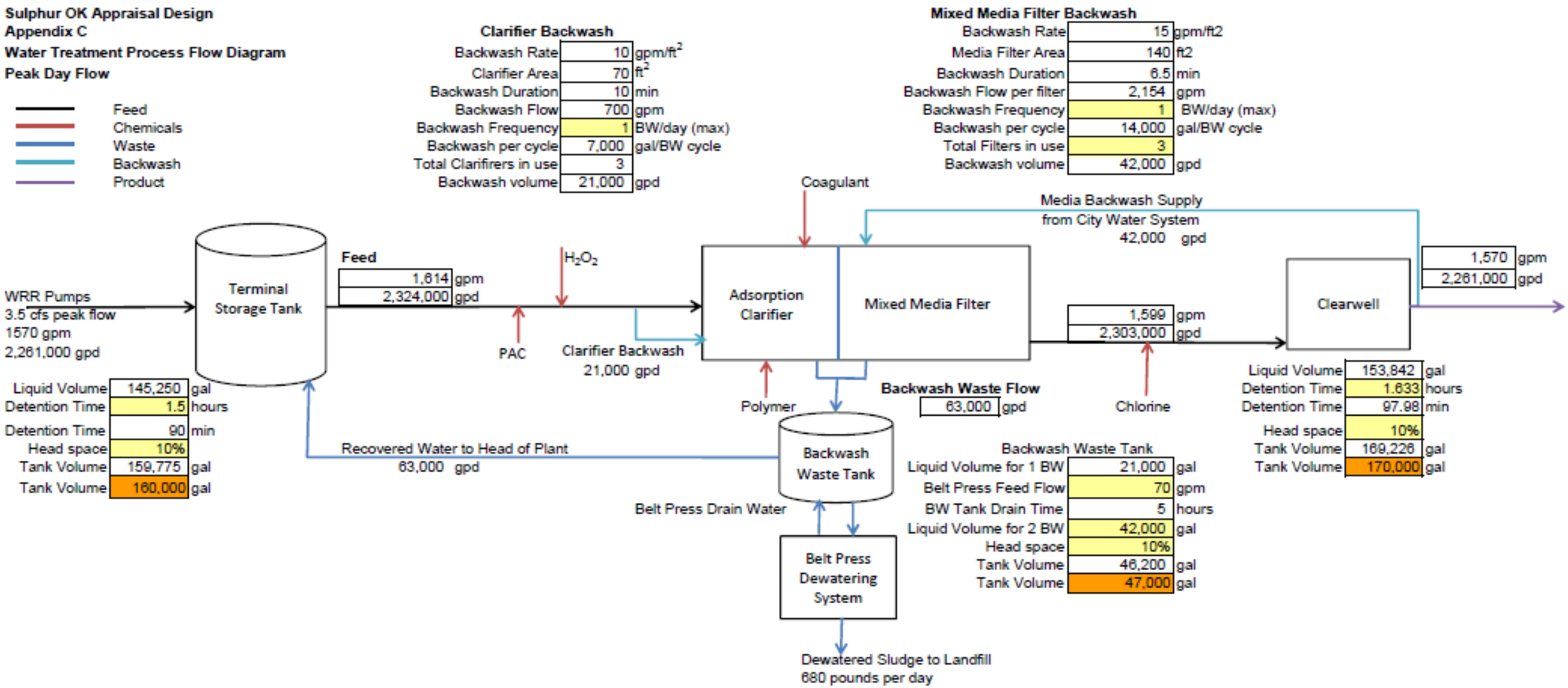
B.T. Hyde
DESIGNED

C.D. Van Ollenbeke, PE
REVIEWED PLANT STRUCTURES GROUP

DENVER, COLORADO

FIGURE 2
SHEET 1 OF 1

Appendix C: Treatment Process Flow Diagram



Appendix D: Detailed Cost Estimate

BUREAU OF RECLAMATION **ESTIMATE WORKSHEET** Sheet __1__ of __1__

FEATURE: **Total Sulphur Pipeline Cost Summary** Pump water from existing Arbuckle Reservoir intake using the existing Wynnewood Aqueduct to the Regulating Reservoir for storage, then pump water to the new treatment plant outside of Sulphur. Contingencies are not embedded within the individual amounts shown for Pay-items 1 - 6.	PROJECT: City of Sulphur - 2011 Rural Water Program - Appraisal Investigation Construction Cost Estimate
	WOID: / ESTIMATE LEVEL: Appraisal
	REGION: GP / UNIT PRICE LEVEL Jan-12
	FILE:

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	AMOUNT
	1	Pipeline (see pay item 1 from Sulphur Pipeline, Pumping Plant,			$1,900,000
		and Storage Tank sheet 1 for detailed line items)			
	2	Wynnewood Pumping Plant (see wynnewood pumping plant			$1,050,000
		from Sulphur Pipeline Regional Rural Water Project sheet 34)			
		Wynnewood Pumping Plant and Pipeline (Proportionate Share)			$480,000
		(see pay item 3 from Sulphur Pipeline, Pumping Plant, and			
		Storage Tank sheet 1 for detailed line items)			
	3	Booster Pumping Plant (see regulating reservoir outlet structure			$1,100,000
		from Sulphur Pipeline Regional Rural Water Project sheet 34)			
	4	Water Treatment Plant (see water treatment plant from Sulphur			$5,500,000
		Pipeline Regional Rural Water Project sheet 34)			
	5	Terminal Storage Tank (see pay item 4 from Sulphur Pipeline,			$300,000
		Pumping Plant, and Storage Tank sheet 1 for detailed line items)			
	6	Land Cost (see pay item 2 from Sulphur Pipeline, Pumping Plant,			$70,000
		and Storage Tank sheet 1 for detailed line items)			
		Subtotal			$10,400,000
		Mobilization	+/-	5%	$520,000
		SUBTOTAL			$10,920,000
		Design Contingency	+/-	15%	$1,630,000
		Allowance for Procurement	+/-	5%	$550,000
		CONTRACT COST			$13,100,000
		Construction Contingency	+/-	25%	$3,300,000
		TOTAL FIELD COST			$16,400,000
		Feasibility Study	+/-	6%	$980,000
		Environmental Compliance Documentation	+/-	1%	$160,000
		Design and Specifications	+/-	4%	$700,000
		Service Facilities and Other Costs	+/-	2%	$330,000
		Construction Management	+/-	2%	$330,000
		NON CONTRACT COSTS			$2,500,000
		CONSTRUCTION COST			$18,900,000

DATE PREPARED See Detail Sheets	REVIEWED	DATE	PRICE LEVEL

BUREAU OF RECLAMATION **ESTIMATE WORKSHEET** Sheet 1 of 2

FEATURE:	PROJECT:
Sulphur Pipeline, Pumping Plant, and Storage Tank Pump water from existing Arbuckle Reservoir intake using the existing Wynnewood Aqueduct to the Regulating Reservoir for storage, then pump water to the new treatment plant outside of Sulphur. Column labeled "Amount" contains rounded values.	City of Sulphur - 2011 Rural Water Program - Appraisal Investigation Construction Cost Estimate
	WOID: ESTIMATE LEVEL: Appraisal
	REGION GP UNIT PRICE LEVEL: Jan-12
	FILE:

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
	1	Pipeline					
		14" Diameter Pipe		33,265	L.F.	$36.00	$1,200,000
		Earthwork					
		Common Excavation		19,050	C.Y.	$13.00	$250,000
		Rock Excavation		6,700	C.Y.	$32.00	$210,000
		Backfill		14,700	C.Y.	$5.45	$80,000
		Compacted Backfill		11,000	C.Y.	$9.50	$100,000
		Structures					
		air valves		3	EA	$3,333	$10,000
		blowoffs		4	EA	$2,500	$10,000
		county road crossing		5	EA	$2,000	$10,000
		state highway crossing		0	EA	$62,700	
		air chamber		0	EA	$33,440	
		stream crossing		1	EA	$30,000	$30,000
	2	Land Cost		5	MILE	$14,000.00	$70,000
	3	Reservoir Pumping Plant					
		Share of Original Construction Cost		1	EA	$478,600	$480,000
	4	Terminal Storage Tank		1	EA	$300,000	$300,000
		SUBTOTAL THIS SHEET					$2,750,000

QUANTITIES		PRICES		
BY M Warren	CHECKED A Hogg	BY M Warren	CHECKED A Hogg	REVIEWED
DATE PREPARED 9/14/2011	REVIEWED	DATE 9/14/2011	PRICE LEVEL Jan 2012	

BUREAU OF RECLAMATION ESTIMATE WORKSHEET Sheet 2 of 2

FEATURE:	PROJECT:
Sulphur Pipeline, Pumping Plant, and Storage Tank Pump water from existing Arbuckle Reservoir intake using the existing Wynnewood Aqueduct to the Regulating Reservoir for storage, then pump water to the new treatment plant outside of Sulphur. Column labeled "Amount" contains rounded values.	City of Sulphur - 2011 Rural Water Program - Appraisal Investigation Construction Cost Estimate WOID: ESTIMATE LEVEL: Appraisal REGION GP UNIT PRICE LEVEL: Jan-12 FILE:

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Subtotal					$2,750,000
		Mobilization	5%	+/-			$140,000
		Subtotal with Mobilization					$2,890,000
		Contract Cost Allowances (sum of):	20%	+/-			$580,000
		Design Contingencies, 15% (+/-)					
		APS, 5% (+/-). Type of Procurement: Request for Proposal					
		CONTRACT COST					$3,470,000
		Construction Contingencies	25%	+/-			$870,000
		FIELD COST (Unit Price Level July 2012)					**$4,340,000**
		Escalation Notice to Proceed (NTP)				See Detailed Cost Table	
		FIELD COST (with Escalation to NTP)				See Detailed Cost Table	
		Non-Contract Costs				See Detailed Cost Table	
		CONSTRUCTION COST				See Detailed Cost Table	

QUANTITIES		PRICES		
BY M Warren	CHECKED A Hay	BY M Warren	CHECKED A Hay	REVIEWED
DATE PREPARED 9/14/2011	REVIEWED	DATE 9/14/2011	PRICE LEVEL Jan 2012	

BUREAU OF RECLAMATION **ESTIMATE WORKSHEET** SHEET _1_ OF _34_

FEATURE: Sulphur Pipeline Regional Rural Water Project Water Treatment Plant Structural/Architectural	**PROJECT:** Arbuckle Project, Oklahoma
	WOID: OPSPA **ESTIMATE LEVEL:** Appraisal
	REGION: GP **UNIT PRICE LEVEL:** Jul-12
	FILE: H:\D8170\EST\Spreadsheet\Bailey\2012 - UB Estimates\Sulphur Pipeline Regional Water Project\002-a Worksheets in Progress\[IN PROGRESS.Sulphur Compiled Estimate Sheets.rev.perPR.xlsx]Wynnewood PP 1 8420

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Sulphur Water Treatment Plant					
		Stripping (Remove and dispose 6" topsoil)	86-68120	1,200	yd3	$12.00	$14,400.00
		Excavation for Sitework - common	86-68120	1,600	yd3	$10.00	$16,000.00
		Place and compact embankment for service yard	86-68120	2,900	yd3	$25.00	$72,500.00
		Structural Excavation - common	86-68120	2,400	yd3	$20.00	$48,000.00
		Backfill for Structures	86-68120	800	yd3	$15.00	$12,000.00
		Compact Backfill for Structures	86-68120	800	yd3	$15.00	$12,000.00
		Gravel surfacing - 6-inch thick	86-68120	4,600	yd2	$10.00	$46,000.00
		Base course material - 6-inch thick	86-68120	1,050	yd2	$10.00	$10,500.00
		Bituminous pavement - 3-inch thick	86-68120	1,050	yd2	$36.00	$37,800.00
		Furnish, Form and Place Concrete	86-68120	1,020	yd2	$900.00	$918,000.00
		4500 psi					
		Water Treatment Plant foundation = 410 yd3					
		(115 tons cement)					
		Clearwell = 480 yd3 (135 tons cement)					
		Backwash Tank = 115 yd3 (32 tons cement)					
		Air Chamber foundation = 18 yd3 (4.5 tons cement)					
		SUBTOTAL THIS SHEET					$1,187,200.00

QUANTITIES		PRICES	
BY B. D. VanOtterloo	CHECKED B. K. Goplen	BY Ian Bailey	CHECKED
DATE PREPARED 07/27/12	PEER REVIEW / DATE B. K. Goplen, P.E.	DATE PREPARED 09/10/12	PEER REVIEW / DATE T. Hanke - 9/12/12

BUREAU OF RECLAMATION **ESTIMATE WORKSHEET** SHEET _2_ OF _34_

FEATURE: Sulphur Pipeline Regional Rural Water Project Water Treatment Plant Structural/Architectural	**PROJECT:** Arbuckle Project, Oklahoma
	WOID: OPSPA **ESTIMATE LEVEL:** Appraisal
	REGION: GP **UNIT PRICE LEVEL:** Jul-12
	FILE: H:\D8170\EST\Spreadsheet\Bailey\2012 - IJB Estimates\Sulphur Pipeline Regional Water Project\002-a Worksheets in Progress\[IN_PROGRESS.Sulphur Compiled Estimate Sheets.rev.perPR.xlsx]Wynnewood PP 1 8420

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Sulphur Water Treatment Plant (continued)					
		Furnished and place reinforcing bars	86-68120	153,000	lbs	$1.50	$229,500.00
		Water Treatment Plant foundation = 61,500 lbs					
		Clearwell = 72,000 lbs					
		Backwash Tank = 17,250 lbs					
		Air Chamber foundation = 2,250 lbs					
		7-foot chain link fence for service yard	86-68120	1,000	lin ft	$45.00	$45,000.00
		Include 2- 20 ft. double swing gate					
		Miscellaneous Metalwork	86-68120	28,000	lbs	$8.00	$224,000.00
		Assume all miscellaneous metalwork is steel.					
		Includes raised walkways, ladders, bollards					
		SUBTOTAL THIS SHEET					**$498,500.00**

QUANTITIES		PRICES	
BY B. D. VanOtterloo	**CHECKED** B. K. Goplen	**BY** Ian Bailey	**CHECKED**
DATE PREPARED 07/27/12	**PEER REVIEW / DATE** B. K. Goplen, P.E.	**DATE PREPARED** 09/10/12	**PEER REVIEW / DATE** T. Hanke - 9/12/12

BUREAU OF RECLAMATION **ESTIMATE WORKSHEET** SHEET _3_ OF _34_

FEATURE: Sulphur Pipeline Regional Rural Water Project Water Treatment Plant Structural/Architectural		**PROJECT:** Arbuckle Project, Oklahoma	
		WOID: OPSPA	**ESTIMATE LEVEL:** Appraisal
		REGION: GP	**UNIT PRICE LEVEL:** Jul-12
		FILE: H:\D8170\EST\Spreadsheet\Bailey\2012 - IJS Estimates\Sulphur Pipeline Regional Water Project\002-a Worksheets in Progress\(IN PROGRESS.Sulphur Compiled Estimate Sheets.rev.perPR.xlsx]Wynnewood PP 1 8420	

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Sulphur Water Treatment Plant					
		(continued)					
		Furnish and erect pre-engineered metal	86-68120	1	ls	$570,000.00	$570,000.00
		building for water treatment plant:					
		Building dimension: 80' W x 110' L w/20' eave					
		height. Primary structural support system: 6					
		steel rigid frames with equal bay spacing.					
		Secondary structural support systems:					
		interconnecting light gauge girts and purlins.					
		Gable roof with 1:12 pitch. Designed for					
		10 ton double girder top running bridge crane.					
		(8,800 ft2)					
		Building manufactured by:					
		Star Building Systems - Lockeford, CA 95237					
		PH: 800-568-7827, Website: www.starbuildings.com					
		Includes:					
		Exterior Wall Panels:					
		Pre-finished, pre-insulated (R-20 min.),					
		metal wall panels. (approx. 7,870 ft2)					
		Exterior Roof Panels:					
		Pre-finished, pre-insulated (R-32 min.),					
		metal wall panels. (approx. 8,830 ft2)					
		Roof & Wall Panels manufactured by:					
		Metl-Span - Lewisville, TX 75057					
		PH: 972-221-6656, Website: metl-span.com					
		SUBTOTAL THIS SHEET					**$570,000.00**

QUANTITIES		PRICES	
BY B. D. VanOtterloo	**CHECKED** B. K. Goplen	**BY** Ian Bailey	**CHECKED**
DATE PREPARED 07/27/12	**PEER REVIEW / DATE** B. K. Goplen, P.E.	**DATE PREPARED** 09/10/12	**PEER REVIEW / DATE** T. Hanke - 9/12/12

BUREAU OF RECLAMATION **ESTIMATE WORKSHEET** SHEET _4_ OF _34_

FEATURE: Sulphur Pipeline Regional Rural Water Project Water Treatment Plant Structural/Architectural		**PROJECT:** Arbuckle Project, Oklahoma	
		WOID: OPSPA	**ESTIMATE LEVEL:** Appraisal
		REGION: GP	**UNIT PRICE LEVEL:** Jul-12
		FILE: H:\D8170\EST\Spreadsheet\Bailey\2012 - IJB Estimates\Sulphur Pipeline Regional Water Project\002-e Worksheets In Progress\[IN PROGRESS Sulphur Compiled Estimate Sheets rev.perPR.xlsx]SUMMARY SHEET	

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Sulphur Water Treatment Plant (continued)					
		Furnish and erect pre-engineered metal building for water treatment plant (continued):	86-68120			ITEMS INCLUDED IN LUMP SUM - SHEET 3	
		Interior Gypsum Board Wall Assembly:					
		6" structural steel studs @ 16"o.c. w/5/8" type ' XP' gypsum board each side, 10' high. (approx. 3,100 ft2)					
		Non-structural Interior Ceilings:					
		40psf, 1" t&g wood decking on 10" bar joist @ 24" o.c. w/5/8" type ' XP' gypsum board on bottom side (approx. 3,300 ft2)					
		Exterior Roll-up Doors (complete w/ hardware):					
		10'-0"w x 12'-0"h exterior, motor operated (2 ea.)					
		16'-0"w x 16'-0"h exterior, motor operated (1 ea.)					
		Steel Doors & Frames: (complete w/hrdwr)					
		EXTERIOR-					
		3' x 7', extr., single, metal, insulated. (3 ea.)					
		INTERIOR-					
		3' x 7', intr., single, metal, half glass. (5 ea.)					
		6' x 7', intr., double, metal, insulated. (4 ea.)					
		Steel Windows & Glazing:					
		6' x 3', fixed, insulated. (control room) (2 ea.)					
		3' x 4', fixed, insulated. (office) (2 ea.)					
		3' x 4', fixed, insulated. (lab) (3 ea.)					
		SUBTOTAL THIS SHEET					

QUANTITIES		PRICES	
BY B. D. VanOtterloo	**CHECKED** B. K. Goplen	**BY** Ian Bailey	**CHECKED**
DATE PREPARED 07/27/12	**PEER REVIEW / DATE** B. K. Goplen, P.E.	**DATE PREPARED** 09/10/12	**PEER REVIEW / DATE** T. Hanke - 9/12/12

BUREAU OF RECLAMATION **ESTIMATE WORKSHEET** SHEET _5_ OF _34_

FEATURE: Sulphur Pipeline Regional Rural Water Project Water Treatment Plant Structural/Architectural	**PROJECT:** Arbuckle Project, Oklahoma
	WOID: OPSPA **ESTIMATE LEVEL:** Appraisal
	REGION: GP **UNIT PRICE LEVEL:** Jul-12
	FILE: H:\D8170\EST\Spreadsheet\Bailey\2012 - IJB Estimates\Sulphur Pipeline Regional Water Project\002-e Worksheets In Progress\[IN.PROGRESS.Sulphur Compiled Estimate Sheets.rev.perPR.xlsx]WTP 5 8120SA

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Sulphur Water Treatment Plant (continued)					
		Furnish and erect pre-engineered metal building for water treatment plant (continued):	86-68120			ITEMS INCLUDED IN LUMP SUM - SHEET 3	
		12'x19' unisex restroom with shower and lockers					
		Gutters, downspouts and splashblocks: (ea. side)					
		SUBTOTAL THIS SHEET					

QUANTITIES		PRICES	
BY B. D. VanOtterloo	CHECKED B. K. Goplen	BY Ian Bailey	CHECKED
DATE PREPARED 07/27/12	PEER REVIEW / DATE B. K. Goplen, P.E.	DATE PREPARED 09/10/12	PEER REVIEW / DATE T. Hanke - 9/12/12

BUREAU OF RECLAMATION **ESTIMATE WORKSHEET** SHEET _6_ OF _34_

FEATURE: Sulphur Pipeline Regional Rural Water Project Water Treatment Plant Structural/Architectural	**PROJECT:** Arbuckle Project, Oklahoma
	WOID: OPSPA **ESTIMATE LEVEL:** Appraisal
	REGION: GP **UNIT PRICE LEVEL:** Jul-12
	FILE: H:\D8170\EST\Spreadsheet\Bailey\2012 - IJB Estimates\Sulphur Pipeline Regional Water Project\002-e Worksheets In Progress\[IN.PROGRESS.Sulphur Compiled Estimate Sheets.rev.perPR.xlsx]Wynnewood PP 1 8420

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Sulphur Water Treatment Plant					
		(continued)					
		Furnish and erect pre-engineered metal	86-68120	1	ls	$28,000.00	$28,000.00
		building for Air Chambers:					
		Building dimension: 18' W x 19' L w/10' eave					
		height. Primary structural support system: 2					
		steel rigid frames with 15'-6" clear span.					
		Secondary structural support systems:					
		interconnecting light gauge girts and purlins.					
		Gable roof with 1:12 pitch. (342 ft2)					
		Building manufactured by:					
		Star Building Systems - Lockeford, CA 95237					
		PH: 800-568-7827, Website: www.starbuildings.com					
		Includes:					
		Exterior Wall Panels:					
		Pre-finished, pre-insulated (R-13 min.),					
		metal wall panels. (approx. 750 ft2)					
		Exterior Roof Panels:					
		Pre-finished, pre-insulated (R-19 min.),					
		metal wall panels. (approx. 340 ft2)					
		Roof & Wall Panels manufactured by:					
		Metl-Span - Lewisville, TX 75057					
		PH: 972-221-6656, Website: metl-span.com					
		SUBTOTAL THIS SHEET					**$28,000.00**

QUANTITIES		PRICES	
BY B. D. VanOtterloo	**CHECKED** B. K. Goplen	**BY** Ian Bailey	**CHECKED**
DATE PREPARED 07/27/12	**PEER REVIEW / DATE** B. K. Goplen, P.E.	**DATE PREPARED** 09/10/12	**PEER REVIEW / DATE** T. Hanke - 9/12/12

BUREAU OF RECLAMATION **ESTIMATE WORKSHEET** SHEET _7_ OF _34_

FEATURE: Sulphur Pipeline Regional Rural Water Project Water Treatment Plant Structural/Architectural		**PROJECT:** Arbuckle Project, Oklahoma	
		WOID: OPSPA	**ESTIMATE LEVEL:** Appraisal
		REGION: GP	**UNIT PRICE LEVEL:** Jul-12
		FILE: H:\D8170\EST\Spreadsheet\Bailey\2012 - IJB Estimates\Sulphur Pipeline Regional Water Project\002-e Worksheets in Progress\[IN.PROGRESS.Sulphur Compiled Estimate Sheets.rev.perPR.xlsx]WTP 5 8120SA	

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Sulphur Water Treatment Plant (continued)					
		Furnish and erect pre-engineered metal building for Air Chambers (continued):	86-68120			ITEMS INCLUDED IN LUMP SUM - SHEET 6	
		Steel Doors & Frames: (complete w/ hardware):					
		6'-0" x 7'-0" x 1 3/4", double, insulated. (1 ea.)					
		Gutters, downspouts and splashblocks:					
		(ea. side)					
		SUBTOTAL THIS SHEET					

QUANTITIES		PRICES	
BY B. D. VanOtterloo	CHECKED B. K. Goplen	BY Ian Bailey	CHECKED
DATE PREPARED 07/27/12	PEER REVIEW / DATE B. K. Goplen, P.E.	DATE PREPARED 09/10/12	PEER REVIEW / DATE T. Hanke - 9/12/12

FEATURE: Sulphur Pipeline Regional Rural Water Project Water Treatment Plant Water Treatment			**PROJECT:** Arbuckle Project, Oklahoma **WOID:** OPSPA **ESTIMATE LEVEL:** Appraisal **REGION:** GP **UNIT PRICE LEVEL:** Jul-12 **FILE:** H:\D8170\EST\Spreadsheet\Bailey\2012 - IJB Estimates\Sulphur Pipeline Regional Water Project\002-a Worksheets in Progress\[N.PROGRESS.Sulphur Compiled Estimate Sheets.rev.perPR.xlsx]Wynnewood PP 1 8420				
PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Water Treatment Equipment					
		Powdered Activated Carbon	86-68120	2	LS	$6,500.00	$13,000.00
		Tecweigh Model CR 5 PAC volumetric feeder					
		Includes the volumetric feeder, liquid mix tank,					
		tank cover, mixer motor and shaft, feeder support					
		stand, and electrical control panel					
		5 lbs/hr feed rate					
		Sludge Treatment	86-68120	2	LS	$320,000.00	$640,000.00
		Belt Press Dewatering System					
		Siemens PressPack™ 2000					
		Includes belt press, feed pump, polymer feed					
		system, air compressor, booster pump, and					
		controls for 70 gpm feed flow rate					
		Packaged Water Trreatment System	86-68120	1	LS	$1,000,000.00	$1,000,000.00
		Siemens Microfloc Trident Model TR 420A					
		3 units @ 700 gpm nominal capacity each					
		each unit includes adsorption clarifier and media filter					
		system includes chemical feed systems for polymer					
		and coagulant; rapid mixer; air compressor for air scour;					
		and control system					
		Backwash waste decant recycle pump	86-68120	2	LS	$3,700.00	$7,400.00
		Centrifugal Pump, 75 gpm					
		Approximate TDH - 30 psi					
		Backwash waste decant recycle pipe	86-68120				
		ASTM A53 galvanized steel					
		3" Diameter, with supports		35	LF	$190.00	$6,650.00
		3" Diameter, buried in yard		40	LF	$100.00	$4,000.00
		SUBTOTAL THIS SHEET					$1,671,050.00

QUANTITIES		PRICES	
BY John L Walp	CHECKED RAJurenka 7/30/2012	BY Ian Bailey	CHECKED
DATE PREPARED 07/27/12	PEER REVIEW / DATE RAJurenka 7/30/2012	DATE PREPARED 09/10/12	PEER REVIEW / DATE T. Hanke - 9/12/12

BUREAU OF RECLAMATION **ESTIMATE WORKSHEET** SHEET 9 OF 34

FEATURE: Sulphur Pipeline Regional Rural Water Project Water Treatment Plant Water Treatment			**PROJECT:** Arbuckle Project, Oklahoma **WOID:** OPSPA **ESTIMATE LEVEL:** Appraisal **REGION:** GP **UNIT PRICE LEVEL:** Jul-12 **FILE:** H:\D8170\EST\Spreadsheet\Bailey\2012 - IJB Estimates\Sulphur Pipeline Regional Water Project\002-a Worksheets in Progress\[IN.PROGRESS.Sulphur Compiled Estimate Sheets.rev.per'PR.xlsx]Wynnewood PP 1 8420				
PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Water Treatment Equipment (cont.)					
		Steel Air Scour Supply Pipe	86-68120				
		ASTM A53 galvanized steel					
		6" Diameter, with supports		80	LF	$250.00	$20,000.00
		4" Diameter, with supports		50	LF	$220.00	$11,000.00
		Steel Backwash Supply Pipe	86-68120				
		ASTM A53 galvanized steel					
		10" Diameter, with supports		100	LF	$340.00	$34,000.00
		10" Diameter, buried in yard		100	LF	$160.00	$16,000.00
		Steel Backwash Waste Pipe	86-68120				
		ASTM A53 galvanized steel					
		14" Diameter, with supports		50	LF	$380.00	$19,000.00
		14" Diameter, encased in foundation concrete		50	LF	$200.00	$10,000.00
		Steel Effluent Pipe	86-68120				
		ASTM A53 galvanized steel					
		14" Diameter, with supports		50	LF	$380.00	$19,000.00
		14" Diameter, encased in foundation concrete		50	LF	$200.00	$10,000.00
		Motor Operated Butterfly Valve	86-68120				
		AWWA C504 cast iron body w/AWWA C542					
		electric actuator					
		4" Diameter, with supports (air supply)		3	ea	$5,000.00	$15,000.00
		6" Diameter, with supports (air supply)		3	ea	$7,000.00	$21,000.00
		8" Diameter, with supports (filter to waste)		3	ea	$9,000.00	$27,000.00
		10" Diameter, with supports (Backwash supply)		3	ea	$10,500.00	$31,500.00
		12" Diameter, with supports (Effluent)		3	ea	$12,000.00	$36,000.00
		14" Diameter, with supports (Backwash waste)		3	ea	$13,000.00	$39,000.00
		SUBTOTAL THIS SHEET					$308,500.00

QUANTITIES		PRICES	
BY John L Walp	CHECKED RAJurenka 7/30/2012	BY Ian Bailey	CHECKED
DATE PREPARED 07/27/12	PEER REVIEW / DATE RAJurenka 7/30/2012	DATE PREPARED 09/10/12	PEER REVIEW / DATE T. Hanke - 9/12/12

BUREAU OF RECLAMATION

ESTIMATE WORKSHEET

FEATURE: Sulphur Pipeline Regional Rural Water Project
Water Treatment Plant

Water Treatment

PROJECT: Arbuckle Project, Oklahoma

WOID:	OPSPA	ESTIMATE LEVEL:	Appraisal
REGION:	GP	UNIT PRICE LEVEL:	Jul-12

FILE: H:\D8170\EST\Spreadsheet\Bailey\2012 - LIB Estimates\Sulphur Pipeline Regional Water Project\002-a Worksheets in Progress\[IN.PROGRESS.Sulphur Compiled Estimate Sheets.rev.perPR.xlsx]Wynnewood PP 1 8420

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Water Treatment Equipment (cont.)					
		Backwash Flow Control System	86-68120	1	LS	$45,000.00	$45,000.00
		Includes one each of the following:					
		10" Isolation gate valve, cast iron					
		10" pressure reducing valve, adjustable 5-20psi					
		10" motorized , positionable, butterfly valve					
		8" Magnetic flowmeter					
		Electronic rate of flow controls w/interface to Package Treatment PLC					
		Chemical feed lines	86-68120	100	LF	$15.00	$1,500.00
		1/2" Diameter Schedule 80 PVC, with supports					
		SUBTOTAL THIS SHEET					$46,500.00

QUANTITIES		PRICES	
BY: John L Walp	CHECKED: RAJurenka 7/30/2012	BY: Ian Bailey	CHECKED
DATE PREPARED: 07/27/12	PEER REVIEW / DATE: RAJurenka 7/30/2012	DATE PREPARED: 09/10/12	PEER REVIEW / DATE: T. Hanke - 9/12/12

BUREAU OF RECLAMATION **ESTIMATE WORKSHEET** SHEET 11 OF 34

FEATURE: Sulphur Pipeline Regional Rural Water Project Water Treatment Plant Mechanical				**PROJECT:** Arbuckle Project, Oklahoma **WOID:** OPSPA **ESTIMATE LEVEL:** Appraisal **REGION:** GP **UNIT PRICE LEVEL:** Jul-12 **FILE:** H:\D8170\EST\Spreadsheet\Bailey\2012 - UB Estimates\Sulphur Pipeline Regional Water Project\002-a Worksheets in Progress\[IN.PROGRESS.Sulphur Compiled Estimate Sheets.rev.perPR.xlsx]WTP 1 8420			
PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Water Treatment Plant - Mechanical					
		Furnish and Install:					
		Pipe to pump suction (epoxy lined and coated)		1	LS	$60,000.00	$60,000.00
		14" OD Steel, 0.25" wall, 38 lb. per ft		110	LF		
		14" OD Steel Dished Head, 25 psi design		1	ea		
		14" AWWA C504 Rubber Seated Buttterfly					
		Valve, Class 25B, manually actuated		1	ea		
		14"x8"x14"AWWA C208 Steel Tee 0.25" Wall		3	ea		
		8" Std. Steel Pipe, 28.6 lb. per ft		18	LF		
		8" Sleeve Coupling, 6.5 psi design pressure		3	ea		
		Harness set for 8" sleeve coupling		3	ea		
		8" AWWA C504 Rubber Seated Buttterfly					
		Valve, Class 25B, manually actuated		3	ea		
		Horizontal Split Case Centrifugal Pump and		3	ea	$31,000.00	$93,000.00
		electrical motor, 1.75 cfs @ 25 ft TDH, Goulds					
		Model 3408A, 6x8-12M with 7.5 hp, 1775 rpm					
		480 volt, three phased, inverter rated					
		Discharge Piping to Rapid Mix Tank (epoxy lined		1	LS	$130,000.00	$130,000.00
		& coated)					
		6" AWWA C504 Rubber Seated Buttterfly					
		Valve, Class 25B, elec. motor actuated		3	ea		
		6" Tilting disc check valve & bottom					
		dampener, 17 psi design pressure at shutoff		3	ea		
		6x8 Steel expander, 0.25" wall		3	ea		
		8" Sleeve Coupling, 17 psi design pressure		3	ea		
		Harness set for 8" sleeve coupling		3	ea		
		8" AWWA C504 Rubber Seated Buttterfly					
		Valve, Class 25B, manually actuated		3	ea		
		SUBTOTAL THIS SHEET					$283,000.00

QUANTITIES		PRICES	
BY Jerry R Waugh	CHECKED Toby Turnage	BY Ian Bailey	CHECKED
DATE PREPARED 07/27/12	PEER REVIEW / DATE Toby Turnage 7/27/2012	DATE PREPARED 09/10/12	PEER REVIEW / DATE T. Hanke - 9/12/12

BUREAU OF RECLAMATION **ESTIMATE WORKSHEET** SHEET 12 OF 34

FEATURE: Sulphur Pipeline Regional Rural Water Project Water Treatment Plant Mechanical			**PROJECT:** Arbuckle Project, Oklahoma **WOID:** OPSPA **ESTIMATE LEVEL:** Appraisal **REGION:** GP **UNIT PRICE LEVEL:** Jul-12 **FILE:** H:\D8170\EST\Spreadsheet\Bailey\2012 - IJB Estimates\Sulphur Pipeline Regional Water Project\002-a Worksheets in Progress\[N.PROGRESS.Sulphur Compiled Estimate Sheets.rev.perPR.xlsx]WTP 2 8420				
PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Water Treatment Plant - Mechanical					
		Discharge Piping to Rapid Mix Tank (Cont.)				ITEMS INCLUDED IN LUMP SUM - SHEET 11	
		14"x8"x14"AWWA C208 Steel Tee 0.25" Wall		6	ea		
		6" Std. steel pipe		7	lf		
		8" Std. steel pipe		19	lf		
		14" OD steel pipe, 0.25" wall		50	lf		
		14" OD Steel Dished Head, 17 psi design		2	ea		
		8" AWWA C504 Rubber Seated Butterfly					
		Valve, Class 25B, elec. motor actuated		6	ea		

QUANTITIES		PRICES	
BY Jerry R Waugh	CHECKED Toby Turnage	BY Ian Bailey	CHECKED
DATE PREPARED 07/27/12	PEER REVIEW / DATE Toby Turnage 7/27/2012	DATE PREPARED 09/10/12	PEER REVIEW / DATE T. Hanke - 9/12/12

BUREAU OF RECLAMATION **ESTIMATE WORKSHEET** SHEET 13 OF 34

FEATURE: Sulphur Pipeline Regional Rural Water Project Water Treatment Plant Mechanical	**PROJECT:** Arbuckle Project, Oklahoma WOID: OPSPA ESTIMATE LEVEL: Appraisal REGION: GP UNIT PRICE LEVEL: Jul-12 FILE: H:\D5170\EST\Spreadsheet\Bailey\2012 - UB Estimates\Sulphur Pipeline Regional Water Project\002-a Worksheets in Progress\[IN.PROGRESS.Sulphur Compiled Estimate Sheets.rev.perPR.xlsx]WTP 3 8420

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Water Treatment Plant - Mechanical					
		Furnish and install the following:					
		Vertical turbine pump, 785.5 gpm @ 130 ft TDH					
		4 stage, 1780 rpm, Goulds Model VIT,					
		Size 10DHLO, with 40 hp, 480 volt, three phase,					
		Inverter rated, electrical motor		3	ea	$55,000.00	$165,000.00
		6" AWWA C504 Rubber Seated Buttterfly					
		Valve, Class 150B, elec. motor actuated		3	ea	$7,000.00	$21,000.00
		6" Tilting disc check valve & bottom dampener					
		damper, 150 psi design pressure at shutoff		3	ea	$4,500.00	$13,500.00
		6x8 Steel expander, 0.25" wall		3	ea	$520.00	$1,560.00
		8" Sleeve Coupling, 150 psi design pressure		3	ea	$400.00	$1,200.00
		Harness set for 8" sleeve coupling		3	ea	$200.00	$600.00
		8" AWWA C504 Rubber Seated Buttterfly					
		Valve, Class 150B, manually actuated		3	ea	$3,500.00	$10,500.00
		14"x8"x14"AWWA C208 Steel Tee 0.25" Wall		3	ea	$1,000.00	$3,000.00
		6" Std. steel pipe		5	lf	$215.00	$1,075.00
		8" Std. steel pipe		11	lf	$215.00	$2,365.00
		14" OD steel pipe, 0.25" wall		6	lf	$280.00	$1,680.00
		14" OD Steel Dished Head, 67 psi design		1	ea	$250.00	$250.00
		Yard Pipe to fence 25 feet from wall of PP					
		14" OD steel pipe, 0.25" wall		30	lf	$280.00	$8,400.00
		Hydraulic transient mitigation		1	LS	$135,000.00	$135,000.00
		793 gallon bladder style horizontal air					
		chamber, Charlatte Hydrochoc, 47" dia.,					
		119" long, 75 psi design pressure		2	ea		
		8" BFV Isolation Valve, AWWA C 504 ,					
		Class 75B, manually actuated		2	ea		
		8" Std. steel pipe		6	lf		
		All pipe epoxy lined and coated					
		SUBTOTAL THIS SHEET					$365,130.00

QUANTITIES		PRICES	
BY Jerry R Waugh	CHECKED Toby Turnage	BY Ian Bailey	CHECKED
DATE PREPARED 07/27/12	PEER REVIEW / DATE Toby Turnage 7/27/2012	DATE PREPARED 09/10/12	PEER REVIEW / DATE T. Hanke - 9/12/12

BUREAU OF RECLAMATION **ESTIMATE WORKSHEET** SHEET _14_ OF _34_

FEATURE: Sulphur Pipeline Regional Rural Water Project Water Treatment Plant Electrical	**PROJECT:** Arbuckle Project, Oklahoma
	WOID: OPSPA **ESTIMATE LEVEL:** Appraisal
	REGION: GP **UNIT PRICE LEVEL:** Jul-12
	FILE: H:\D8170\EST\Spreadsheet\Bailey\2012 - IJB Estimates\Sulphur Pipeline Regional Water Project\002-a Worksheets in Progress\[IN.PROGRESS.Sulphur Compiled Estimate Sheets.rev.perPR.xlsx]Wynnewood PP 8430

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Water Treatment Plant - Electrical					
		Plant & Tank Grounding System (F&I)	86-68430				
	1	Stranded bare copper conductors					
		No. 2 AWG		500	lf	$5.30	$2,650.00
		No. 4 AWG		200	lf	$4.20	$840.00
		4/0 AWG		2,500	lf	$9.20	$23,000.00
	2	Ground rods, 10 ft, 3/4" dia., copper-clad		40	ea	$210.00	$8,400.00
		Plant Service Motor Control Center (F&I)	86-68430				
	3	Indoor Motor Control Equipment					
		600 Volt, 60 Hz, 3 Phase, 600 Amps					
		NEMA type 1 enclosure		1	ea	$125,000.00	$125,000.00
		One incoming power section for control and metering circuits					
		Three feed water pump variable frequency drives					
		Three clear well pump variable frequency drives					
		One 480V distribution panelboard sections					
		Sixteen three-pole molded case circuit breakers					
		Automatic Transfer Switch (F&I)	86-68430				
	4	Outdoor, Service Entrance Rated.					
		600 Volt, 60 Hz, 3 Phase, 600 Amps					
		NEMA type 3R enclosure		1	ea	$10,500.00	$10,500.00
		SUBTOTAL THIS SHEET					**$170,390.00**

QUANTITIES		PRICES	
BY D. Liscomb	**CHECKED** M. Schuh	**BY** Ngoc Dam	**CHECKED** 9/14/12
DATE PREPARED 07/24/12	**PEER REVIEW / DATE** M. Schuh 7/24/12	**DATE PREPARED** 09/10/12	**PEER REVIEW / DATE** L. Ziomke - 9/12/12

BUREAU OF RECLAMATION **ESTIMATE WORKSHEET** SHEET _15_ OF _34_

FEATURE: Sulphur Pipeline Regional Rural Water Project Water Treatment Plant Electrical			**PROJECT:** Arbuckle Project, Oklahoma **WOID:** OPSPA **ESTIMATE LEVEL:** Appraisal **REGION:** GP **UNIT PRICE LEVEL:** Jul-12 **FILE:** H:\D6170\EST\Spreadsheet\Bailey\2012 - I/B Estimates\Sulphur Pipeline Regional Water Project\002-a Worksheets in Progress\[IN PROGRESS.Sulphur Compiled Estimate Sheets.rev.perPR.xlsx]Wynnewood PP 8430				
PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Water Treatment Plant - Electrical					
		Dry-Type Transformer and Panelboards (F&I)	86-68430				
	5	Dry-Type Transformer:		1	ea	$5,300.00	$5,300.00
		112.5 kVA, 480V-208Y/120V					
		floor mounted					
	6	208Y/120 V 42-pole panelboard		3	ea	$5,300.00	$15,900.00
		200 A main circuit breaker					
		Bus size: 225 A					
		Wiring Devices (F&I)	86-68430				
	7	Wiring devices to include: Light switches,		1	ls	$10,500.00	$10,500.00
		120 V receptacles, 120 V GFCI receptacles					
		Power receptacles, 600 volt, 3-wire,					
		4-pole, 100 ampere					
		Motor Control Equipment (F&I)	86-68430				
	8	Non-fusible Motor disconnect switch		6	ea	$790.00	$4,740.00
		480 V, 30 Amp, 3 phase with auxiliary contacts					
		NEMA 4 enclosure					
		Exterior Luminaires (F&I)	86-68430				
	9	208 V, 70 watt, metal halide		6	EA	$400.00	$2,400.00
		wall pack.					
	10	208 V, 150 watt, metal halide		4	EA	$420.00	$1,680.00
		wall pack.					
	11	208 V, 400 watt metal halide		6	ea	$3,700.00	$22,200.00
		street & parking luminaire					
		35 foot pole					
		SUBTOTAL THIS SHEET					**$62,720.00**

QUANTITIES		**PRICES**	
BY D. Liscomb	**CHECKED** M. Schuh	**BY** Ngoc Dam	**CHECKED** 9/14/12
DATE PREPARED 07/24/12	**PEER REVIEW / DATE** M. Schuh 7/24/12	**DATE PREPARED** 09/10/12	**PEER REVIEW / DATE** L. Ziomke - 9/12/12

BUREAU OF RECLAMATION **ESTIMATE WORKSHEET** SHEET _16_ OF _34_

FEATURE: Sulphur Pipeline Regional Rural Water Project Water Treatment Plant Electrical	**PROJECT:** Arbuckle Project, Oklahoma		
	WOID: OPSPA	**ESTIMATE LEVEL:**	Appraisal
	REGION: GP	**UNIT PRICE LEVEL:**	Jul-12
	FILE: H:\D8170\EST\Spreadsheet\Bailey\2012 - IJB Estimates\Sulphur Pipeline Regional Water Project\002-a Worksheets In Progress\[IN PROGRESS.Sulphur Compiled Estimate Sheets.rev.perPR.xlsx]Wynnewood PP 8430		

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Water Treatment Plant - Electrical					
		Interior Luminaires (F&I)	86-68430				
	12	120/277 V, Emergency Exit Signs		6	ea	$550.00	$3,300.00
	13	120/277 V, 4 ft high-bay fluorescent fixtures with six 32 watt T8 lamps		24	ea	$340.00	$8,160.00
	14	120/277 V, 4 ft surface mount fluorescent fixtures with two 32 watt T8 lamps		26	ea	$170.00	$4,420.00
	15	120/277 V, 4 ft recessed mount fluorescent fixtures with two 32 watt T8 lamps		24	ea	$180.00	$4,320.00
	16	120 V, Emergency lighting fixtures with two 12 watt halogen lamps 6 V lead calcium battery		6		$290.00	$1,740.00
		Lighting Controller (F&I)	86-68430				
	17	120/277 V lighting control manual & programmable control		1	EA	$10,500.00	$10,500.00
	18	**F&I Fire Detection & Alarm System**	86-68430	1	ls	$115,000.00	$115,000.00
		SUBTOTAL THIS SHEET					**$147,440.00**

QUANTITIES		PRICES	
BY D. Liscomb	CHECKED M. Schuh	BY Ngoc Dam	CHECKED 9/14/12
DATE PREPARED 07/24/12	PEER REVIEW / DATE M. Schuh 7/24/12	DATE PREPARED 09/10/12	PEER REVIEW / DATE L. Zlomke - 9/12/12

BUREAU OF RECLAMATION **ESTIMATE WORKSHEET** SHEET _17_ OF _34_

FEATURE: Sulphur Pipeline Regional Rural Water Project Water Treatment Plant Electrical	**PROJECT:** Arbuckle Project, Oklahoma
	WOID: OPSPA **ESTIMATE LEVEL:** Appraisal
	REGION: GP **UNIT PRICE LEVEL:** Jul-12
	FILE: H:\D8170\EST\Spreadsheet\Bailey\2012 - I/B Estimates\Sulphur Pipeline Regional Water Project\002-a Worksheets in Progress\[IN.PROGRESS.Sulphur Compiled Estimate Sheets.rev.parPR.xlsx]Wynnewood PP 8430

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Water Treatment Plant - Electrical					
		Raceways (F&I)	86-66430				
	19	Rigid Metal Conduit (RMC)					
		3/4-inch		200	lf	$11.00	$2,200.00
		1-inch		1,600	lf	$14.00	$22,400.00
		1 1/2-inch		200	lf	$18.50	$3,700.00
		2-inch		100	lf	$24.00	$2,400.00
		3- inch		100	lf	$48.00	$4,800.00
		3 1/2-inch		200	lf	$57.00	$11,400.00
	20	Liquidtight Flexible Metal Conduit					
		1-inch		200	lf	$13.00	$2,600.00
	21	6" x 6" lay-in type wireway, NEMA 1		150	lf	$94.00	$14,100.00
	22	8" x 8" lay-in type wireway, NEMA 1		200	lf	$110.00	$22,000.00
	23	Cable tray, aluminum ladder-type					
		6-inch deep, 24-inch wide		100	lf	$56.00	$5,600.00
		6-inch deep, 12-inch wide		100	lf	$44.00	$4,400.00
		SUBTOTAL THIS SHEET					$95,600.00

QUANTITIES		PRICES	
BY D. Liscomb	CHECKED M. Schuh	BY Ngoc Dam	CHECKED 9/12/12
DATE PREPARED 07/24/12	PEER REVIEW / DATE M. Schuh 7/24/12	DATE PREPARED 09/10/12	PEER REVIEW / DATE L. Zlomke - 9/12/12

BUREAU OF RECLAMATION **ESTIMATE WORKSHEET** SHEET _18_ OF _34_

FEATURE: Sulphur Pipeline Regional Rural Water Project Reregulating Reservoir Pumping Plant Structural/Architectural	**PROJECT:** Arbuckle Project, Oklahoma		
	WOID: OPSPA	**ESTIMATE LEVEL:**	Appraisal
	REGION: GP	**UNIT PRICE LEVEL:**	Jul-12
	FILE: H:\D8170\EST\Spreadsheet\Bailey\2012 - IJB Estimates\Sulphur Pipeline Regional Water Project\002-e Worksheets In Progress\[IN.PROGRESS.Sulphur Compiled Estimate Sheets.rev.perPR.xlsx]Wynnewood PP 1 $420		

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Regulating Reservoir Outlet Structure and Pump Station					
		Construct and Remove Cofferdam around Regulating Reservoir Outlet Structure	86-68120	1	ls	$62,100.00	$62,100.00
		Bottom of Regulating Reservoir: El. 979.0					
		Assumed Top of Cofferdam Wall: El. 988.0					
		"Super Sack" Cofferdam					
		Construct out of 40 ft3 "Super Sack" bulk storage bags. Construct after water in reg. reservoir is drawn down below El. 988.0					
		Furnish, Fill, Install and Remove "Super Sacks"					
		82 sacks @ 38" x 38" x 38" (40 ft3 ea.)					
		Place sacks with crane - 2.5 tons at 40 ft reach					
		Use fill from site excavation to fill sacks					
		Initial unwatering behind "Super Sack" cofferdam					
		20 gpm pump for 24 hours per day					
		for 2 continuous days					
		Continuous unwatering during construction					
		2 - 50 gallon sumps with 5 gpm sump pumps					
		Assume run time of 10 minutes every hour					
		and 6 weeks for construction of outlet structure					
		SUBTOTAL THIS SHEET					**$62,100.00**

QUANTITIES		PRICES	
BY B. K. Goplen	**CHECKED** B. D. VanOtterloo	**BY** Ian Bailey	**CHECKED**
DATE PREPARED 07/27/12	**PEER REVIEW / DATE** B. D. VanOtterloo, P.E.	**DATE PREPARED** 09/10/12	**PEER REVIEW / DATE** T. Hanke - 9/12/12

BUREAU OF RECLAMATION **ESTIMATE WORKSHEET** SHEET _19_ OF _34_

FEATURE: Sulphur Pipeline Regional Rural Water Project Reregulating Reservoir Pumping Plant Structural/Architectural	**PROJECT:** Arbuckle Project, Oklahoma
	WOID: OPSPA **ESTIMATE LEVEL:** Appraisal
	REGION: GP **UNIT PRICE LEVEL:** Jul-12
	FILE: H:\D8170\EST\Spreadsheet\Bailey\2012 - IJB Estimates\Sulphur Pipeline Regional Water Project\002-a Worksheets in Progress\[IN.PROGRESS.Sulphur Compiled Estimate Sheets.rev.perPR.xlsx]Wynnewood PP 1 5420

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Regulating Reservoir Outlet Structure and Pump Station (cont.)					
		Sawcut and remove existing 4-inch thick reinforced concrete reservoir lining	86-68120	1	ls	$14,200.00	$14,200.00
		Sawcut 75 lin ft. 4" concrete reservoir lining					
		Remove/Dispose 640 ft2 of 4" reservoir lining					
		Stripping (Remove and dispose 6" topsoil)	86-68120	155	yd3	$15.00	$2,325.00
		Pump Station Service Yard					
		Place and compact embankment for service yard	86-68120	600	yd3	$30.00	$18,000.00
		Structural Excavation - common	86-68120	1,160	yd3	$20.00	$23,200.00
		Outlet Structure = 400 yd3					
		Intake Pipe Trench = 190 yd3					
		Pump Station = 570 yd3					
		Backfill for Structures	86-68120	840	yd3	$15.00	$12,600.00
		Outlet Structure = 330 yd3					
		Intake Pipe Trench = 190 yd3					
		Pump Station = 320 yd3					
		Compact Backfill for Structures	86-68120	840	yd3	$15.00	$12,600.00
		Outlet Structure = 330 yd3					
		Intake Pipe Trench = 190 yd3					
		Pump Station = 320 yd3					
		SUBTOTAL THIS SHEET					**$82,925.00**

QUANTITIES		PRICES	
BY B. K. Goplen	CHECKED B. D. VanOtterloo	BY Ian Bailey	CHECKED
DATE PREPARED 07/27/12	PEER REVIEW / DATE B. D. VanOtterloo, P.E.	DATE PREPARED 09/10/12	PEER REVIEW / DATE T. Hanke - 9/12/12

BUREAU OF RECLAMATION **ESTIMATE WORKSHEET** SHEET _20_ OF _34_

FEATURE: Sulphur Pipeline Regional Rural Water Project Reregulating Reservoir Pumping Plant Structural/Architectural	**PROJECT:** Arbuckle Project, Oklahoma
	WOID: OPSPA **ESTIMATE LEVEL:** Appraisal
	REGION: GP **UNIT PRICE LEVEL:** Jul-12
	FILE: H:\D8170\EST\Spreadsheet\Bailey\2012 - IJB Estimates\Sulphur Pipeline Regional Water Project\002-a Worksheets In Progress\[IN.PROGRESS.Sulphur Compiled Estimate Sheets.rev.parPR.xlsx]Wynnewood PP 1 8420

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Regulating Reservoir Outlet Structure and Pump Station (cont.)					
		4-inch thick reinforced concrete reservoir lining	86-68120	1	ls	$4,000.00	$4,000.00
		Place and finish 520 ft2					
		Furnish, Form and Place Concrete	86-68120	183	yd2	$800.00	$146,400.00
		4500 psi					
		Outlet Structure = 47 yd3 (13.5 tons cement)					
		Pump Station = 120 yd3 (34 tons cement)					
		Air Chamber foundation = 16 yd3 (4.5 tons cement)					
		Furnished and place reinforcing bars	86-68120	27,300	lbs	$1.50	$40,950.00
		Outlet Structure = 7,050 lbs					
		Pump Station = 18,000 lbs					
		Air Chamber foundation = 2,250 lbs					
		Miscellaneous Metalwork	86-68120	1,210	lbs	$10.00	$12,100.00
		Assume all miscellaneous metalwork is steel.					
		Includes frame and grating, access hatch, ladders, and bollards					
		Outlet Structure = 610 lbs					
		Pump Station = 600 lbs					
		Gravel surfacing - 6-inch thick	86-68120	690	yd2	$10.00	$6,900.00
		7-foot chain link fence for service yard	86-68120	335	lin ft	$45.00	$15,075.00
		Include 1- 20 ft. double swing gate					
		SUBTOTAL THIS SHEET					**$225,425.00**

QUANTITIES		PRICES	
BY B. K. Goplen	CHECKED B. D. VanOtterloo	BY Ian Bailey	CHECKED
DATE PREPARED 07/27/12	PEER REVIEW / DATE B. D. VanOtterloo, P.E.	DATE PREPARED 09/10/12	PEER REVIEW / DATE T. Hanke - 9/12/12

BUREAU OF RECLAMATION **ESTIMATE WORKSHEET** SHEET _21_ OF _34_

FEATURE: Sulphur Pipeline Regional Rural Water Project Reregulating Reservoir Pumping Plant Structural/Architectural		**PROJECT:** Arbuckle Project, Oklahoma	
		WOID: OPSPA	**ESTIMATE LEVEL:** Appraisal
		REGION: GP	**UNIT PRICE LEVEL:** Jul-12
		FILE: H:\D8170\EST\Spreadsheet\Bailey\2012 - IJB Estimates\Sulphur Pipeline Regional Water Project\002-a Worksheets In Progress\[IN PROGRESS.Sulphur Compiled Estimate Sheets.rev.perPR.xlsx]Wynnewood PP 1 8420	

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Regulating Reservoir Outlet Structure and Pump Station (cont.)					
		Furnish and erect pre-engineered metal building for Pump Station:	66-68120	1	ls	$85,000.00	$85,000.00
		Building dimension: 32.5' W x 40' L w/12' eave height. Primary structural support system: 4 steel rigid frames with 29'-0" clear span and equal bay spacing. Secondary structural support systems: interconnecting light gauge girts and purlins. Gable roof with 1:12 pitch. Designed for 1.5 ton single girder under hung bridge crane. (1300 ft2)					
		Building manufactured by:					
		Star Building Systems - Lockeford, CA 95237					
		PH: 800-568-7827, Website: www.starbuildings.com					
		Includes:					
		Exterior Wall Panels: Pre-finished, pre-insulated (R-13 min.), metal wall panels. (approx. 1,500 ft2) Include 24" high continuous vision panel on the two longitudinal sides of bldg. (approx. 80 lf)					
		SUBTOTAL THIS SHEET					$85,000.00

QUANTITIES		PRICES	
BY B. D. VanOtterloo	CHECKED B. K. Goplen	BY Jan Bailey	CHECKED
DATE PREPARED 07/27/12	PEER REVIEW / DATE B. K. Goplen, P.E.	DATE PREPARED 09/10/12	PEER REVIEW / DATE T. Hanke - 9/12/12

BUREAU OF RECLAMATION **ESTIMATE WORKSHEET** SHEET _22_ OF _34_

FEATURE: Sulphur Pipeline Regional Rural Water Project Reregulating Reservoir Pumping Plant Structural/Architectural	**PROJECT:** Arbuckle Project, Oklahoma
	WOID: OPSPA **ESTIMATE LEVEL:** Appraisal
	REGION: GP **UNIT PRICE LEVEL:** Jul-12
	FILE: H:\D8170\EST\Spreadsheet\Bailey\2012 - IJB Estimates\Sulphur Pipeline Regional Water Project\002-a Worksheets In Progress\[IN PROGRESS Sulphur Compiled Estimate Sheets rev.per PR.xlsx]Wynnewood PP 1 8420

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Regulating Reservoir Outlet Structure and Pump Station (cont.)					
		Furnish and erect pre-engineered metal building for Pump Station (continued):	86-68120			Items Included in Lump Sum - Sheet 21	
		Exterior Roof Panels:					
		Pre-finished, pre-insulated (R-19 min.), metal wall panels. (approx. 1300 ft2)					
		Roof & Wall Panels manufactured by:					
		Metl-Span - Lewisville, TX 75057					
		PH: 972-221-6656, Website: metl-span.com					
		Exterior Roll-up Doors (complete w/ hardware):					
		10'-0"w x 10'-0"h exterior, motor operated (1 ea.)					
		Steel Doors & Frames: (complete w/ hardware):					
		3'-0" x 7'-0" x 1 3/4", single, insulated. (2 ea.)					
		Steel Windows & Frames:					
		3'-0" x 4'-0", fixed, insulated. (2 ea.)					
		Gutters, downspouts and splashblocks:					
		(ea. side)					
		SUBTOTAL THIS SHEET					

QUANTITIES		**PRICES**	
BY B. D. VanOtterloo	**CHECKED** B. K. Goplen	**BY** Ian Bailey	**CHECKED**
DATE PREPARED 07/27/12	**PEER REVIEW / DATE** B. K. Goplen, P.E.	**DATE PREPARED** 09/10/12	**PEER REVIEW / DATE** T. Hanke - 9/12/12

BUREAU OF RECLAMATION **ESTIMATE WORKSHEET** SHEET _23_ OF _34_

FEATURE: Sulphur Pipeline Regional Rural Water Project Reregulating Reservoir Pumping Plant Structural/Architectural	**PROJECT:** Arbuckle Project, Oklahoma WOID: OPSPA — ESTIMATE LEVEL: Appraisal REGION: GP — UNIT PRICE LEVEL: Jul-12 FILE: H:\D8170\EST\Spreadsheet\Bailey\2012 - IJB Estimates\Sulphur Pipeline Regional Water Project\002-a Worksheets In Progress\[IN PROGRESS.Sulphur Compiled Estimate Sheets.rev.perPR.xlsx]Wynnewood PP 1 8420

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Regulating Reservoir Outlet Structure and Pump Station (cont.)					
		Furnish and erect pre-engineered metal building for Air Chambers:	86-68120	1	ls	$28,000.00	$28,000.00
		Building dimension: 18' W x 19' L w/10' eave height. Primary structural support system: 2 steel rigid frames with 15'-6" clear span. Secondary structural support systems: interconnecting light gauge girts and purlins. Gable roof with 1:12 pitch. (342 ft2)					
		Building manufactured by:					
		Star Building Systems - Lockeford, CA 95237					
		PH: 800-568-7827, Website: www.starbuildings.com					
		Includes:					
		Exterior Wall Panels: Pre-finished, pre-insulated (R-13 min.), metal wall panels. (approx. 750 ft2)					
		Exterior Roof Panels: Pre-finished, pre-insulated (R-19 min.), metal wall panels. (approx. 340 ft2)					
		Roof & Wall Panels manufactured by:					
		Metl-Span - Lewisville, TX 75057					
		PH: 972-221-6656, Website: metl-span.com					
		SUBTOTAL THIS SHEET					$28,000.00

QUANTITIES		PRICES	
BY B. D. VanOtterloo	CHECKED B. K. Goplen	BY Ian Bailey	CHECKED
DATE PREPARED 07/27/12	PEER REVIEW / DATE B. K. Goplen, P.E.	DATE PREPARED 09/10/12	PEER REVIEW / DATE T. Hanke - 9/12/12

BUREAU OF RECLAMATION **ESTIMATE WORKSHEET** SHEET _24_ OF _34_

FEATURE: Sulphur Pipeline Regional Rural Water Project Reregulating Reservoir Pumping Plant Structural/Architectural		**PROJECT:** Arbuckle Project, Oklahoma	
		WOID: OPSPA	**ESTIMATE LEVEL:** Appraisal
		REGION: GP	**UNIT PRICE LEVEL:** Jul-12
		FILE: H:\D8170\EST\Spreadsheet\Bailey\2012 - IJB Estimates\Sulphur Pipeline Regional Water Project\C02-e Worksheets in Progress\[IN.PROGRESS.Sulphur Compiled Estimate Sheets.rev.perPR.xlsx]Wynnewood PP 1 8420	

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Regulating Reservoir Outlet Structure and Pump Station (cont.)					
		Furnish and erect pre-engineered metal building for Air Chambers (continued):	86-68120			Items included in Lump Sum - Sheet 23	
		Steel Doors & Frames: (complete w/ hardware): 6'-0" x 7'-0" x 1 3/4", double, insulated. (1 ea.)					
		Gutters, downspouts and splashblocks: (ea. side)					
		SUBTOTAL THIS SHEET					

QUANTITIES		PRICES	
BY B. D. VanOtterloo	CHECKED B. K. Goplen	BY Ian Bailey	CHECKED
DATE PREPARED 07/27/12	PEER REVIEW / DATE B. K. Goplen, P.E.	DATE PREPARED 09/10/12	PEER REVIEW / DATE T. Hanke - 9/12/12

BUREAU OF RECLAMATION **ESTIMATE WORKSHEET** SHEET 25 OF 34

FEATURE: Sulphur Pipeline Regional Rural Water Project Reregulating Reservoir Pumping Plant Mechanical				**PROJECT:** Arbuckle Project, Oklahoma **WOID:** OPSPA **ESTIMATE LEVEL:** Appraisal **REGION:** GP **UNIT PRICE LEVEL:** Jul-12 **FILE:** H:\D8170\EST\Spreadsheet\Bailey\2012 - UB Estimates\Sulphur Pipeline Regional Water Project\002-a Worksheets In Progress\(IN PROGRESS.Sulphur Compiled Estimate Sheets.rev.perFR.xlsx]ReReg 1 8420			
PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Intake		1	LS	$40,000.00	$40,000.00
		Trashrack		2,800	lb		
		14" square slide gate		1	ea		
		Suction Pipe to exterior wall of Pumping Plant					
		14" OD Steel, 0.25" wall, 38 lb. per ft		74	LF	$280.00	$20,720.00
		Suction Piping within Pumping Plant		1	LS	$40,000.00	$40,000.00
		14" OD Steel, 0.25" wall, 38 lb. per ft		15	LF		
		14" OD Steel Dished Head, 25 psi design		1	ea		
		8" Std. Steel Pipe, 28.6 lb. per ft		22	LF		
		14"x8"x14"AWWA C208 Steel Tee 0.25" Wall		3	ea		
		8"x4" AWWA C208 Steel Reducer, 0.25" Wall		3	ea		
		8" Sleeve Coupling, 6.5 psi design pressure		3	ea		
		Harness set for 8" sleeve coupling		3	ea		
		8" AWWA C504 Rubber Seated Buttterfly					
		Valve, Class 25B, manually actuated		3	ea		
		All pipe epoxy lined and coated					
		Horizontal Split Case Centrifugal Pump and					
		electrical motor, 1.75 cfs @ 140 ft TDH, Goulds					
		Model 3408, 4x6-12A-2A with 50 hp, 1775 rpm					
		480 volt, three phase, furnished and installed		3	ea	$47,000.00	$141,000.00
		Discharge Piping within Pumping Plant		1	LS	$65,000.00	$65,000.00
		All pipe epoxy lined and coated					
		6" AWWA C504 Rubber Seated Buttterfly					
		Valve, Class 75B, elec. motor actuated		3	ea		
		6" Tilting disc check valve & bottom					
		dampener, 76 psi design pressure at shutoff		3	ea		
		6x8 Steel expander, 0.25" wall		3	ea		
		8" Sleeve Coupling, 76 psi design pressure		3	ea		
		Harness set for 8" sleeve coupling		3	ea		
		8" AWWA C504 Rubber Seated Buttterfly					
		Valve, Class 150B, manually actuated		3	ea		$306,720.00

QUANTITIES		PRICES	
BY Jerry R Waugh	CHECKED Toby Turnage	BY Ian Bailey	CHECKED
DATE PREPARED 07/27/12	PEER REVIEW / DATE Toby Turnage 7/27/2012	DATE PREPARED 09/10/12	PEER REVIEW / DATE T. Hanke - 9/12/12

BUREAU OF RECLAMATION **ESTIMATE WORKSHEET** SHEET 26 OF 34

FEATURE: Sulphur Pipeline Regional Rural Water Project
Reregulating Reservoir Pumping Plant
Mechanical

PROJECT: Arbuckle Project, Oklahoma

WOID: OPSPA | ESTIMATE LEVEL: Appraisal
REGION: GP | UNIT PRICE LEVEL: Jul-12
FILE: H:\D8170\EST\Spreadsheet\Bailey\2012 - IJB Estimates\Sulphur Pipeline Regional Water Project\002-e Worksheets In Progress\[IN PROGRESS Sulphur Compiled Estimate Sheets.rev.perPR.xlsx]ReReg 2 8420

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Discharge Piping within Pumping Plant (Cont.)				SEE LUMP SUM ON PREVIOUS SHEET	
		14"x8"x14"AWWA C208 Steel Tee 0.25" Wall		3	ea		
		6" Std. steel pipe, epoxy lined and coated		5	LF		
		8" Std. steel pipe, epoxy lined and coated		20	LF		
		14" OD steel pipe, 0.25" wall, epoxy lined & coated		15	LF		
		14" OD Steel Dished Head, 67 psi design		1	ea		
		Yard Pipe to fence 25 feet from wall of PP					
		14" OD steel pipe, 0.25" wall, epoxy lined & coated		30	LF	$280.00	$8,400.00
		Hydraulic transient mitigation		1	LS	$135,000.00	$135,000.00
		793 gallon bladder style horizontal air chamber, Charlatte Hydrochoc, 47" dia., 119" long, 75 psi design pressure		2	ea		
		8" BFV Isolation Valve, AWWA C 504 , Class 75B, manually actuated		2	ea		
		8" Std. steel pipe, epoxy lined and coated		6	lf		
		SUBTOTAL THIS SHEET					$143,400.00

QUANTITIES		PRICES	
BY Jerry R Waugh	CHECKED Toby Turnage	BY Ian Bailey	CHECKED
DATE PREPARED 07/27/12	PEER REVIEW / DATE Toby Turnage 7/27/2012	DATE PREPARED 09/10/12	PEER REVIEW / DATE T. Hanke - 9/12/12

BUREAU OF RECLAMATION **ESTIMATE WORKSHEET** SHEET _27_ OF _34_

FEATURE: Sulphur Pipeline Regional Rural Water Project Reregulating Reservoir Pumping Plant Electrical	**PROJECT:** Arbuckle Project, Oklahoma
	WOID: OPSPA **ESTIMATE LEVEL:** Appraisal
	REGION: GP **UNIT PRICE LEVEL:** Jul-12
	FILE: H:\D8170\EST\Spreadsheet\Bailey\2012 - IJB Estimates\Sulphur Pipeline Regional Water Project\602-e Worksheets In Progress\[IN.PROGRESS.Sulphur Compiled Estimate Sheets.rev.parPR.xlsx]Wynnewood PP 8430

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Plant Service Motor Control Center (F&I)	86-68430	1	ls	$115,000.00	$115,000.00
	1	600 V Motor Control Center					
		NEMA 12 enclosure with the following					
		features:					
		600 volt, 600 ampere bus					
		Three full voltage non-reversing NEMA size 3 motor starter					
		One 200A circuit breaker (main disconnect)					
		One integrated 120 volt panelboard					
		One 7.5 kVA 480-120V transformer					
		Four 20A molded-case circuit breakers					
		Conduit System (F&I)	86-68430				
	2	Rigid steel conduit					
		1 inch		200	ft	$14.00	$2,800.00
		1.5 inch		100	ft	$19.00	$1,900.00
	3	Plastic-coated rigid steel (PCRS)					
		3 inch		200	ft	$78.00	$15,600.00
		Grounding System (F&I)	86-68430				
	4	10 ft, 3/4 in dia copper ground rod		2	ea	$210.00	$420.00
	5	4 AWG bare stranded-copper cable		150	ft	$4.20	$630.00
		Exterior Lighting	86-68430				
	6	120 V, 150 watt, metal halide		1	ea	$420.00	$420.00
		wall pack.					
		Interior Lighting	86-68430				
	7	Watertight incandescent fixtures					
		120 VAC, 150 watt		4	ea	$190.00	$760.00
	8	120/277 V, 4 ft surface mount fluorescent fixtures with					
		two 32 watt T8 lamps		2	ea	$170.00	$340.00
		SUBTOTAL THIS SHEET					**$137,870.00**

QUANTITIES		PRICES	
BY D. Liscomb	CHECKED M. Schuh	BY Ngoc Dam	CHECKED IJB 9/14/12
DATE PREPARED 07/24/12	PEER REVIEW / DATE M. Schuh 7/24/12	DATE PREPARED 09/10/12	PEER REVIEW / DATE L. Ziomke - 9/12/12

BUREAU OF RECLAMATION **ESTIMATE WORKSHEET** SHEET _28_ OF _34_

FEATURE: Sulphur Pipeline Regional Rural Water Project Reregulating Reservoir Pumping Plant Electrical	**PROJECT:** Arbuckle Project, Oklahoma
	WOID: OPSPA **ESTIMATE LEVEL:** Appraisal
	REGION: GP **UNIT PRICE LEVEL:** Jul-12
	FILE: H:\D8170\EST\Spreadsheet\Bailey\2012 - IJB Estimates\Sulphur Pipeline Regional Water Project\002-e Worksheets in Progress\[IN.PROGRESS.Sulphur Compiled Estimate Sheets.rev.perPR.xlsx]Wynnewood PP 8430

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Wiring Devices (F&I)	86-68430				
	9	Wiring devices to include: Light switches,		1	ls	$10,500.00	$10,500.00
		120 V GFCI receptacles					
		Power receptacle, 600 volt, 3-wire,					
		4-pole, 100 ampere					
		~~**Pump Motors**~~	86-68420				
	10	~~Horizontal, TEFC, 460 volt, 3Ø, 1800 RPM~~					
		~~Premium efficiency, Class F insulation~~					
		~~50 horsepower~~		3	ea		DELETED
		Automatic Transfer Switch (F&I)	86-68430				
	11	Outdoor, Service Entrance Rated.					
		480 Volt, 60 Hz, 3 Phase, 200 Amps					
		NEMA type 3R enclosure		1	ea	$7,400.00	$7,400.00
	12	**F&I Fire Detection & Alarm System**	86-68430	1	ls	$4,400.00	$4,400.00
		Assumptions: 480 volt, 3Φ, power available					
		at the site. To be furnished by others.					
		SUBTOTAL THIS SHEET					**$22,300.00**

QUANTITIES		PRICES	
BY D. Liscomb	**CHECKED** M. Schuh	**BY** Ngoc Dam	**CHECKED** 9/14/12
DATE PREPARED 07/24/12	**PEER REVIEW / DATE** M. Schuh 7/24/12	**DATE PREPARED** 09/10/12	**PEER REVIEW / DATE** L. Zlomke - 9/12/12

BUREAU OF RECLAMATION **ESTIMATE WORKSHEET** SHEET _29_ OF _34_

FEATURE: Sulphur Pipeline Regional Rural Water Project Wynnewood Pumping Plant Upgrade Structural/Architectural			**PROJECT:** Arbuckle Project, Oklahoma **WOID:** OPSPA **ESTIMATE LEVEL:** Appraisal **REGION:** GP **UNIT PRICE LEVEL:** Jul-12 **FILE:** H:\D8170\EST\Spreadsheet\Bailey\2012 - IJB Estimates\Sulphur Pipeline Regional Water Project\002-e Worksheets In Progress\[IN.PROGRESS.Sulphur Compiled Estimate Sheets.rev.perPR.xlsx]Wynnewood PP 1 8420				
PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Wynnewood Pumping Plant Modifications					
		Remove and dispose of existing reinforced concrete pump pedestals 4 pedestals @ 1 yd3 ea. = 4 yd3 total	86-68120	1	ls	$8,000.00	$8,000.00
		New reinforced concrete pump pedestals 4 pedestals includes: 4.8 yd3 4500 psi concrete Reinforcing steel = 630 lbs	86-68120	1	ls	$15,000.00	$15,000.00
		SUBTOTAL THIS SHEET					$23,000.00

QUANTITIES		PRICES	
BY B. K. Goplen	CHECKED B. D. VanOtterloo	BY Ian Bailey	CHECKED
DATE PREPARED 07/27/12	PEER REVIEW / DATE B. D. VanOtterloo, P.E.	DATE PREPARED 09/10/12	PEER REVIEW / DATE T. Hanke - 9/12/12

BUREAU OF RECLAMATION

ESTIMATE WORKSHEET

FEATURE: Sulphur Pipeline Regional Rural Water Project
Wynnewood Pumping Plant Upgrade
Mechanical

PROJECT: Arbuckle Project, Oklahoma

WOID: OPSPA **ESTIMATE LEVEL:** Appraisal

REGION: GP **UNIT PRICE LEVEL:** Jul-12

FILE: H:\D8170\EST\Spreadsheet\Bailey\2012 - UB Estimates\Sulphur Pipeline Regional Water Project\002-a Worksheets In Progress\[N.PROGRESS.Sulphur Compiled Estimate Sheets.rev.perPR.xlsx]Wynnewood PP 1 8420

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Remove existing items from Wynnewood PP:					
		Suction piping		1	LS	$7,500.00	$7,500.00
		10" steel pipe		10	lf		
		10 x 8" reducer		4	ea		
		8" steel pipe		13	lf		
		8" gate valve		4	ea		
		Split case centrifugal pump with		1	LS	$12,500.00	$12,500.00
		1785 rpm, 100 Hp motor, 480 volts, 3 phase					
		Q=3.45 cfs@ 179' TDH		4	ea		
		Discharge piping		1	LS	$7,500.00	$7,500.00
		6" steel pipe		24	lf		
		6" Hydraulically actuated gate valve		4	ea		
		6" Gate valve, manually actuated,		4	ea		
		6 x10 expander		4	ea		
		Hydraulic Fluid Power Unit with 150 psi air over		1	LS	$10,000.00	$10,000.00
		oil accumulator with sight guage, pressure relief					
		valve, check valve, press. guage, drain valve,					
		isolation valve, oil pump, air compressor, oil					
		reservoir, reservoir isolation valves, 4 directional					
		control valves, 4 flow control valves, 8 air bleed					
		valves, 4 isolation valves, 4 filters,					
		float switches, pressure switches					
		Small diameter hydraulic fluid piping		200	ft	Included in Lump Sum Above	
		SUBTOTAL THIS SHEET					$37,500.00

QUANTITIES		PRICES	
BY Jerry R Waugh	CHECKED Toby Turnage	BY Ian Bailey	CHECKED
DATE PREPARED 07/27/12	PEER REVIEW / DATE Toby Turnage 7/27/2012	DATE PREPARED 09/10/12	PEER REVIEW / DATE T. Hanke - 9/12/12

BUREAU OF RECLAMATION **ESTIMATE WORKSHEET** SHEET 31 OF 34

FEATURE: Sulphur Pipeline Regional Rural Water Project Wynnewood Pumping Plant Upgrade Mechanical	**PROJECT:** Arbuckle Project, Oklahoma
	WOID: OPSPA **ESTIMATE LEVEL:** Appraisal
	REGION: GP **UNIT PRICE LEVEL:** Jul-12
	FILE: H:\D8170\EST\Spreadsheet\Bailey\2012 - IJB Estimates\Sulphur Pipeline Regional Water Project\002-e Worksheets In Progress\[IN PROGRESS.Sulphur Compiled Estimate Sheets.rev.perPR.xlsx]Wynnewood PP 2 8420

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Furnish and install the following:					
		Intake piping		1	LS	$39,000.00	$39,000.00
		8" Std steel pipe per AWWA C200,					
		epoxy lined and coated		25	lf		
		8" Rubber seated, manually actuated BFV,					
		AWWA C504 Class 25B		4	ea		
		10"x8" reducer		4	ea		
		Split case centrifugal pump,ITT Goulds 8x8-17,					
		1785 rpm, 125 Hp motor, Q=4.37 cfs@ 180' TDH		4	ea	$95,000.00	$380,000.00
		Discharge piping		1	LS	$66,000.00	$66,000.00
		8" Std steel pipe per AWWA C200,					
		epoxy lined and coated		27	lf		
		8" Hydraulically actuated gate valve, AWWA					
		C500, 200 psi design pressure		4	ea		
		8" Rubber seated BFV, manually actuated,					
		AWWA C504 Class 150B		4	ea		
		8"x10" expander		4	ea		
		Hydraulic Fluid Power Unit with 300 psi air over					
		oil accumulator with sight guage, pressure relief					
		valve, check valve, press. guage, drain valve,					
		isolation valve, oil pump, air compressor, oil					
		reservoir, reservoir isolation valves, 4 directional					
		control valves, 4 flow control valves, 8 air bleed					
		valves, 4 isolation valves, 4 filters,		1	ls	$75,000.00	$75,000.00
		float switches, pressure switches					
		2" Hydraulic fluid steel piping, 300psi design					
		pressure		125	lf	$40.00	$5,000.00
		1" Hydraulic fluid steel piping, 300 psi design					
		pressure		80	lf	$25.00	$2,000.00
		SUBTOTAL THIS SHEET					$567,000.00

QUANTITIES		PRICES	
BY Jerry R Waugh	CHECKED Toby Turnage	BY Ian Bailey	CHECKED
DATE PREPARED 07/27/12	PEER REVIEW / DATE Toby Turnage 7/27/2012	DATE PREPARED 09/10/12	PEER REVIEW / DATE T. Hanke - 9/12/12

BUREAU OF RECLAMATION

ESTIMATE WORKSHEET

FEATURE: Sulphur Pipeline Regional Rural Water Project
Wynnewood Pumping Plant Upgrade
Electrical

PROJECT: Arbuckle Project, Oklahoma

WOID:	OPSPA	ESTIMATE LEVEL:	Appraisal
REGION:	GP	UNIT PRICE LEVEL:	Jul-12

FILE: H:\D8170\EST\Spreadsheet\Bailey\2012 - IJB Estimates\Sulphur Pipeline Regional Water Project\002-a Worksheets In Progress\IN PROGRESS.Sulphur Compiled Estimate Sheets.rev.perPR.xlsx]Wynnewood PP 8430

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
	1	**Modifications**	86-68430				
		Modify existing conduit and cable associated					
		with equipment replecement.		720	lf	$11.50	$8,280.00
		Provide additional conduit and cable as necessary		180	lf	$78.00	$14,040.00
		to support new 750kVA transformer.					
	2	**Removal of Existing Electrical Equipment**	86-68430				
		600 Volt Motor Control Center		1	ea	$1,450.00	$1,450.00
		200 kW Engine Generator		1	ea	$2,700.00	$2,700.00
		Include support equipment					
	3	**Automatic Transfer Switch (F&I)**	86-68430				
		Outdoor, Service Entrance Rated.		1	ea	$19,500.00	$19,500.00
		600 Volt, 60 Hz, 3 Phase, 1000 Amps					
		NEMA type 3R enclosure					
	4	**600 Volt Motor Control Center (F&I)**	86-68430				
		NEMA 1 enclosure with following features:		1	ea	$190,000.00	$190,000.00
		600 volt, 1000 ampere horizontal bus					
		Four NEMA size 5 starters					
		One incoming line section					
		One 480 volt station service section					
		One 25 kVA 480-240/120 volt transformer					
		One 240/120 volt distribution section					
		One 30 kVA 480-208Y/120 volt transformer					
		One 208Y/120 volt distribution section					
							$235,970.00

QUANTITIES		PRICES	
BY D. Liscomb	CHECKED M. Schuh	BY Ngoc Dam	CHECKED 9/14/12
DATE PREPARED 07/26/12	PEER REVIEW / DATE M. Schuh 7/26/12	DATE PREPARED 09/10/12	PEER REVIEW / DATE L. Ziomke - 9/12/12

BUREAU OF RECLAMATION **ESTIMATE WORKSHEET** SHEET _33_ OF _34_

FEATURE: Sulphur Pipeline Regional Rural Water Project Wynnewood Pumping Plant Upgrade Electrical	**PROJECT:** Arbuckle Project, Oklahoma
	WOID: OPSPA **ESTIMATE LEVEL:** Appraisal
	REGION: GP **UNIT PRICE LEVEL:** Jul-12
	FILE: H:\D8170\EST\Spreadsheet\Bailey\2012 - IJB Estimates\Sulphur Pipeline Regional Water Project\C02-e Worksheets In Progress\[IN PROGRESS Sulphur Compiled Estimate Sheets rev.perPR.xlsx]Wynnewood PP 8430

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
	5	**Engine genrator set and fuel supply system (F&I)**					
		400 kW Diesel Engine Generator Set	86-68430	1	ls	$200,000.00	$200,000.00
		- 480/277 volt, 3 phase, 60 Hz					
		- Weather protective housing					
		Above ground, diesel fuel storage tank					
		- Spill containment					
		- Double walled tank					
		- Double walled fuel piping					
		Assumptions:					
		750 kVA , 480 volt, 3Φ transformer					
		to be furnished by others.					
		Engine Generator sized to provide power for					
		two pumps and station service equipment.					
		Station service loads to remain the same.					
		SUBTOTAL THIS SHEET					**$200,000.00**

QUANTITIES		PRICES	
BY D. Liscomb	**CHECKED** M. Schuh	**BY** Ngoc Dam	**CHECKED** 9/14/12
DATE PREPARED 07/26/12	**PEER REVIEW / DATE** M. Schuh 7/26/12	**DATE PREPARED** 09/10/12	**PEER REVIEW / DATE** L. Zlomke - 9/12/12

BUREAU OF RECLAMATION **ESTIMATE WORKSHEET** SHEET _34_ OF _34_

FEATURE: Sulphur Pipeline Regional Rural Water Project Water Treatment Plant & Pumping Plants Summary Sheet				**PROJECT:** Arbuckle Project, Oklahoma			
				WOID: OPSPA		**ESTIMATE LEVEL:**	Appraisal
				REGION: GP		**UNIT PRICE LEVEL:**	Jul-12
				FILE: H:\D6170\EST\Spreadsheet\Bailey\2012 - I/B Estimates\Sulphur Pipeline Regional Water Project\002-e Worksheets in Progress\[IN PROGRESS.Sulphur Compiled Estimate Sheets.rev.perPR.xlsx]Wynnewood PP 8430		
PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		FEATURE SUBTOTALS:					
						WATER TREATMENT PLANT	$5,434,030.00
						REGULATING RESERVOIR OUTLET STRUCTURE	
						AND PUMPING STATION	$1,093,740.00
						WYNNEWOOD PUMPING PLANT	$1,083,470.00
		Subtotal					**$7,591,240.00**
		Mobilization	5%	+/-			$380,000.00
		Subtotal with Mobilization					**$7,971,240.00**
		Contract Cost Allowances (Sum of):	20%	+/-			$1,628,760.00
		Design Contingencies, 15 % (+/-)					
		APS, 5 % (+/-). Type of procurement: Request for Proposal					
		CONTRACT COST					**$9,600,000.00**
		Construction Contingencies	25%	+/-			$2,400,000.00
		FIELD COST (Unit Price Level July 2012)					**$12,000,000.00**
		Escalation to Notice to Proceed (NTP)		**To be determined by the appropriate responsible office**			
		FIELD COST (with Escalation to NTP)		**To be determined by the appropriate responsible office**			
		Non-Contract Costs		**To be determined by the appropriate responsible office**			
		CONSTRUCTION COST		**To be determined by the appropriate responsible office**			
		Ref.: For appropriate use and terminology, see Reclamation Manual, Directives and Standards FAC; 09-01, 09-02 and 09-03.					

QUANTITIES		PRICES	
BY See Group's Sheets	CHECKED See Group's Sheets	BY Ian Bailey	CHECKED
DATE PREPARED See Group's Sheets	PEER REVIEW / DATE See Group's Sheets	DATE PREPARED 09/10/12	PEER REVIEW / DATE T. Hanke - 9/12/12

BUREAU OF RECLAMATION **ESTIMATE WORKSHEET** Sheet __1__ of __1___

FEATURE: Rural Water District Pipeline and Lift Station Pump water from existing Sulphur Water Plant to the Rural Water District's existing Standpipe. Contingencies are not embedded within the individual amounts shown for Pay-items 1 - 3. Column labeled "Amount" contains rounded values.	PROJECT: City of Sulphur - 2011 Rural Water Program - Appraisal Investigation Construction Cost Estimate WOID: ESTIMATE LEVEL: Appraisal REGION GP UNIT PRICE LEVEL: Jan-12 FILE:

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
	1	Pipeline					
		10" Diameter Pipe		12,000	L.F.	$22.82	$270,000
		Earthwork					
		Common Excavation		2,700	C.Y.	$13.00	$35,000
		Rock Excavation		950	C.Y.	$32.00	$30,000
		Backfill		2,700	C.Y.	$5.45	$15,000
		Compacted Backfill		950	C.Y.	$9.50	$9,000
		Structures					
		air valves		1	EA	$3,000.00	$3,000
		blowoffs		2	EA	$2,500.00	$5,000
		state highway crossing		1	EA	$63,000.00	$63,000
	2	Land Cost		2.2	MILE	$14,000.00	$30,000
	3	Lift Station		1	L.S.	$528,850	$530,000
		Subtotal					$990,000
		Mobilization	5%	+/-			$50,000
		Subtotal with Mobilization					$1,040,000
		Contract Cost Allowances (sum of):	20%	+/-			$210,000
		Design Contingencies, 15% (+/-)					
		APS, 5% (+/-), Type of Procurement: Request for Proposal					
		CONTRACT COST					$1,250,000
		Construction Contingencies	25%	+/-			$310,000
		FIELD COST (Unit Price Level July 2012)					$1,560,000
		Escalation Notice to Proceed (NTP)					See Detailed Cost Table
		FIELD COST (with Escalation to NTP)					
		Non-Contract Costs	15%	+/-			$240,000
		CONSTRUCTION COST					$1,800,000

QUANTITIES		PRICES		
BY MWarren	CHECKED AHuang	BY MWarren	CHECKED AHuang	REVIEWED JDA
DATE PREPARED 9/14/2011	REVIEWED JDA	DATE 9/14/2011	PRICE LEVEL Jan 2012	