OWRB / USACE TULSA DISTRICT

WATER FOR 2060 – PHASE 2

TECHNICAL MEMORANDUM NO. 4
WATER FOR 2060 HOT SPOT BASIN REGIONALIZATION ANALYSES

FINAL
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WATER FOR 2060 HOT SPOT BASIN REGIONALIZATION ANALYSES

1.0 INTRODUCTION

The Governor of Oklahoma signed the Water for 2060 Act into law in 2012. It set a statewide goal of consuming no more fresh water in 2060 than was consumed in 2012, while continuing to grow the state's population and economy. Water for 2060 emphasizes the use of education and incentives, rather than mandates, to achieve this ambitious goal without limiting Oklahoma's future growth and prosperity. Toward this goal, the Oklahoma Water Resources Board (OWRB) is promoting water efficiency in partnership with the U.S. Army Corps of Engineers (USACE) through a series of Water for 2060 activities, with an emphasis on potential means of alleviating the water shortages projected in the 2012 Update of the Oklahoma Comprehensive Water Plan (OCWP).

The analyses described herein provide information regarding the potential benefits and costs of water supply system regionalization in the OCWP Southwest Watershed Planning Region, as a demonstration for other areas in Oklahoma that may benefit from adding interconnections. The analyses are presented on an informational basis only. Public water supply systems discussed in this analysis are offered this information as a resource to support local planning efforts. However, there is no requirement for any public water supply system to implement any regionalization project.

2.0 BACKGROUND

OWRB, in partnership with USACE, is implementing a phased set of activities to support the Water for 2060 goals. Work conducted by Carollo Engineers under Phase 1 of the Water for 2060 program included facilitation of the legislatively-directed Water for 2060 Advisory Council work. The Advisory Council will submit a report recommending certain incentives and programs to the Governor and Legislature in late 2015, toward greater water use efficiency across Oklahoma. Detailed information is available at www.owrb.ok.gov/2060.

Phase 2 of the Water for 2060 partnership focuses on mitigating the projected surface water supply gaps and groundwater depletions in the "hot spot" basins, defined in the OCWP as those basins with the greatest future water supply challenges (Figure 4.1). Phase 2 activities demonstrate how water conservation, marginal quality water supplies, and public water supply system regionalization strategies can address the needs of hot spot basins on a local implementation level. Basin 26 was selected for a demonstration of the potential of increased conservation, Basin 51 was selected for a demonstration of marginal quality water use, and Basin 38, the primary focus of these analyses, was selected for regionalization analyses. Other technical memoranda (TM) address the conservation and marginal quality water demonstration projects. Selection of hot spot basins for these demonstration studies was based in part on input received in a series of spring 2014 public

meetings hosted by OWRB, as further detailed in TM No. 1 (Screening of Hot Spot Basins for Detailed Water for 2060 Analyses, June 2014).

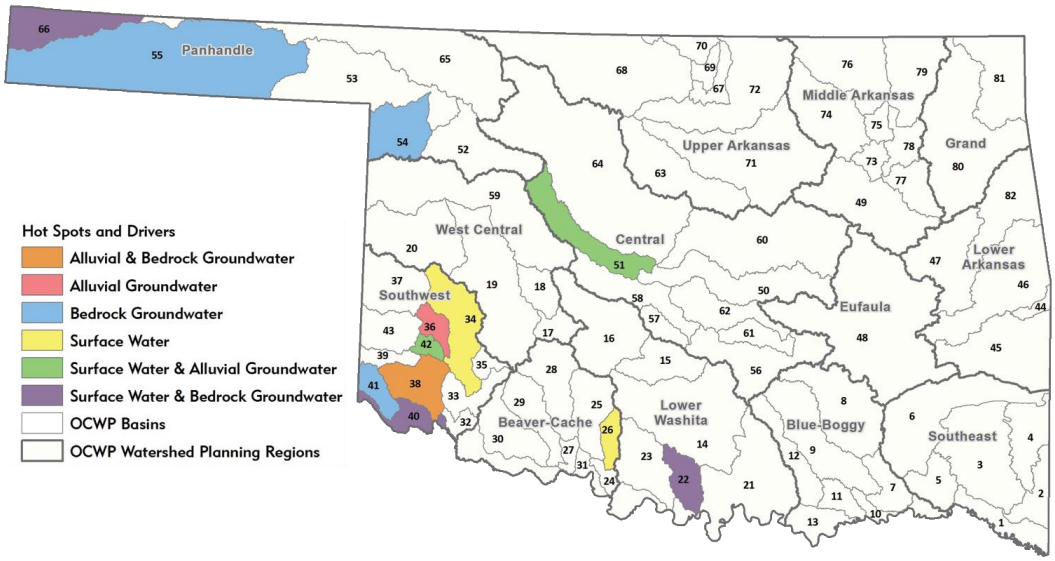


Figure 4.1 OCWP Hot Spot Basins

Basin 38 in the OCWP Southwest Watershed Planning Region shows a high potential for public supply regionalization. The City of Altus, nearby rural water districts (including those with service areas extending beyond the boundaries of Basin 38), and others already have the ability to share water supplies through system interconnections on an emergency and/or ongoing basis. Expanding upon these interconnections and strategically adding new interconnections has the potential to improve water supply robustness. This TM discusses multiple aspects of regionalization, and examines opportunities to expand interconnections in the Southwest Region and strategically add new regional supply sources to improve water supply robustness.

3.0 REGIONALIZATION

The term “regionalization” has been used in different contexts with different meanings. While it can mean consolidating or merging public water providers into a single entity, that concept was not explored in this investigation. Instead, the Water for 2060 Hot Spot Basin analyses primarily investigated regionalization opportunities associated with physical interconnections between existing providers’ systems to achieve water supply benefits. This in turn can add diversity to each interconnected provider’s supply portfolio and facilitate sharing of supplies and treatment facilities, offering additional reliability and efficiencies in infrastructure and operations.

Reliably meeting water needs is challenging in southwest Oklahoma, particularly under extended drought conditions such as those experienced in 2011 through early 2014. Emergency outages and other supply constraints can also affect deliveries to customers. Access to a diverse portfolio of groundwater and surface water supplies through regionalization can help increase overall system reliability, and providing interconnections between systems can be one way of realizing that goal. A second option is to create centralized supply and/or treatment facilities accessible to two or more regional partners.

Examples of the potential benefits of regionalization include:

- Increased water supply reliability by accessing multiple supplies,
- Access to supplies during a short-term water disruption or emergency,
- Reduced project costs through economy of scale, shared operation and maintenance costs of regional facilities, and
- Ability to finance large water projects through shared commitment.

Challenges associated with regionalization can include:

- Technical feasibility of connections between distribution systems,
- Costs of developing interconnections and treatment facilities,
- Sharing control over supply and/or treatment,
- Developing and operating under intergovernmental agreements,
- Mixing of dissimilar waters (e.g., groundwater and surface water or different water quality) may cause adverse impacts in the distribution system, and
- Additional regulatory responsibilities may be triggered.

3.1 Statewide Applicability

Regionalization was identified in the OCWP and preliminary Water for 2060 activities as one way Oklahoma's public water supply systems can increase reliability, share supplies, and work toward meeting the Water for 2060 goals. The regionalization projects discussed in this TM were developed specifically for the Southwest Region; however, they demonstrate regionalization concepts that are applicable state-wide. For example, concepts and infrastructure presented for interconnections between rural water districts and municipalities, described in Section 5, could be applied throughout the state. More specifically, this demonstration study illustrates examples of how interconnected systems can benefit by gaining access to shared resources and regional sources of supply, including both existing and potential new regional groundwater sources (e.g., regional wellfields) and surface water sources (e.g., new reservoirs).

3.2 Southwest Oklahoma Water Supply Action Plan

The Southwest Oklahoma Water Supply Action Plan or "SW Action Plan" (May 2014) was initiated by a proactive group of water interests to provide an implementable plan to firm up the reliability of supplies for all water users in the region. Three of the 11 water supply strategies identified in the SW Action Plan focused on actions that can be key elements of system regionalization. These include:

- Interconnection of distribution systems,
- Additional groundwater supplies, and
- New or expanded reservoir development.

The SW Action Plan identifies specific actions for each water supply strategy for the first 2 years, 2- to 5-year time period, and greater than 5-year time period. This approach of collaboration between water users, setting goals, and identifying specific actions demonstrates how regional planning can succeed and benefit the area as a whole. Beyond demonstrating the value of regional cooperation in terms of planning, it also reinforces the benefits of regionalization in terms of water resource sharing and regional infrastructure development.

4.0 EXISTING REGIONAL WATER SYSTEMS AND INITIATIVES

The Southwest Region already has numerous systems that are interconnected with one another under the terms of intergovernmental agreements between the public water supply providers. For the purpose of the regionalization analyses, information on existing water systems in the proximity of Basin 38 was first analyzed and ongoing/current initiatives were reviewed.

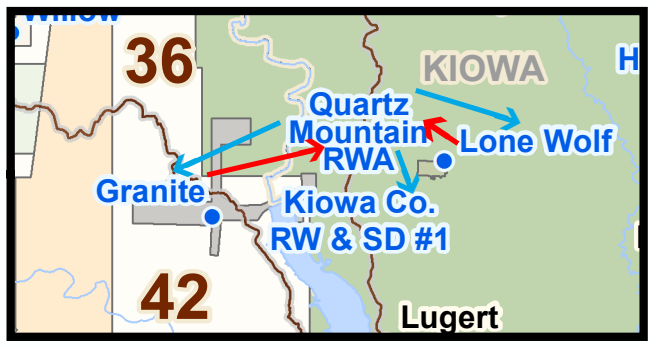
4.1 Existing Regional Water Supply and Treatment Systems

Regional water supply and/or treatment can provide an opportunity for multiple water users to develop and share a single source. Two examples of existing regional systems in the Southwest Region are the Mountain Park Master Conservancy District (MCD) and the Quartz Mountain Regional Water Authority (QMRWA), as shown schematically in Figure 4.2. Connections from the Mountain Park MCD to its member cities are shown as purple lines and from QMRWA are shown as blue lines in the “Detail A” inset. Interconnections between distribution systems, shown as red arrows and green arrows, are discussed in the next section.

Regional water sources, such as Tom Steed reservoir which supplies Mountain Park MCD, often involve larger sources or higher yields than individual water system sources. This can accommodate a greater number of users and reduce costs through economies of scale and potentially allow access to more reliable sources of supply and/or sources with better water quality. Longer-distance transmission mains are relatively common and will oftentimes traverse basin and county boundaries due to their length. For example, the City of Altus in Basins 33 and 38 receives water supply from Mountain Park MCD in Basin 35.

Regional treatment of raw water supplies may also provide benefits of reduced capital and operation and maintenance (O&M) costs through economy of scale, as well as have advantages in permitting and regulatory compliance. The QMRWA is a unique example of a regional water treatment partnership in the Southwest Region. QMRWA primarily provides advanced treatment of purchased water from wells owned by the Oklahoma State Reformatory, Town of Granite, and Town of Lone Wolf. Treated water is sold back to these three entities, Kiowa County Rural Water and Sewer District, and small customers on a wholesale basis.

Detail A



Dempsey
ROGER MILLS
Grimes
Sweetwater
Berlin
Elk City
Beckham Co. RWD #2
Beckham Co. RWD #3
City of Canute
Mayfield
37
Sayre
New Cordell
Dill City
Texola
Erick
Carter
WASHITA
BECKHAM
34
Retrop
Foss Reservoir MCD
Sentinel
Rocky
GREER
43
Beckham Co. RWD #1
Cambridge
Thirsty Water Corp
Willow
36
KIOWA
Hobart
Butler
Brinkman
Quartz Mountain RWA
Lone Wolf
Granite
Kiowa Co. RW & SD #1
Babbs
42
Lugert
Detail A
Reed
Vinson
Mangum
39
Harmon Electric
Frederick
Roosevelt
McKnight
Hester
Blair
35
Cold Springs
Caddo Co. RWD #3
HARMON
Martha
Hollis
Duke Central Vue Water
Mountain Park MCD
Mountain Park
Gould
38
Comanche CO RWD #4
McQueen
Jackson Co Water Co
Altus
Snyder
41
Duke PWA
Headrick
Harmon Co Water Corp
Comanche Co RWD #4
33
Humphreys
Olustee
TILLMAN
Creta
Tipton
Eldorado
40
Elmer
JACKSON
Burt
Fredrick PWA
32

Note: Interconnections are shown schematically to indicate which systems are interconnected. This map is not intended to indicate pipeline routings, points of initiation/termination, or lengths.

Legend

- City
- City - OCWP PWS System
- Municipal Boundaries

Interconnections

- Ongoing
- MCD
- Emergency
- Two-way Interconnection
- Regional Treatment

N

0 4 8 16 Miles

EXISTING SUPPLY CONNECTIONS WATER FOR 2060

FIGURE 4.2

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State of Oklahoma OWRB Water Resources Board the water agency

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4.2 Existing Distribution System Interconnections

Providers in the Southwest Region have already implemented substantial regionalization through distribution system interconnections. Existing distribution system interconnections in the Southwest Region are shown schematically in Figure 4.2. Interconnections may be on an ongoing basis (red arrows) and/or emergency basis (green arrows). The existing interconnections extend across basin and county boundaries in most cases. For example, the City of Altus serves its retail and wholesale customers in Basin 38, but also has an interconnection with Creta Water Company in Basin 40. Therefore, the regionalization evaluation extended beyond the borders of the selected basin (Basin 38), due to the extent of public water suppliers' service areas and the existing interconnections between systems and basins.

Interconnections can be divided into those north of Lugert-Altus Reservoir (Mangum, Hobart, Beckham County Rural Water District (RWD) #1, etc.), south of the reservoir (Altus, Hollis, Jackson County Water Corporation, etc.), and the Elk City area. This divide reflects the geography of the region and prevalent water supplies. Providers to the north rely primarily on groundwater supplies, while those to the south are supplied by both surface water and groundwater sources. The Elk City area was not evaluated in this study due to its distance from Basin 38.

Distribution system interconnections can be characterized by two main attributes:

1. Frequency of use: ongoing vs. emergency use.
2. Treatment of supplies: treated (potable) vs. raw water (requiring treatment before distribution).

The frequency of use reflects the needs of the providers and the degree of integration of the interconnected systems' operations. Most interconnections exchange treated supplies between distribution systems. However, interconnections may also deliver raw water before treatment. For example, the Mountain Park MCD delivers untreated water from Tom Steed Reservoir to Altus, Frederick, and Snyder for treatment in those communities. Details on individual interconnections are listed in Appendix 4A, based on available information from Oklahoma Department of Environmental Quality records and the OCWP. Additionally, Gary Brickley of Fox, Drechsler & Brickley, Inc. generously reviewed the interconnections using his expertise with local water providers.

4.3 Reinstatement of City of Altus Wells

The City of Altus is actively working to reinstate the Holloway and Round Timber well fields in north Texas, supported in part by an Oklahoma Emergency Drought Relief Commission grant of $575,000. The well fields "ceased operation years ago due to high operating costs and treatment requirements during times of high surface water availability" (Southwest Oklahoma Water Supply Action Plan 2014). While not an in-basin regional supply, the reinstatement of the wells will have a positive impact on regional water supplies, including:

- Use of the wells will help alleviate demands on the Mountain Park MCD (Tom Steed Reservoir), extending the use of available reservoir supplies, and may improve the City of Altus' water quality through blending of groundwater and surface water supplies.
- Potential enhancement of the reliability of water deliveries to communities with existing interconnections with Altus.

Reinstating the wells will require a new booster pump station, construction of two new wells, and rehabilitation of existing piping and wells. The SW Action Plan states that the Holloway wells are expected to provide 700,000 gallons per day initially, with a future peak capacity of 2 million gallons per day (mgd). The evaluation and design of project components are ongoing. The City of Altus also has received a $2.3 million loan from the Drinking Water State Revolving Fund (DWSRF) for distribution infrastructure related to the project.

4.4 Mountain Park MCD Groundwater Infrastructure Development Project

The Mountain Park MCD provides public water supplies from the Bureau of Reclamation's Mountain Park Project (Tom Steed Reservoir). Mountain Park MCD is a regional supplier to its member cities of Altus, Snyder, and Frederick. In response to persistent drought conditions, Mountain Park MCD initiated a program in late 2014 and early 2015 to implement new groundwater wells, which will accomplish the following (MPMCD 2015):

- Enhance the ability of Mountain Park MCD to reliably supply water to its customers through future periods of extended drought.
- Slow the rate of decline of Tom Steed Reservoir water levels through future droughts, with associated water supply benefits and the environmental, recreational, and soil conservation benefits of higher water levels.

Development of the wells will benefit the Mountain Park MCD's members (Altus, Snyder, and Frederick), as well as those providers interconnected to the members. Initial conceptual planning costs for new wells were estimated at $550,000 per well, including estimates of the pipeline infrastructure needed to connect the wells to the Mountain Park MCD's existing transmission lines but excluding land acquisition costs. Test wells will be developed in late 2015 or 2016 to estimate production well yields, identify the number of wells required for the project, and characterize water quality.

5.0 POTENTIAL REGIONAL WATER SUPPLY OPTIONS AND COST ESTIMATES

Opportunities for regional water supply include development of additional well fields, additional interconnections and water supplies, and new or expanded reservoir development. Information regarding new reservoir supplies was adapted from the OCWP analyses.

In areas with substantial existing interconnections, like the Southwest Region, many of the lower-cost interconnections between nearby adjoining providers have already been made or proposed. The remaining opportunities are typically more complex and would come at a

higher cost. Therefore, costs may be the largest challenge to implementing additional regionalization projects. To aid providers in evaluating interconnections, conceptual-level unit costs have been initiated for each regionalization project described in the following sections. The basis for these costs, with the exception of the "New or Expanded Reservoir Supplies" section, is described in Appendix 4B. In all cases, more information would be needed to size project components, and project-specific information would affect actual implementation costs. With the assistance of local partners, the estimated implementation costs should be updated as more information becomes available.

5.1 Potential Northern Regional Well Field

Well fields for multiple public water providers are in close proximity northeast of the Town of Willow in the North Fork of the Red River Alluvium Aquifer, including:

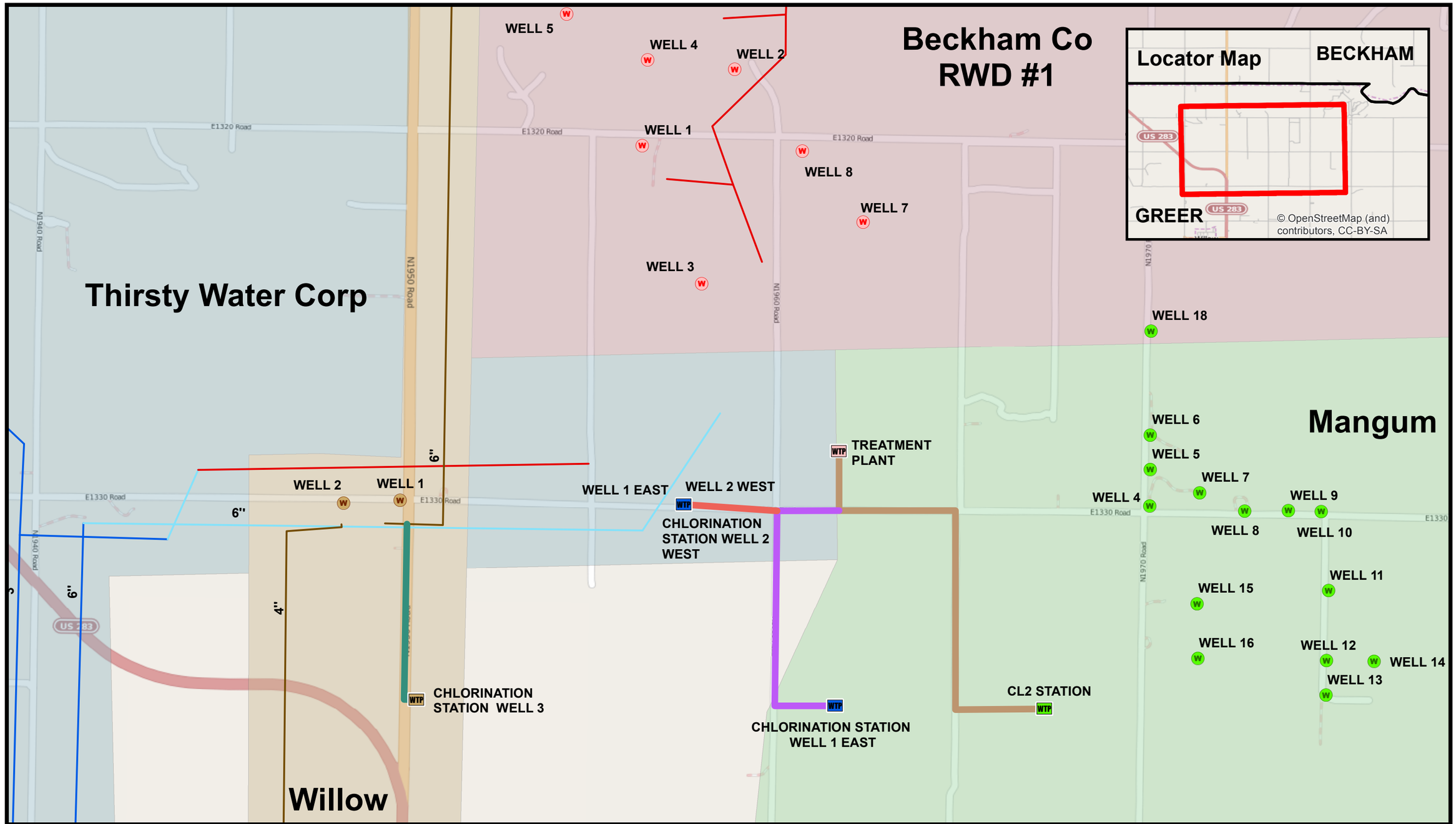
- Mangum PWS,
- Beckham County Rural Water District #1,
- Thirsty Water Corporation, and
- Willow.

Each provider has independently identified a need for new groundwater supplies in the future. Connecting the existing facilities to form a Northern Regional Well Field that all four providers could access may benefit the providers in multiple ways:

- Delay drilling new local wells by using available wholesale capacity from connected providers.
- Share in the cost of new wells.
- Provide redundancy for short-term disruptions, such as mechanical failures.
- Enhanced collaboration in groundwater monitoring and wellhead protection.

Initially, the Northern Regional Well Field would be similar to interconnections between distribution systems, where new pipelines will connect existing transmission mains to exchange treated water. However, the proximity of the wells would allow providers to collaborate on groundwater monitoring and wellhead protection, which is a benefit of a regional well field. Future development of new wells through shared resources will more strongly differentiate the project as a regional well field.

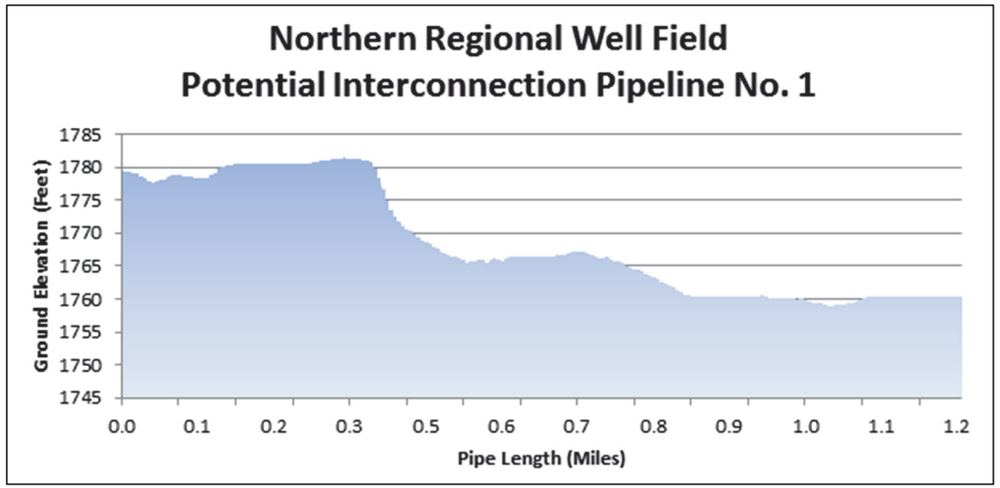
Based on available GIS data, it appears that approximately 15,100 linear feet (LF) of new piping would be necessary to interconnect the four providers' wells and distribution systems, forming a Northern Regional Well Field. Maps of potential alignments are shown in Figure 4.3. Figure 4.4 shows a profile of the ground surface elevation for each new pipe segment, while costs for the segments are presented in Table 4.1. Coordinating the pressure of the supplies between providers' distribution systems is a potential technical challenge.

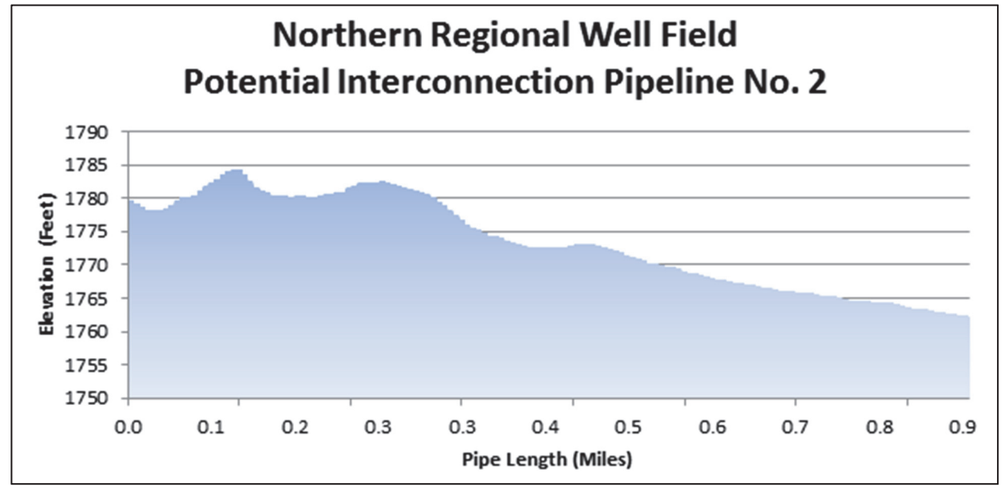


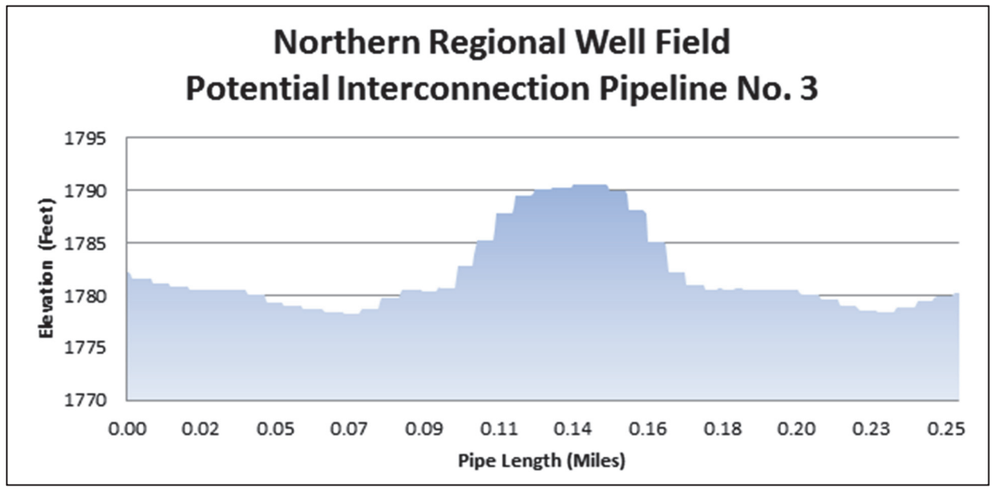
NORTHERN REGIONAL WELL FIELD WATER FOR 2060

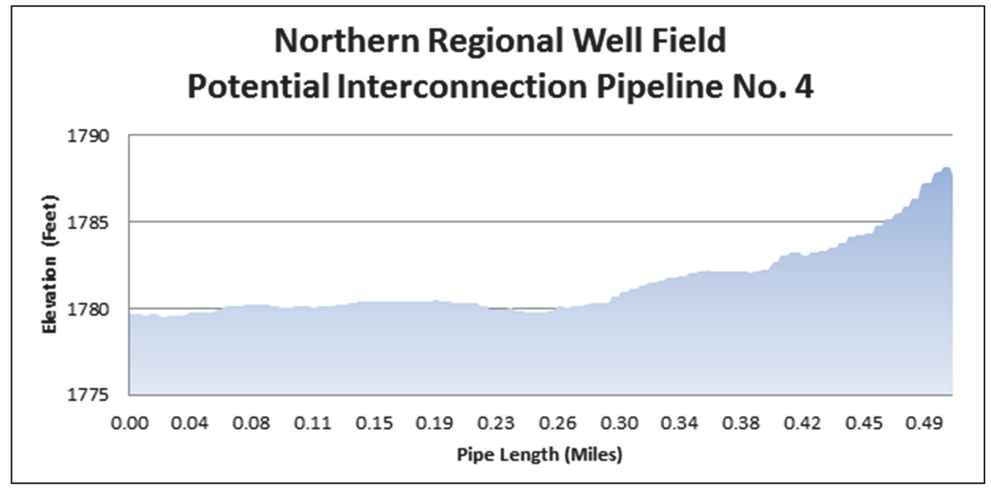
FIGURE 4.3

State of Oklahoma OWRB Water Resources Board the water agency









ELEVATION PROFILES FOR NORTHERN REGIONAL WELL FIELD INTERCONNECTIONS

FIGURE 4.4

OWRB / USACE TULSA DISTRICT
WATER FOR 2060 HOT SPOT BASIN REGIONALIZATION ANALYSES

carollo

Information on the pressure or hydraulic grade line (HGL) of each of the providers' wells would be needed to identify the necessary components of the regional supply system. It is recommended that a single HGL for the regional well field distribution system be established, where individual providers would use booster pump stations to increase pressure, or PRVs to decrease pressure, to achieve each system's specific needs. This approach would require the least piping. Alternatively, individual interconnections could be created between providers, which would likely result in the use of multiple parallel pipes. In lieu of system-specific distribution system information, the total cost of the Northern Regional Well Field could not be estimated.

Table 4.1 Northern Regional Well Field Piping Costs

Piping Profile	Value[(1)]	Conceptual Unit Cost	Total Cost
1	6,600 LF	$63 per LF[(1)]	$415,800
2	4,500 LF	$63 per LF[(1)]	$283,500
3	1,300 LF	$63 per LF[(1)]	$81,900
4	700 LF	$63 per LF[(1)]	$44,100

Notes:
(1) Assumes 6-inch piping installed in a rural setting.

The following additional information would be needed to confirm the feasibility of the Northern Regional Well Field and refine the analysis:

- Need for and benefits of using the well field interconnections for ongoing versus. emergency supplies.
- Confirmation of treatment or chlorination facilities locations.
- Confirmation of preferred alignments for interconnection pipelines.
- HGL of well fields and providers' distribution systems to determine infrastructure required for interconnections.

5.2 Potential Southern Regional Well Field

The following providers in Jackson County have identified plans to develop new groundwater supplies to meet their future needs:

- Jackson County Water Corporation,
- Blair PWA, and
- Duke Central Vue Water.

Rather than develop individual wells, developing a regional well field in the general area of the existing Blair PWA wells may provide substantial benefits. A new regional well field in the North Fork of the Red River major alluvium aquifer (shown in Figure 4.5) may allow access to higher yielding wells that produce greater than 150 gallons per minute (gpm) of yield per well with good water quality. Duke Central Vue Water (not shown on the map) is located to the west of Jackson County Water Corporation. It may receive water through existing interties with Jackson County Water Corporation. An approximately 11.5-mile (60,500 LF) long transmission main, shown in Figure 4.6, would be required to convey the supplies to the providers and would cost approximately $3.8 million. Additional costs will likely include distribution piping, pump stations, as well as PRV/metering. Dedicated lands for water rights and access would be required to develop the new well field, in addition to easements for the transmission and distribution piping.

Alternately, Jackson County Water Corporation and Duke Central Vue Water could consider investigating interconnections with Blair PWA to access the existing, nearby supplies on a wholesale basis. This approach would be particularly attractive if existing source and transmission capacity could be used, rather than constructing new wells and transmission mains.

6.0 OPPORTUNITIES FOR INTERCONNECTIONS

The Southwest Region public water supply providers have made numerous existing interconnections over the years. However, there are opportunities for additional interconnections to gain access to existing or future shared supplies. Additional information is needed to confirm the technical and financial feasibility of additional interconnections. Potential interconnections were identified and divided into two groups, Adjacent Service Area Interconnections and Long-distance Interconnections, which are described in the following sections.

6.1 Adjacent Service Area Interconnections

Several providers may have opportunities for additional interconnections to achieve greater regionalization. Opportunities for new interconnections were identified to connect a RWD or county water corporation with adjacent municipalities, as shown in Figure 4.7. Potential connections include:

- Beckham County RWD #1 and Hobart,
- Beckham County RWD #1 and QMRWA,
- Hollis and Harmon Water Corporation, and
- Blair and Jackson County Water Corporation.

Connections may be used on an ongoing or emergency basis, depending on the needs of the providers. Additionally, connections may require a booster pump station depending on whether the intent is for two-way flow and depending on system hydraulics.

Lugert-Altus Reservoir

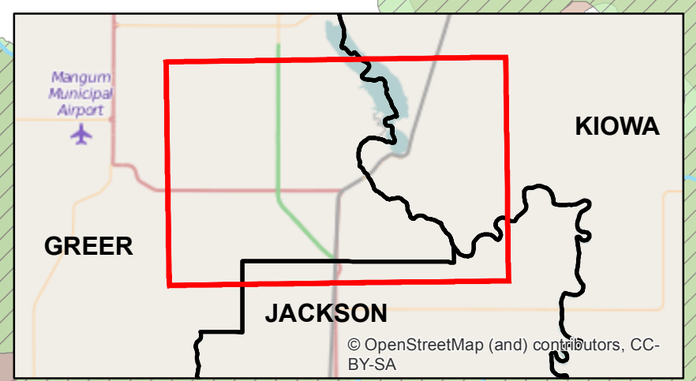
Southwestern Oklahoma

Aproximate Location of Southern Regional Well Field

North Fork of the Red River

Western Oklahoma

Blair



Legend

Water System Pipelines
- BECKHAM CO RWD #1
- BLAIR
- HARMON ELECTRIC

Water System Wells
- (W) BLAIR PUBLIC WORKS AUTHORITY

Water Treatment Plant
- WTP BLAIR PUBLIC WORKS AUTHORITY

- DEDICATED LANDS

Aquifers
- Alluvial, Major, North Fork of the Red River
- Bedrock, Minor, Southwestern Oklahoma
- Bedrock, Minor, Western Oklahoma

0 0.5 1 2 Miles

N W E S

SOUTHERN REGIONAL WELL FIELD WATER FOR 2060

FIGURE 4.5

carollo

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State of Oklahoma OWRB Water Resources Board the water agency

Approimate Location of Southern Well Field

B

Blair

Beckham Co RWD #1

Jackson Co Water Corp

A

Note: Duke Central Vue Water is located to the west and may be supplied by Jackson Co. Water Corp.

2"

4"

3"

6"

6"

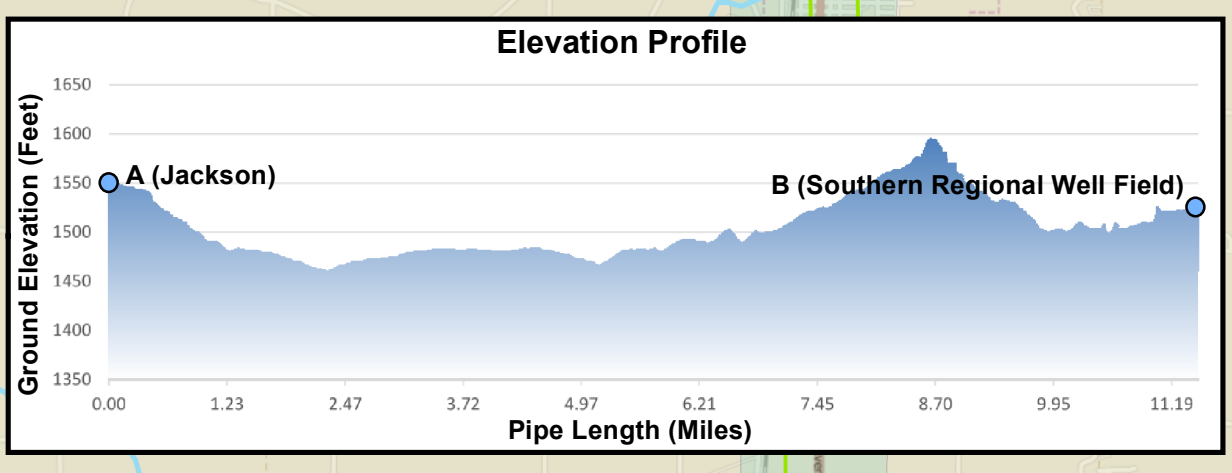
2"

3"

6"

2"

4"



Legend

POTENTIAL INTERCONNECTION

Water System Wells

- BLAIR PUBLIC WORKS AUTHORITY
- JACKSON CO WATER CORP

Water Treatment Plant

- BLAIR PUBLIC WORKS AUTHORITY
- JACKSON CO WATER CORP

Water System Pipelines

- BECKHAM CO RWD #1
- BLAIR
- JACKSON CO WATER CORP

N

Feet
0 1,300 2,600

SOUTHERN REGIONAL WELL FIELD TRANSMISSION WATER FOR 2060

FIGURE 4.6

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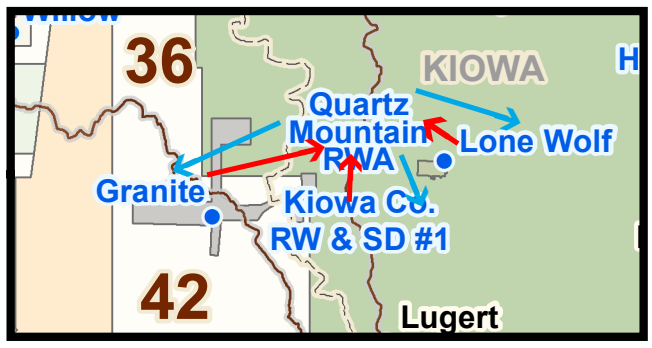
D:\Oklahoma\Figures\Fig X.mxd

Detail A



Dempsey
ROGER MILLS
Grimes
Sweetwater
Berlin
Elk City
Beckham Co. RWD #2
Beckham Co. RWD #3
City of Canute
Mayfield
37
Sayre
New Cordell
Dill City
Texola
Erick
Carter
WASHITA
BECKHAM
34
Foss Reservoir MCD
Retrop
Sentinel
Rocky
GREER
43
Beckham Co. RWD #1
Cambridge
Thirsty Water Corp
Willow
36
KIOWA
Hobart
Butler
Brinkman
Quartz Mountain RWA
Lone Wolf
Granite
Kiowa Co. RW & SD #1
Babbs
42
Lugert
Detail A
Reed
Vinson
Mangum
39
Harmon Electric
Frederick
Roosevelt
McKnight
Hester
Blair
35
Cold Springs
Caddo Co. RWD #3
HARMON
Martha
Hollis
Duke Central Vue Water
Mountain Park MCD
Mountain Park
Gould
38
McQueen
Jackson Co Water Co
Duke PWA
Altus
Snyder
Comanche CO RWD #4
41
Headrick
Harmon Co Water Corp
33
Comanche Co RWD #4
Olustee
Humphreys
TILLMAN
Creta
Eldorado
40
Elmer
Tipton
JACKSON
Burt
Fredrick PWA
32

Note: Interconnections are shown schematically to indicate which systems are interconnected. This map is not intended to indicate pipeline routings, points of initiation/termination, or lengths.

Legend

- City
- City - OCWP PWS System
- Municipal Boundaries

Interconnections

- Two-way
- Ongoing
- Potential One-way
- MCD
- Potential Two-way
- Emergency
- Regional Treatment

N

Miles: 0, 4, 8, 16

EXISTING AND POTENTIAL SUPPLY CONNECTIONS WATER FOR 2060

FIGURE 4.7

carollo

State of Oklahoma OWRB Water Resources Board the water agency

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Adjacent service area connections may also be beneficial for addressing localized areas that are difficult to serve due to location or service elevation; reducing costs through shared operation. For example, Beckham County RWD #1 has contracted with Beckham County RWD #3 to serve a high elevation area at the boundary of the RWDs. Rather than Beckham County RWD #1 pumping supply to the customers, supply is now gravity fed by Beckham County RWD #3.

Additional system information is needed to further evaluate the feasibility of the interconnections, including:

- Distribution System HGL. If HGLs are significantly different, the interconnection may be limited to one-way or a booster pump station may be required.
- Capacity in existing distribution system. Ability to convey supplies to/from interconnections to support the intended use.
- Route of piping. Availability of land/easements for distribution piping and intertie facilities.

Connections may require additional piping, new land or easements, a pump station, and PRV/metering. Piping for the proposed adjacent service area interconnections is expected to be installed in a more developed setting. Therefore, costs per LF of pipe may be on the higher end of the range presented in Appendix 4B. These connections may require only a half-mile (2,640 LF) of piping, with a piping cost of approximately $200,000, assuming $76 per LF. Therefore, the costs of a new interconnection may be competitive with drilling a new well or other supply improvements. In optimal circumstances, piping between two providers will cross and require no significant piping to interconnect, such as Blair and Jackson County Water Corporation.

6.2 Long-Distance Interconnections

In several cases, interconnections requiring long transmission mains may provide substantial benefit by allowing access to new supplies. This benefit must be weighed against the costs required to convey supplies. Two potential new long-distance interconnections were identified in this analysis.

6.2.1 Jackson County Water Corporation and Beckham County RWD #1 Interconnection

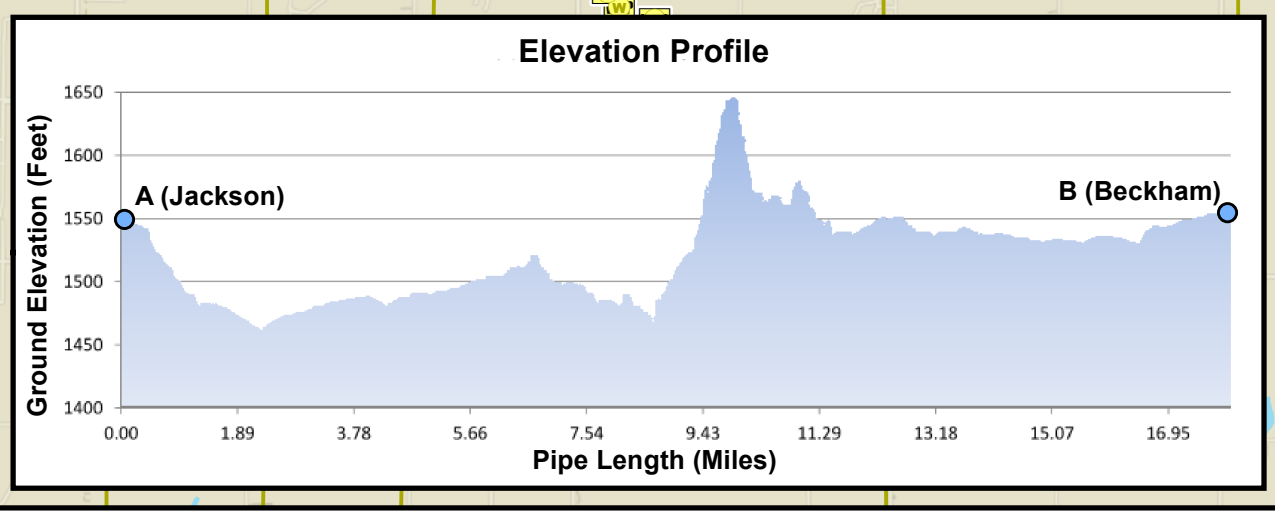
There is currently no connection between providers north and south of Lugert-Altus Reservoir. A north-south interconnection would provide increased reliability for the region by allowing access to major groundwater supplies in the north and major surface water supplies in the south. The two nearest providers are Jackson County Water Corporation and Beckham County RWD #1, which are approximately 18 miles apart as shown in Figure 4.8. Connecting these systems would require approximately $6 million for an interconnecting pipeline. Additionally, a pump station would likely be required, but could not be sized using available information. These costs should be weighed against the benefits of connecting providers north and south of Lugert-Altus Reservoir.

Granite

Kiowa Co RWS & SWMD #1

Blair

Jackson Co Water Corp



Legend

POTENTIAL INTERCONNECTION

Water System Wells

- BLAIR PUBLIC WORKS AUTHORITY
- GRANITE PWS
- JACKSON CO WATER CORP
- QUARTZ MOUNTAIN REG WATER AUTH

Water Treatment Plant

- BECKHAM CO RWD # 1
- BLAIR PUBLIC WORKS AUTHORITY
- GRANITE PWS
- JACKSON CO WATER CORP

Water System Pipelines

- BECKHAM CO RWD #1
- BLAIR
- GRANITE
- JACKSON CO WATER CORP

JACKSON CO. WATER CORP. AND BECKHAM CO. RWD #1 INTERCONNECTION WATER FOR 2060

Feet
0 2,250 4,500

FIGURE 4.8

carollo

D:\Oklahoma\Figures\Fig 6.mxd

6.2.2 Reed Water Corporation and Harmon Water Corporation

Reed Water Corporation has an ongoing connection with Mangum on the eastern portion of its service area. A future connection to Harmon Water Corporation could provide increased reliability to the system by providing an alternative source of supply in the western portion of the system. The interconnection would require an approximately 7.2-mile transmission main, as shown in Figure 4.9, which was estimated to cost $2.4 million. Additionally, a pump station would likely be required, but could not be sized using available information. However, this option may be more cost effective than developing new supplies, especially considering the limited groundwater or surface supplies in the western portion of the system.

6.3 New or Expanded Reservoir Supplies

The SW Action Plan calls for the evaluation of new or expanded reservoir development, which would likely serve as a regional supply. The evaluation may include “raising existing dams at Lake Altus and/or Tom Steed Reservoir, new major reservoir sites, and investigation of new or expanded Natural Resources Conservation Service (NRCS) dams” (Carollo 2014). The OCWP reviewed major reservoir sites that have been studied but not developed, and also briefly considered the potential for expanded use of NRCS reservoirs for local water storage. In the OCWP analyses, the Lower Mangum Reservoir (Lower Dam) site and Port Reservoir site were found to the most feasible of the sites in the Southwest Region. Past evaluations found that Port Reservoir could provide 9,000 acre-feet per year (AFY) of dependable yield, and Mangum Reservoir could provide 18,494 AFY of dependable yield.

The Port Reservoir cost estimate in 2013 dollars was $117,629,000. No previous cost estimate for the Lower Mangum Reservoir site was available; however, it is expected to be on the same order of magnitude as Port Reservoir (i.e., over $100,000,000). Therefore, it is expected that consideration of either of these potential reservoir projects would need to be as a regional supply source to access sufficient funding for construction and to share costs and benefits between public water providers, agricultural interests, and/or industrial users.

Sedimentation has limited the available yield of small to medium reservoirs throughout Oklahoma, which may be addressed through sediment removal. Hobart is actively working to restore yield to its historical source of supply, Rocky Lake, through sediment removal. While supplies are unavailable during the work in the Lake, Hobart receives its supplies through a regional water supplier, Foss Master Conservancy District.

Reed

Harmon
Water Corp

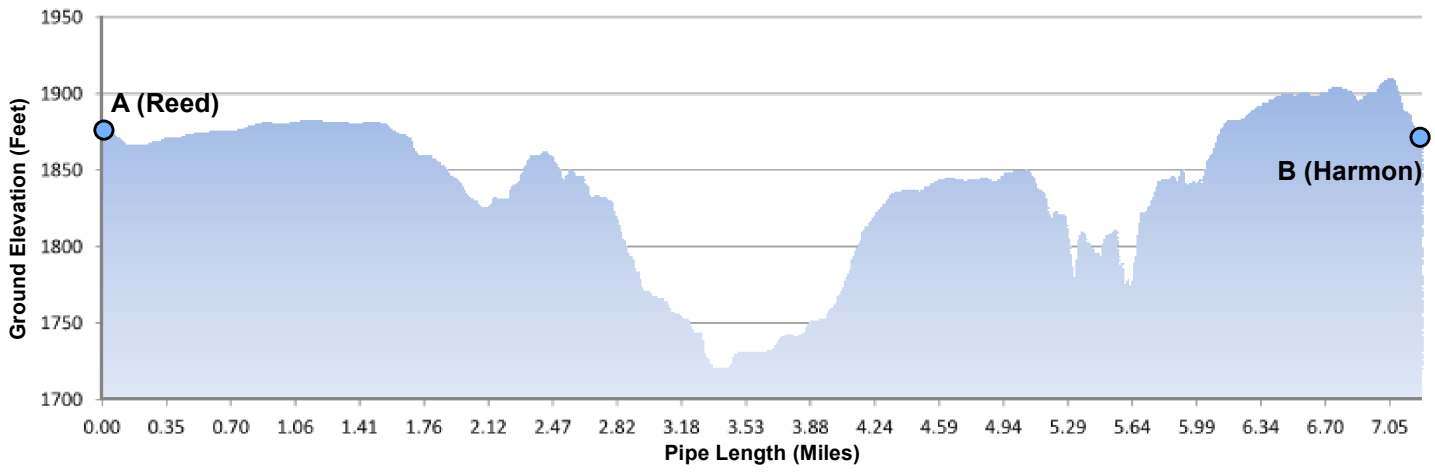
Hollis

B

A

4"
2"
3"
2"
2"
2"
2"
2"
2"
6"
6"
6"
4"
4"
3"
2"
6"
2"
4"

Elevation Profile



Legend

POTENTIAL INTERCONNECTION

Water System Wells

HARMON WATER CORP

HOLLIS

Water Treatment Plant

HARMON WATER CORP

HOLLIS

Water System Pipelines

HARMON WATER CORP

HOLLIS

REED

N W E S

0 3,300 6,600 Feet

REED WATER CORP. AND HARMON WATER CORP. INTERCONNECTION WATER FOR 2060

FIGURE 4.9

carollo

D:\Oklahoma\Figures\Fig 7.mxd

7.0 FUNDING RESOURCES

There are many funding resources available for communities and rural water districts to access low cost loans and grants. The OWRB publishes a Loan and Grant Resource guide (http://www.owrb.ok.gov/financing/resources.pdf) that lists potential funding sources for water projects from ten state and federal funding agencies. Some funding opportunities provide specified incentives that promote regional planning. For example, while funding amounts vary from year to year, Oklahoma's Drinking Water State Revolving Fund (DWSRF) gives "principal forgiveness," or subsidization, for project loans that meet the Oklahoma Department of Environmental Quality's criteria for regionalization. For Fiscal Year 2015, there was $2,831,400 of principal forgiveness available to qualifying systems. In addition, the Water for 2060 Advisory Council has expressed support for regionalization and may be recommending ways to further encourage and incentivize public water supply regionalization in its report scheduled to be submitted to the Governor and Legislature in late 2015.

APPENDIX 4A – WHOLESALE WATER TRANSFERS IN THE SOUTHWEST REGION

Table 4A.1 Existing Wholesale Water Transfers in the Southwest Region							
Provider	**SDWIS ID**	**Sells To**	**Emergency or Ongoing**	**Treated or Raw or Both**	**Purchases From**	**Emergency or Ongoing**	**Treated or Raw or Both**
Altus	OK1011501	Jackson Co. Water Corp.	O	T	Mountain Park MCD	O	R
		Duke PWA	O	T			
		Blair PWA	O	T			
		Olustee PWS	O	T			
		Martha via QMRWA	O	T			
		Creta Water Company	O	T			
Beckham Co. RWD #1	OK2000505	Sentinel PWS	O	T			
		Carter	O	T			
		Rocky	O	T			
		Thirsty Water Corp.	O	T			
Beckham Co. RWD #3	OK2000547	Hammon		T			
Blair PWA	OK2003304				Altus	E	T
Carter	OK3000501	Beckham Co. RWD #1	O	T			
Creta Water Corp.	OK3003310	Eldorado	O	R			
		Olustee PWS	E	T			
Duke PWA	OK3003311				Altus	O	T
					Jackson Co. Water Corp.	O	T
					Harmon Water Corp.	O	T
Duke Central Vue Water	OK2003301	Jackson Co. Water Corp.	E	T			

Table 4A.1 Existing Wholesale Water Transfers in the Southwest Region							
Provider	**SDWIS ID**	**Sells To**	**Emergency or Ongoing**	**Treated or Raw or Both**	**Purchases From**	**Emergency or Ongoing**	**Treated or Raw or Both**
Eldorado	OK3003301				Altus	O	T
					Harmon Water Corp.	O	T
					Creta Water Corporation	O	R
Frederick (Beaver-Cache Region)	OK1011401	Tipton	O	R			
Gould PWA	OK3002901				Harmon Water Corp.	O	B
Granite PWS	OK2002804	Quartz Mountain Reg. Water Auth.	O	R	Quartz Mountain Reg. Water Auth.	O	T
Harmon Electric	OK3002801				Mangum PWS	O	T
Harmon Water Corp.	OK2002902	Gould PWA	O	R			
		Eldorado	O	R			
		Duke PWA	O	T			
Headrick	OK3003302				Jackson Co. Water Corp.	O	T
Hobart	OK1011502	Frontier Dev. Auth.	O	T	Foss Reservoir MCD	O	T
		Butler	O	T			

Table 4A.1 Existing Wholesale Water Transfers in the Southwest Region							
Provider	**SDWIS ID**	**Sells To**	**Emergency or Ongoing**	**Treated or Raw or Both**	**Purchases From**	**Emergency or Ongoing**	**Treated or Raw or Both**
Jackson Co. Water Corp.	OK2003306	Headrick	O	T	Altus	O	T
		Olustee PWS	Inactive	T	Duke Central Vue Water	E	T
		Martha	E	T			
		Duke PWA	O	T			
Kiowa Co. RWS & SWMD #1	OK3003804				Quartz Mountain Reg. Water Auth.	O	T
Lone Wolf	OK2003806	Quartz Mountain Reg. Water Auth.	O	R	Quartz Mountain Reg. Water Auth.	O	T
Mangum PWS	OK2002802	Reed Water Corp.	O	T			
		Harmon Electric	O	T			
Martha	OK3003304				Altus via QMWRA	O	T
Mountain Park	OK3003807				Snyder	O	R
Mountain Park MCD	None	Altus	O	R			
		Frederick	O	R			
		Snyder	O	R			
Olustee PWS	OK3003309				Altus	O	T
					Creta Water Corporation	O	T

Table 4A.1 Existing Wholesale Water Transfers in the Southwest Region							
Provider	**SDWIS ID**	**Sells To**	**Emergency or Ongoing**	**Treated or Raw or Both**	**Purchases From**	**Emergency or Ongoing**	**Treated or Raw or Both**
Quartz Mountain Reg. Water Auth. (QMRWA)	OK2003880	Granite PWS	O	T	Granite PWS	R	
		Lone Wolf	O	T	Lone Wolf	R	
		Kiowa Co. RWS & SWMD #1		T	OK Reformatory	R	
		Mangum PWS	E	T			
Reed Water Corp.	OK3002802	Mangum PWS	O	T			
Rocky	OK3007501				Beckham Co. RWD #1	O	T
Sentinel PWS	OK3007505				Beckham Co. RWD #1	O	T
Snyder	OK1011503	Comanche Co. RWD #4	O	T	Mountain Park MCD	O	B
		Mountain Park, Town of	O	T			
Thirsty Water Corp	OK2002806				Beckham Co. RWD #1	O	T
Tipton	OK2007101				Frederick	O	T

APPENDIX 4B – CONCEPTUAL-LEVEL COST FACTORS

ELEMENTS OF A REGIONALIZATION PROJECT

A typical regionalization project may be divided into individual elements to aid in conceptual planning and costing. Each element represents a type of infrastructure that may be needed to implement a regionalization project. The elements include:

- Regional Supply Source: Regional well fields, reservoirs, or treatment facilities may use reallocated or expanded capacity at existing facilities and/or construction of a new supply source.
- Pressure Reducing Valves (PRV): PRVs allow systems with lower pressure to be supplied by a higher pressure source (supply, interconnection, etc.).
- Metering: Wholesale agreements may stipulate a quantity and price for the supplied water, which requires metering at interconnections and supply inlets.
- Piping: Piping is typically required to connect a new source or interconnection to the existing system. In most areas of the Southwest Region, a pipe diameter of 6 inches or less is typically required for connections that augment supply capacity (but may not be capable of providing fire protection flows, which are oftentimes supplied from storage facilities in the local distribution system).
- Pump Station: A pump station may be used to boost the pressure of a regional supply or interconnection to an appropriate level for a given distribution system. Pump stations may also be needed to convey supplies over long distances to overcome headloss in transmission.
- Treatment Facility: Assures that water sourced from surface and/or groundwater supplies meets regulatory standards and aesthetic water quality goals through treatment. Treatment may range from chlorination to complex treatment trains including advanced processes such as reverse osmosis for salinity removal.
- Land: Land for a project or facility may be in the form of property acquisition, an easement, or right-of-way.

Most regionalization projects will include multiple elements. For example, a new interconnection between providers would likely require piping between the systems, a PRV to address differences in pressure between interconnected systems, metering to track water use, and property or easement acquisition for the new infrastructure.

UNIT COSTS

Direct construction costs may include development of well or other supply source, treatment facilities, PRVs, metering, piping, pump stations, and land acquisition. Conceptual-level unit costs in 2015 dollars for each project element are presented in Table B.1. Source and land costs vary widely; therefore no cost could be estimated for these elements. Typical regionalization projects combine a PRV and metering in a single vault; therefore, a combined cost is presented. Actual costs for each interconnection will vary with site-specific conditions that were not evaluated in detail in this analysis.

Table 4B.1 Conceptual-Level Unit Costs	
Component	**Conceptual Unit Cost[1]**
Source (Well or Reservoir)	Site Specific[2]
PRV/Metering	$38,000 per installation[3][4]
Piping	$63 to $108 per linear foot[4][5]
Pump Station	$6,900 per unit horsepower of capacity[4]
Treatment Facility	Site Specific[2]
Land	Site Specific[2][6]

Notes:

(1) AACE Class 5 cost estimate.

(2) Costs vary widely based on type and location. Treatment facility costs will vary significantly with source water quality.

(3) Costs do not include land, electrical, instrumentation, and SCADA control.

(4) Assumes 30% construction contingency and indirect costs (legal, administrative, and engineering) of 20%.

(5) Assumes 6-inch diameter pipe.

(6) Land may be in the form of property acquisition, an easement, or right-of-way.

Direct costs include the construction cost and a 30 percent construction contingency consistent with the conceptual nature of the costs. Indirect costs, including legal, administrative, and engineering costs, were estimated at 20 percent of the direct costs. These cost estimates should be periodically reevaluated to account for changes in inflation, market bidding conditions, and other factors affecting construction costs.

Cost estimates were developed using a Class 5 order of magnitude estimate, as established by AACE International. This level of estimate is used for initial planning purposes, including long-range capital planning, and represents a 0 percent to 2 percent level of project definition. The expected accuracy range is -30 percent to +50 percent, meaning the actual cost should fall in the range of 30 percent below the estimate to 50 percent above the estimate.