

REGION D
EVALUATIONS OF WATER MANAGEMENT STRATEGIES
FOR MEETING PROJECTED WATER SUPPLY NEEDS
TO YEAR 2070

BOWIE COUNTY

WUGs:

Burns Redbank WSC
Central Bowie County WSC
The City of DeKalb
The City of Hooks
Bowie County Irrigation
Bowie County Livestock
Macedonia-Eylau MUD #1
Bowie County Manufacturing
The City of Maud
The City of Nash
The City of New Boston
The City of Redwater
Riverbend Water Resources District
The City of Texarkana, Texas
The City of Wake Village

EVALUATION OF WATER MANAGEMENT STRATEGIES FOR MEETING THE PROJECTED WATER SUPPLY NEEDS OF BURNS REDBANK WSC

Description of Water User Group:

Burns Redbank Water Supply Corporation (WSC) provides water service in Bowie County. The system population is projected to be 1,576 in 2020 and 1,634 in the year 2070. The WSC has a contract for water supply with the City of Hooks from Lake Wright Patman. The WSC is projected to have a shortage in 2020 due to aging of Texarkana’s Water Treatment Plant.

Water Supply and Demand Analysis:

	2020	2030	2040	2050	2060	2070
Population	1,576	1,620	1,634	1,634	1,634	1,634
Projected Water Demand	201	199	196	194	193	193
Water Demand from other entities	0	0	0	0	0	0
Current Water Supply	0	0	0	0	0	0
Projected Supply Surplus (+) / Deficit (-)	-201	-199	-196	-194	-193	-193

Evaluation of Potentially Feasible Water Management Strategies:

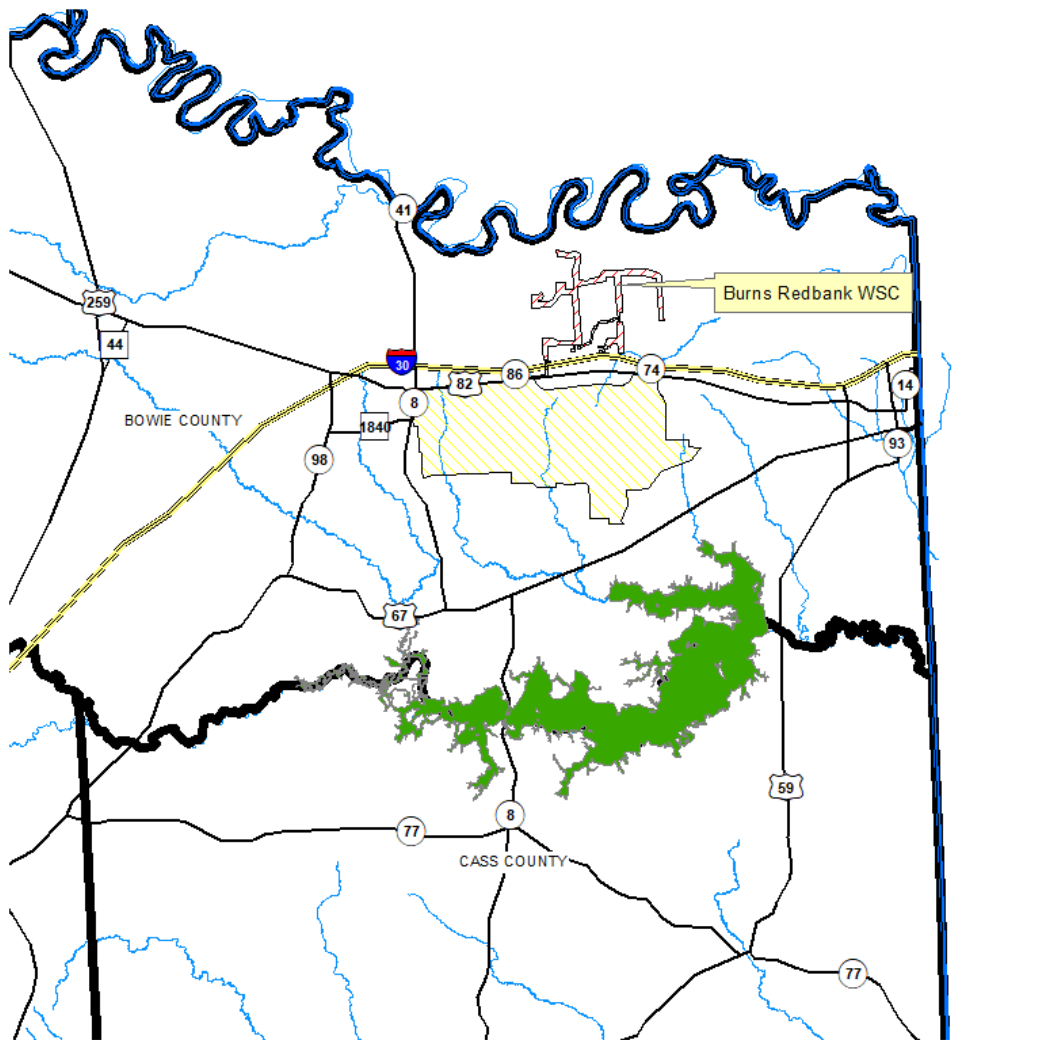
There were four alternative strategies considered to meet the WSC’s water supply shortages as summarized in the Table below. Advanced conservation was not considered because the WSC’s supply is not projected to meet TCEQ regulatory minimums. Reuse is not a feasible option because water supply is mainly used for public consumption. Groundwater was not selected because the WSC is planning on continuing to purchase surface water from the City of Hooks. A request was submitted by Riverbend Water Resources District to consider a new Water Treatment Plant, pipeline, and intake to Wright Patman Reservoir. Thus, a renewal contract with Texarkana/Riverbend has been considered herein.

Strategy	Firm Yield (ac-ft)	Total Capital Cost	Total Annualized Cost	Unit Cost	Environmental Impact
Advanced Water Conservation					
Water Reuse					
Ground Water					
Renew Existing Contract	201		\$97,000	\$483	1

Recommendations:

	2020	2030	2040	2050	2060	2070
Renew Existing Contract (ac-ft/yr)	201	199	196	194	193	193

It is recommended that the Burns Redbank WSC continue its surface water purchase from the City of Hooks contingent upon Riverbend WRD’s strategies.



- Relation**
- Buyer
 - Seller
 - Source
 - Region D Boundary
 - Counties
 - Reservoirs
 - Streams

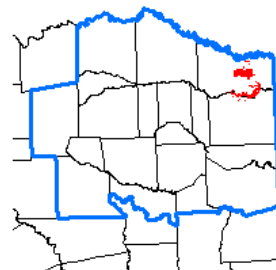
0 15,000 30,000 60,000

Feet

1 inch = 30,000 feet

Attachment A

Burns Redbank WSC
 Recommended Strategy
 Renew Existing Contract (Hooks)



**Cost Estimate Summary
Water Supply Project Option
September 2018 Prices**

Burns Redbank - Renew Existing Contract

**Cost based on ENR CCI 11170.28 for September 2018 and
a PPI of 201.9 for September 2018**

<i>Item</i>	<i>Estimated Costs for Facilities</i>
ANNUAL COST	
Operation and Maintenance	
Intakes and Pump Stations (2.5% of Cost of Facilities)	\$0
Dam and Reservoir (1.5% of Cost of Facilities)	\$0
Water Treatment Plant	\$0
Advanced Water Treatment Facility	\$0
Pumping Energy Costs (0 kW-hr @ 0.08 \$/kW-hr)	\$0
Purchase of Water (201 acft/yr @ 482.23 \$/acft)	<u>\$97,000</u>
TOTAL ANNUAL COST	\$97,000
Available Project Yield (acft/yr)	201
Annual Cost of Water (\$ per acft), based on PF=1	\$483
Annual Cost of Water After Debt Service (\$ per acft), based on PF=1	\$483
Annual Cost of Water (\$ per 1,000 gallons), based on PF=1	\$1.48
Annual Cost of Water After Debt Service (\$ per 1,000 gallons), based on PF=1	\$1.48
<i>JMP</i>	<i>10/2/2019</i>

EVALUATION OF WATER MANAGEMENT STRATEGIES FOR MEETING THE PROJECTED WATER SUPPLY NEEDS OF CENTRAL BOWIE COUNTY WSC

Description of Water User Group:

The Central Bowie County Water Supply Corporation (WSC) provides water service in Bowie County. The system population is projected to be 7,529 in 2020 and 12,101 in the year 2070. The WSC has a contract for 110 ac-ft/yr of water supply from Lake Wright Patman with the City of Texarkana/Riverbend Water Resources District (WRD). The WSC is projected to have a shortage in 2020 due to aging of Texarkana’s Water Treatment Plant.

Water Supply and Demand Analysis:

	2020	2030	2040	2050	2060	2070
Population	7,529	8,037	8,903	9,862	10,924	12,101
Projected Water Demand	619	639	708	784	869	962
Water Demand from other entities	0	0	0	0	0	0
Current Water Supply	0	0	0	0	0	0
Projected Supply Surplus (+) / Deficit (-)	-619	-639	-708	-784	-869	-962

Evaluation of Potentially Feasible Water Management Strategies:

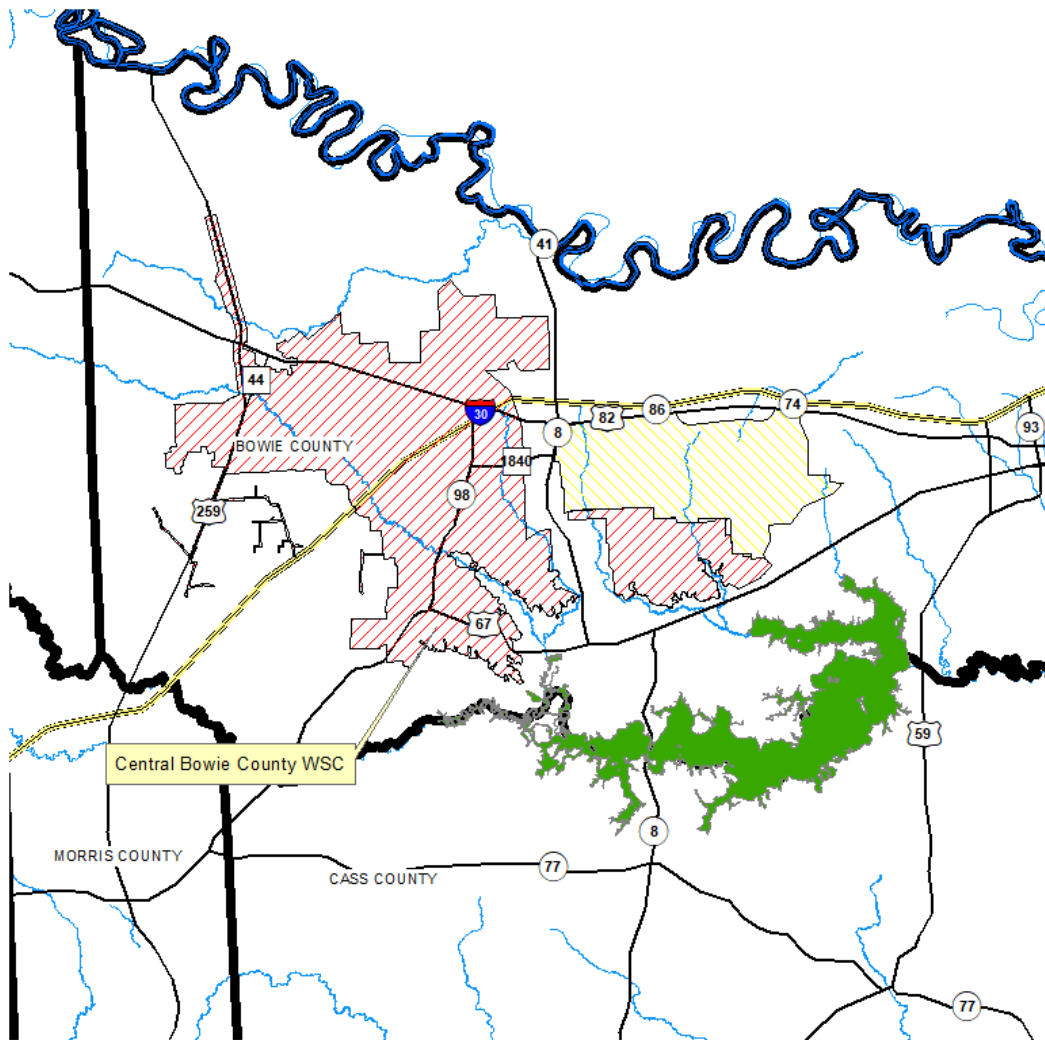
There were four alternative strategies considered to meet the WSC’s water supply shortages as summarized in the Table below. Advanced conservation was not considered because the WSC’s supply would not be projected to meet TCEQ regulatory minimums. Reuse is not a feasible option because water supply is mainly used for public consumption. Groundwater was not selected because the WSC is planning on continuing to purchase surface water from the City of Texarkana and/or Riverbend WRD. A request was submitted by Riverbend Water Resources District to consider a new Water Treatment Plant, pipeline, and intake to Wright Patman Reservoir. Thus, a renewal contract with Texarkana/Riverbend has been considered herein.

Strategy	Firm Yield (ac-ft)	Total Capital Cost	Total Annualized Cost	Unit Cost	Environmental Impact
Advanced Water Conservation					
Water Reuse					
Ground Water					
Renew Existing Contract	962		\$464,000	\$482	1

Recommendations:

	2020	2030	2040	2050	2060	2070
Renew Existing Contract (ac-ft/yr)	619	639	708	784	869	962

It is recommended that the Central Bowie County WSC continue its surface water purchase from the City of Texarkana and/or Riverbend WRD contingent upon Riverbend WRD’s recommended strategies.



- Relation**
-  Buyer
 -  Seller
 -  Source
 -  Region D Boundary
 -  Counties
 -  Reservoirs
 -  Streams

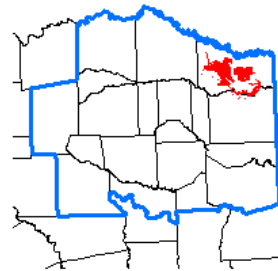
0 15,000 30,000 60,000

Feet

1 inch = 30,000 feet

Attachment A

Central Bowie County WSC
 Recommended Strategy
 Renew Existing Contract (Riverbend WRD)



Cost Estimate Summary Water Supply Project Option September 2018 Prices Central Bowie WSC - Renew Existing Contract	
Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 201.9 for September 2018	
<i>Item</i>	<i>Estimated Costs for Facilities</i>
ANNUAL COST	
Operation and Maintenance	
Intakes and Pump Stations (2.5% of Cost of Facilities)	\$0
Dam and Reservoir (1.5% of Cost of Facilities)	\$0
Water Treatment Plant	\$0
Advanced Water Treatment Facility	\$0
Pumping Energy Costs (0 kW-hr @ 0.08 \$/kW-hr)	\$0
Purchase of Water (962 acft/yr @ 482.23 \$/acft)	<u>\$464,000</u>
TOTAL ANNUAL COST	\$464,000
Available Project Yield (acft/yr)	962
Annual Cost of Water (\$ per acft), based on PF=1	\$482
Annual Cost of Water After Debt Service (\$ per acft), based on PF=1	\$482
Annual Cost of Water (\$ per 1,000 gallons), based on PF=1	\$1.48
Annual Cost of Water After Debt Service (\$ per 1,000 gallons), based on PF=1	\$1.48
<i>JMP</i>	<i>10/2/2019</i>

EVALUATION OF WATER MANAGEMENT STRATEGIES FOR MEETING THE PROJECTED WATER SUPPLY NEEDS OF DE KALB

Description of Water User Group:

The City of De Kalb provides water service in Bowie County. The City population is projected to be 1,711 in 2020 and 1,827 in the year 2070. The City has a contract for water supply with the City of Texarkana from Lake Wright Patman. The City is projected to have a shortage in 2020 due to aging of Texarkana’s Water Treatment Plant.

Water Supply and Demand Analysis:

	2020	2030	2040	2050	2060	2070
Population	1,711	1,748	1,769	1,780	1,803	1,827
Projected Water Demand	295	292	289	291	294	298
Water Demand from other entities	0	0	0	0	0	0
Current Water Supply	0	0	0	0	0	0
Projected Supply Surplus (+) / Deficit (-)	-295	-292	-289	-291	-294	-298

Evaluation of Potentially Feasible Water Management Strategies:

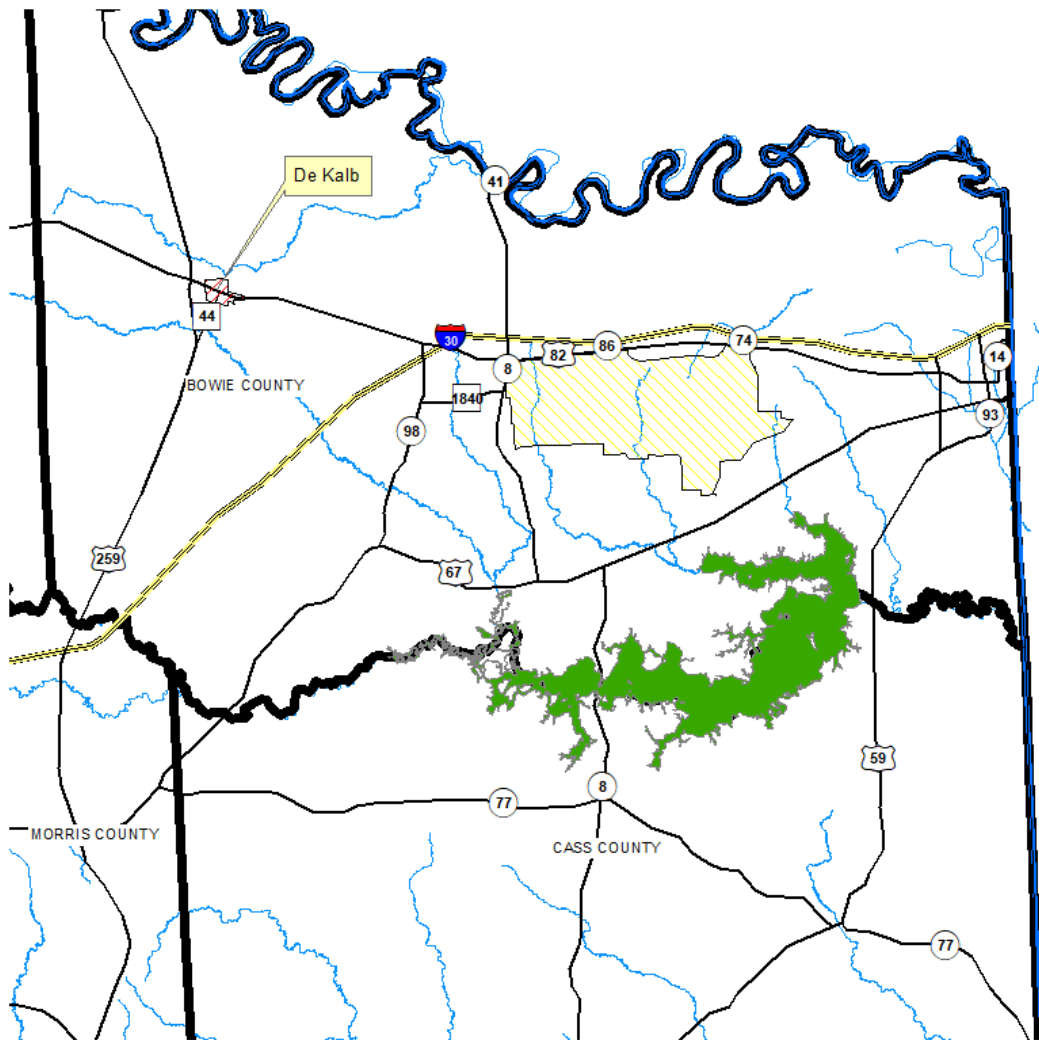
There were four alternative strategies considered to meet the City’s water supply shortages as summarized in the Table below. Advanced conservation was not considered because De Kalb’s supply is not projected to meet TCEQ regulatory minimums. Reuse is not a feasible option because water supply is mainly used for public consumption. Groundwater was not selected because the City is planning on continuing to purchase surface water from the City of Texarkana. A request was submitted by Riverbend Water Resources District to consider a new Water Treatment Plant, pipeline, and intake to Wright Patman Reservoir. Thus, a renewal contract with Texarkana/Riverbend has been considered herein.

Strategy	Firm Yield (ac-ft)	Total Capital Cost	Total Annualized Cost	Unit Cost	Environmental Impact
Advanced Water Conservation					
Water Reuse					
Ground Water					
Renew Existing Contract	298		\$72,000	\$242	1

Recommendations:

	2020	2030	2040	2050	2060	2070
Renew Existing Contract (ac-ft/yr)	295	292	289	291	294	298

It is recommended that the City of DeKalb continue its surface water purchase from Texarkana contingent upon Texarkana/Riverbend strategies.



- Relation**
- Buyer
 - Seller
 - Source
 - Region D Boundary
 - Counties
 - Reservoirs
 - Streams

0 15,000 30,000 60,000

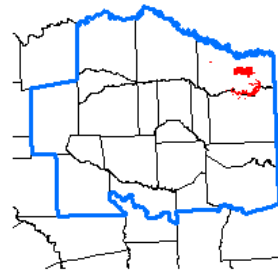


Feet

1 inch = 30,000 feet

Attachment A

De Kalb
 Recommended Strategy
 Renew Existing Contract (Riverbend WRD)



**Cost Estimate Summary
Water Supply Project Option
September 2018 Prices**

De Kalb - Renew Existing Contract

**Cost based on ENR CCI 11170.28 for September 2018 and
a PPI of 201.9 for September 2018**

<i>Item</i>	<i>Estimated Costs for Facilities</i>
ANNUAL COST	
Operation and Maintenance	
Intakes and Pump Stations (2.5% of Cost of Facilities)	\$0
Dam and Reservoir (1.5% of Cost of Facilities)	\$0
Water Treatment Plant	\$0
Advanced Water Treatment Facility	\$0
Pumping Energy Costs (0 kW-hr @ 0.08 \$/kW-hr)	\$0
Purchase of Water (298 acft/yr @ 242.68 \$/acft)	<u>\$72,000</u>
TOTAL ANNUAL COST	\$72,000
Available Project Yield (acft/yr)	298
Annual Cost of Water (\$ per acft), based on PF=1	\$242
Annual Cost of Water After Debt Service (\$ per acft), based on PF=1	\$242
Annual Cost of Water (\$ per 1,000 gallons), based on PF=1	\$0.74
Annual Cost of Water After Debt Service (\$ per 1,000 gallons), based on PF=1	\$0.74
<i>JMP</i>	<i>10/2/2019</i>

EVALUATION OF WATER MANAGEMENT STRATEGIES FOR MEETING THE PROJECTED WATER SUPPLY NEEDS OF HOOKS

Description of Water User Group:

The City of Hooks provides water service in Bowie County. The City population is projected to be 3,049 in 2020 and 3,303 in the year 2070. The City has a contract for water supply with the City of Texarkana from Lake Wright Patman. The City is projected to have a shortage in 2020 due to aging of Texarkana’s Water Treatment Plant.

Water Supply and Demand Analysis:

	2020	2030	2040	2050	2060	2070
Population	3,049	3,173	3,303	3,303	3,303	3,303
Projected Water Demand	281	278	276	271	269	269
Water Demand from other entities	0	0	0	0	0	0
Current Water Supply	0	0	0	0	0	0
Projected Supply Surplus (+) / Deficit (-)	-281	-278	-276	-271	-269	-269

Evaluation of Potentially Feasible Water Management Strategies:

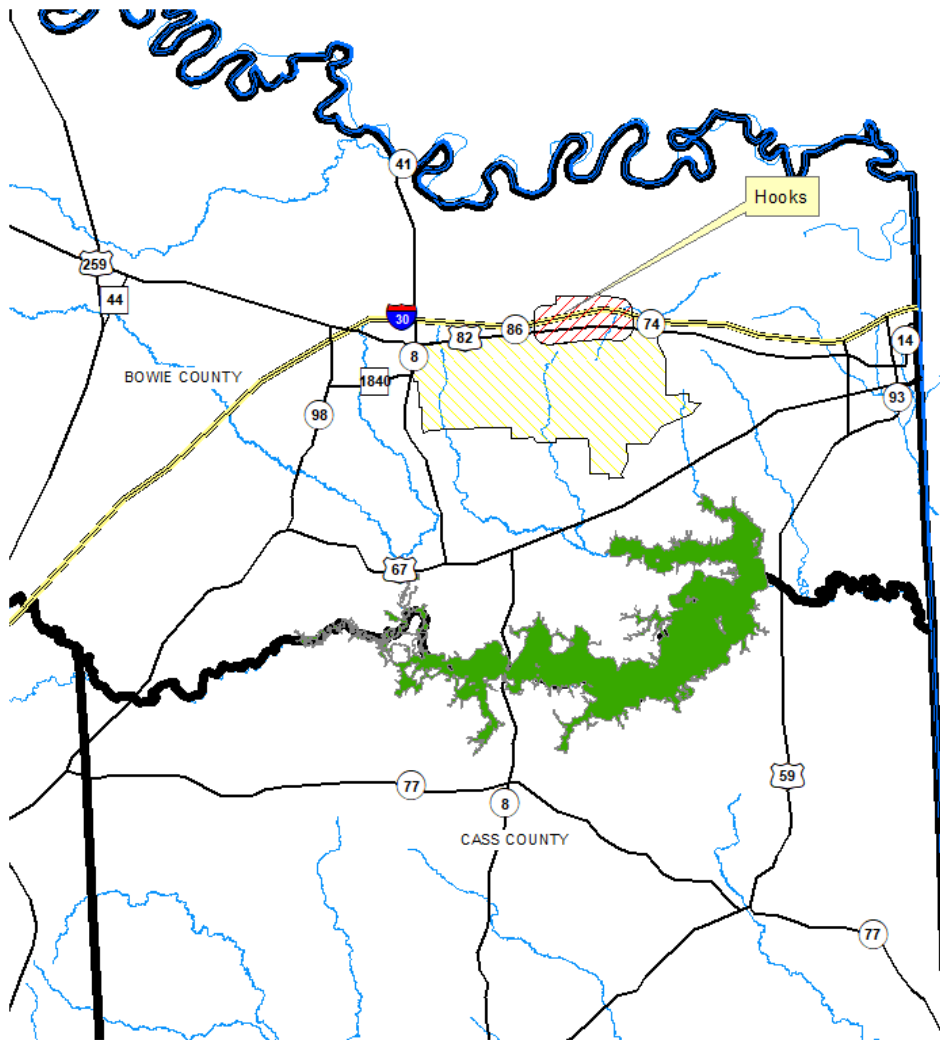
There were four alternative strategies considered to meet the City’s water supply shortages as summarized in the Table below. Advanced conservation was not considered because the per capita use per day was less than the 140 gpcd threshold set by the water planning group. Reuse is not a feasible option because water supply is mainly used for public consumption. Groundwater was not selected because the City is planning on continuing to purchase surface water from the City of Texarkana. A request was submitted by Riverbend Water Resources District to consider a new Water Treatment Plant, pipeline, and intake to Wright Patman Reservoir. Thus, a renewal contract with Texarkana/Riverbend has been considered herein.

Strategy	Firm Yield (ac-ft)	Total Capital Cost	Total Annualized Cost	Unit Cost	Environmental Impact
Advanced Water Conservation					
Water Reuse					
Ground Water					
Renew Existing Contract	281		\$68,000	\$242	1

Recommendations:

	2020	2030	2040	2050	2060	2070
Renew Existing Contract (ac-ft/yr)	281	278	276	271	269	269

It is recommended that the City of Hooks continue its surface water purchase from Texarkana contingent upon Texarkana/Riverbend strategies.



- Relation**
- Buyer
 - Seller
 - Source
 - Region D Boundary
 - Counties
 - Reservoirs
 - Streams

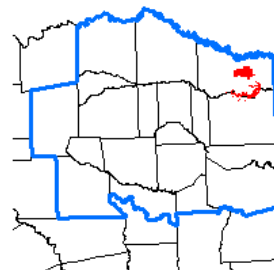
0 15,000 30,000 60,000

Feet

1 inch = 30,000 feet

Attachment A

Hooks
 Recommended Strategy
 Renew Existing Contract (Riverbend WRD)



**Cost Estimate Summary
Water Supply Project Option
September 2018 Prices**

Hooks - Renew Existing Contract

**Cost based on ENR CCI 11170.28 for September 2018 and
a PPI of 201.9 for September 2018**

<i>Item</i>	<i>Estimated Costs for Facilities</i>
ANNUAL COST	
Operation and Maintenance	
Intakes and Pump Stations (2.5% of Cost of Facilities)	\$0
Dam and Reservoir (1.5% of Cost of Facilities)	\$0
Water Treatment Plant	\$0
Advanced Water Treatment Facility	\$0
Pumping Energy Costs (0 kW-hr @ 0.08 \$/kW-hr)	\$0
Purchase of Water (281 acft/yr @ 242.68 \$/acft)	\$68,000
TOTAL ANNUAL COST	\$68,000
Available Project Yield (acft/yr)	281
Annual Cost of Water (\$ per acft), based on PF=1	\$242
Annual Cost of Water After Debt Service (\$ per acft), based on PF=1	\$242
Annual Cost of Water (\$ per 1,000 gallons), based on PF=1	\$0.74
Annual Cost of Water After Debt Service (\$ per 1,000 gallons), based on PF=1	\$0.74
<i>JMP</i>	10/2/2019

EVALUATION OF WATER MANAGEMENT STRATEGIES FOR MEETING THE PROJECTED WATER SUPPLY NEEDS OF IRRIGATION IN BOWIE COUNTY

Description of Water User Group:

The Irrigation WUG in Bowie County has a demand that is projected to be 10,373 ac-ft/yr in 2020 through 2070. The Irrigation WUG in Bowie County is projected to be supplied by surface water supplies from run-of-river diversions from the Red and Sulphur Rivers. The current round of planning has identified a deficit of 4,134 ac-ft/yr in the Sulphur basin and a surplus of 922 ac-ft/yr in the Red River basin, projected to occur in 2020 through 2070.

Water Supply and Demand Analysis:

	2020	2030	2040	2050	2060	2070
Projected Water Demand	10,373	10,373	10,373	10,373	10,373	10,373
Current Water Supply	7,161	7,161	7,161	7,161	7,161	7,161
Projected Supply Surplus (+)/Deficit(-)	-3,212	-3,212	-3,212	-3,212	-3,212	-3,212

Projected Supply Surplus (+)/Deficit(-) by Basin	2020	2030	2040	2050	2060	2070
Red River Basin	922	922	922	922	922	922
Sulphur Basin	-4,134	-4,134	-4,134	-4,134	-4,134	-4,134
Total	-3,212	-3,212	-3,212	-3,212	-3,212	-3,212

Evaluation of Potentially Feasible Water Management Strategies:

Four alternative strategies were considered to meet the Bowie County Irrigation WUG’s projected water supply shortages. Advanced water conservation for irrigation practices were not considered in this planning effort, as present irrigation practices likely already incorporate many BMPs to extend water supplies, thus no additional conservation would be feasible. The use of reuse water from nearby municipalities is not considered feasible as it would not be effective to deliver reuse water to rural farm irrigation systems. Groundwater from the Carrizo-Wilcox aquifer has been identified as a potential source of water for irrigation in Bowie County. Surface water was not considered as a viable alternative to meet projected demands due to this option would be considered cost prohibitive.

Strategy	Strategy Yield (AF)	Total Capital Cost	Total Annualized Cost	Unit Cost	Environmental Impact
Advanced Water Conservation					
Water Reuse					
Drill New Wells (Carrizo-Wilcox, Sulphur River Basin)	4,134	\$10,597,000	\$3,218,000	\$778	1
Surface Water					

Recommendations:

	2020	2030	2040	2050	2060	2070
Drill New Wells (Carrizo-Wilcox, Sulphur River Basin; ac-ft/yr)	4,134	4,134	4,134	4,134	4,134	4,134

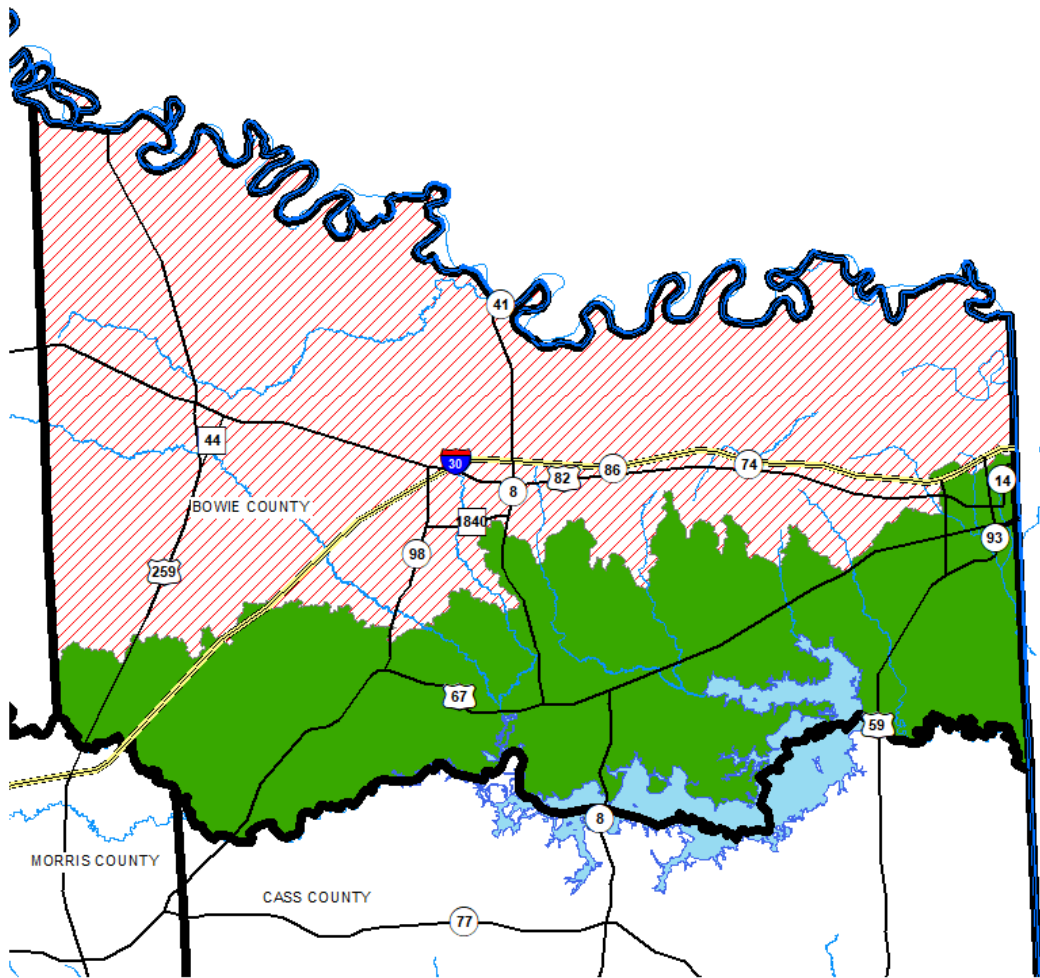
The recommended strategy for the Bowie County Irrigation WUG to meet projected demands during the planning period is to drill 13 new ground water wells with average production capacity of 250 gpm in the Carrizo-Wilcox Aquifer in Bowie County. A well operating at an average of 250 gpm is capable of delivering 403 ac-ft per year per well.

**Cost Estimate Summary
Water Supply Project Option
September 2018 Prices**

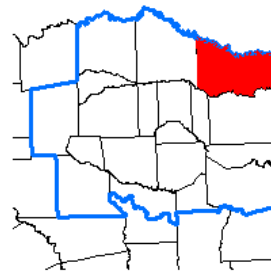
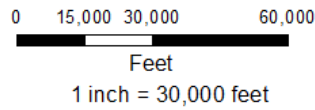
Bowie Irrigation - Drill New Wells (Bowie, Carrizo-Wilcox Aquifer, Sulphur Basin)

**Cost based on ENR CCI 11170.28 for September 2018 and
a PPI of 201.9 for September 2018**

<i>Item</i>	<i>Estimated Costs for Facilities</i>
CAPITAL COST	
Well Fields (Wells, Pumps, and Piping)	\$7,441,000
TOTAL COST OF FACILITIES	\$7,441,000
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	\$2,604,000
Environmental & Archaeology Studies and Mitigation	\$182,000
Land Acquisition and Surveying (17 acres)	\$86,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	<u>\$284,000</u>
TOTAL COST OF PROJECT	\$10,597,000
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	\$746,000
Reservoir Debt Service (3.5 percent, 40 years)	\$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	\$74,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	\$0
Dam and Reservoir (1.5% of Cost of Facilities)	\$0
Water Treatment Plant	\$0
Advanced Water Treatment Facility	\$0
Pumping Energy Costs (4141092 kW-hr @ 0.08 \$/kW-hr)	\$331,000
Purchase of Water (4134 acft/yr @ 500 \$/acft)	<u>\$2,067,000</u>
TOTAL ANNUAL COST	\$3,218,000
Available Project Yield (acft/yr)	4,134
Annual Cost of Water (\$ per acft), based on PF=1	\$778
Annual Cost of Water After Debt Service (\$ per acft), based on PF=1	\$598
Annual Cost of Water (\$ per 1,000 gallons), based on PF=1	\$2.39
Annual Cost of Water After Debt Service (\$ per 1,000 gallons), based on PF=1	\$1.83
<i>JMP</i>	<i>9/30/2019</i>



- Relation**
- Buyer
 - Seller
 - Source
 - Region D Boundary
 - Counties
 - Reservoirs
 - Streams



Attachment A

Irrigation Bowie Co
 Recommended Strategy
 Drill New Wells (Bowie, Carrizo-Wilcox, Sulphur)

EVALUATION OF WATER MANAGEMENT STRATEGIES FOR MEETING THE PROJECTED WATER SUPPLY NEEDS OF LIVESTOCK IN BOWIE COUNTY

Description of Water User Group:

The Livestock WUG in Bowie County has a demand that is projected to be 1,825 ac-ft/yr in 2020 decreasing to 1,136 ac-ft/yr in 2070. The Livestock WUG in Bowie County is projected to be supplied by groundwater supplies from the Carrizo-Wilcox Aquifer, Nacatoch Aquifer and livestock local supply. The current round of planning has identified a deficit of 417 ac-ft/yr in the Sulphur basin and 252 ac-ft/yr in the Red River basin, projected to occur in 2020 and decrease to 260 and 156 ac-ft/yr by 2070.

Water Supply and Demand Analysis:

	2020	2030	2040	2050	2060	2070
Projected Water Demand	1,825	1,825	1,657	1,421	1,217	1,136
Current Water Supply	1,156	1,156	1,050	900	771	720
Projected Supply Surplus (+)/Deficit(-)	-669	-669	-607	-521	-446	-416

Projected Supply Surplus (+)/Deficit(-) by Basin	2020	2030	2040	2050	2060	2070
Red River Basin	-252	-252	-229	-196	-168	-156
Sulphur Basin	-417	-417	-378	-325	-278	-260
Total	-669	-669	-607	-521	-446	-416

Evaluation of Potentially Feasible Water Management Strategies:

Five alternative strategies were considered to meet the Bowie County Livestock WUG’s projected water supply shortages. Advanced water conservation for livestock practices were not considered, as present livestock practices likely result in sale of the livestock to reduce demand and extend water supply. The use of reuse water from nearby municipalities is not considered feasible as the water may be used for livestock consumption. Groundwater from the Carrizo-Wilcox and Nacatoch aquifers has been identified as a potential source of water for livestock in Bowie County. Surface water was not considered as a viable alternative to meet projected demands due to this option would be considered cost prohibitive.

Strategy	Strategy Yield (AF)	Total Capital Cost	Total Annualized Cost	Unit Cost	Environmental Impact
Advanced Water Conservation					
Water Reuse					
Drill New Wells (Carrizo-Wilcox, Sulphur River Basin)	417	\$2,423,000	\$424,000	\$1,017	1
Drill New Wells (Nacatoch, Red Basin)	252	\$1,630,000	\$268,000	\$1,063	1
Surface Water					

Recommendations:

	2020	2030	2040	2050	2060	2070
Drill New Wells (Carrizo-Wilcox, Sulphur River Basin; ac-ft/yr)	417	417	378	325	278	260
Drill New Wells (Nacatoch, Red Basin; ac-ft/yr)	252	252	229	196	168	156

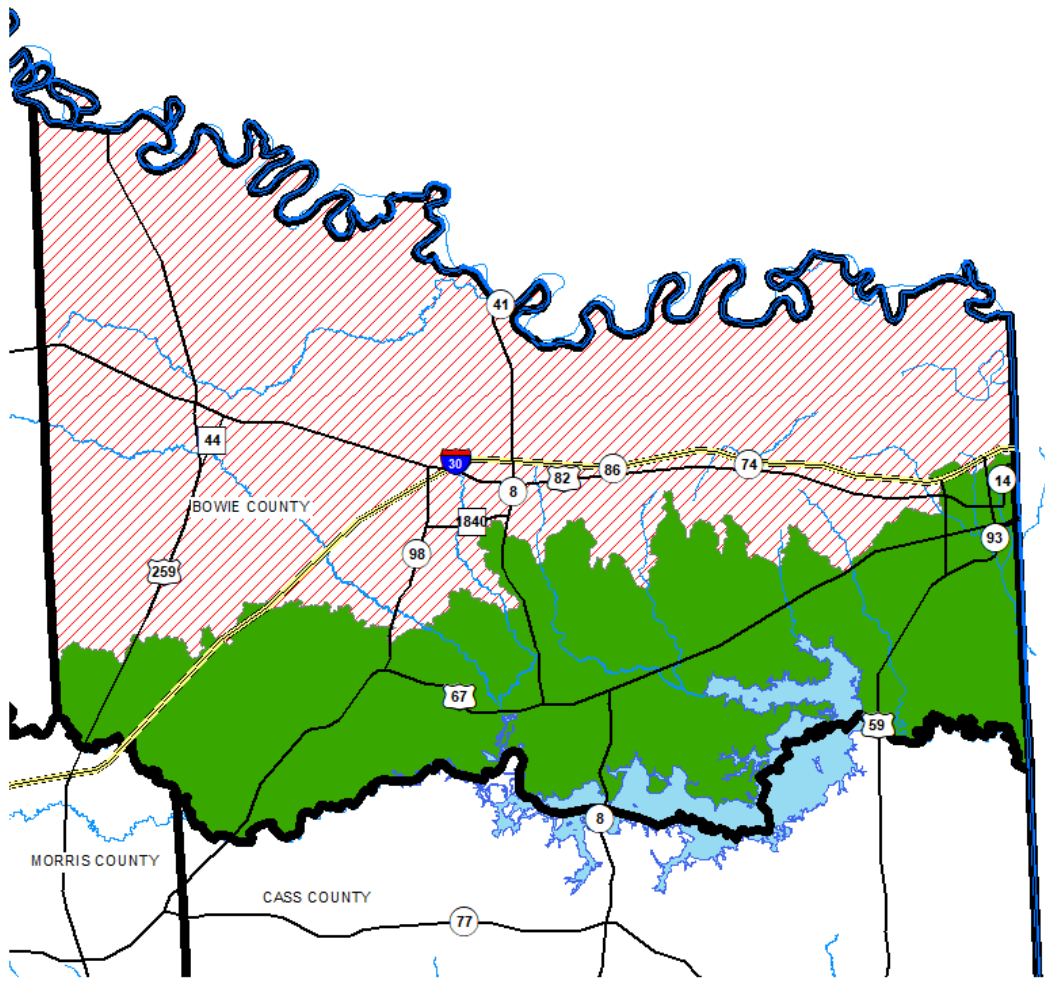
The recommended strategy for the Bowie County Livestock WUG to meet projected demands during the planning period is to drill new ground water wells in the Carrizo-Wilcox and Nacatoch Aquifers in Bowie County. This strategy estimates five (5) new wells at a rated capacity of 75 gpm in the Carrizo-Wilcox Aquifer and four (4) new wells at a rated capacity of 75 gpm in the Nacatoch Aquifer in Bowie County. A well operating at an average of 75 gpm is capable of delivering 121 ac-ft per year per well.

**Cost Estimate Summary
Water Supply Project Option
September 2018 Prices**

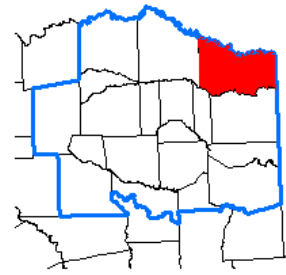
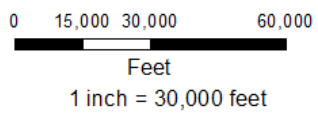
Bowie Livestock Sulphur - Drill New Wells (Bowie Carrizo-Wilcox Aquifer, Sulphur Basin)

**Cost based on ENR CCI 11170.28 for September 2018 and
a PPI of 201.9 for September 2018**

<i>Item</i>	<i>Estimated Costs for Facilities</i>
Well Fields (Wells, Pumps, and Piping)	\$1,659,000
TOTAL COST OF FACILITIES	\$1,659,000
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	\$580,000
Environmental & Archaeology Studies and Mitigation	\$81,000
Land Acquisition and Surveying (7 acres)	\$38,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	<u>\$65,000</u>
TOTAL COST OF PROJECT	\$2,423,000
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	\$170,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	\$17,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	\$0
Dam and Reservoir (1.5% of Cost of Facilities)	\$0
Water Treatment Plant	\$0
Advanced Water Treatment Facility	\$0
Pumping Energy Costs (345061 kW-hr @ 0.08 \$/kW-hr)	\$28,000
Purchase of Water (417 acft/yr @ 500 \$/acft)	<u>\$209,000</u>
TOTAL ANNUAL COST	\$424,000
Available Project Yield (acft/yr)	417
Annual Cost of Water (\$ per acft), based on PF=1	\$1,017
Annual Cost of Water After Debt Service (\$ per acft), based on PF=1	\$609
Annual Cost of Water (\$ per 1,000 gallons), based on PF=1	\$3.12
Annual Cost of Water After Debt Service (\$ per 1,000 gallons), based on PF=1	\$1.87
<i>JMP</i>	<i>9/30/2019</i>



- Relation**
- Buyer
 - Seller
 - Source
 - Region D Boundary
 - Counties
 - Reservoirs
 - Streams



Attachment A

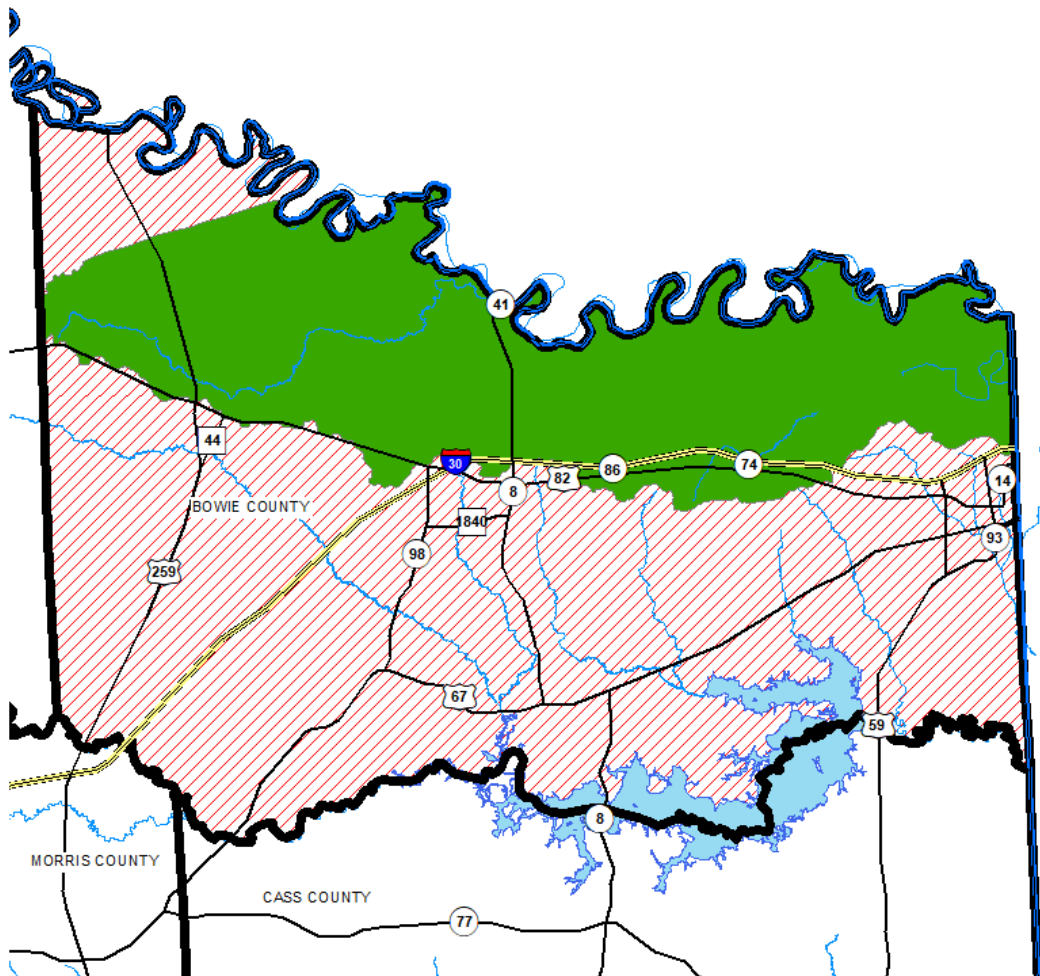
Livestock Bowie Co
 Recommended Strategy
 Drill New Wells (Bowie, Carrizo-Wilcox, Sulphur)

**Cost Estimate Summary
Water Supply Project Option
September 2018 Prices**

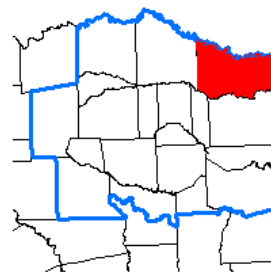
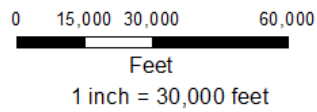
Bowie Livestock Red - Drill New Wells (Bowie, Nacatoch Aquifer, Red Basin)

**Cost based on ENR CCI 11170.28 for September 2018 and
a PPI of 201.9 for September 2018**

<i>Item</i>	<i>Estimated Costs for Facilities</i>
Well Fields (Wells, Pumps, and Piping)	\$1,122,000
TOTAL COST OF FACILITIES	\$1,122,000
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	\$393,000
Environmental & Archaeology Studies and Mitigation	\$53,000
Land Acquisition and Surveying (6 acres)	\$18,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	<u>\$44,000</u>
TOTAL COST OF PROJECT	\$1,630,000
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	\$115,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	\$11,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	\$0
Dam and Reservoir (1.5% of Cost of Facilities)	\$0
Water Treatment Plant	\$0
Advanced Water Treatment Facility	\$0
Pumping Energy Costs (203010 kW-hr @ 0.08 \$/kW-hr)	\$16,000
Purchase of Water (252 acft/yr @ 500 \$/acft)	<u>\$126,000</u>
TOTAL ANNUAL COST	\$268,000
Available Project Yield (acft/yr)	252
Annual Cost of Water (\$ per acft), based on PF=1	\$1,063
Annual Cost of Water After Debt Service (\$ per acft), based on PF=1	\$607
Annual Cost of Water (\$ per 1,000 gallons), based on PF=1	\$3.26
Annual Cost of Water After Debt Service (\$ per 1,000 gallons), based on PF=1	\$1.86
<i>JMP</i>	<i>9/30/2019</i>



- Relation**
- Buyer
 - Seller
 - Source
 - Region D Boundary
 - Counties
 - Reservoirs
 - Streams



Attachment B
 Livestock Bowie Co
 Recommended Strategy
 Drill New Wells (Bowie, Nacatoch, Red)

EVALUATION OF WATER MANAGEMENT STRATEGIES FOR MEETING THE PROJECTED WATER SUPPLY NEEDS OF MACEDONIA-EYLAU MUD#1

Description of Water User Group:

Macedonia-Eylau MUD #1 provides water service in Bowie County. The MUD’s population is projected to be 8,742 in 2020 and 8,939 in the year 2070. The MUD has a contract for water supply with the City of Texarkana for 552 ac-ft/yr that expires in 2019. The MUD is projected to have a deficit of 588 ac-ft in 2020 and increasing to a deficit of 601 ac-ft by 2070.

Water Supply and Demand Analysis:

	2020	2030	2040	2050	2060	2070
Population	8,742	8,892	8,939	8,939	8,939	8,939
Projected Water Demand	588	598	601	601	601	601
Water Demand from other entities	0	0	0	0	0	0
Current Water Supply	0	0	0	0	0	0
Projected Supply Surplus (+) / Deficit (-)	-588	-598	-601	-601	-601	-601

Evaluation of Potentially Feasible Water Management Strategies:

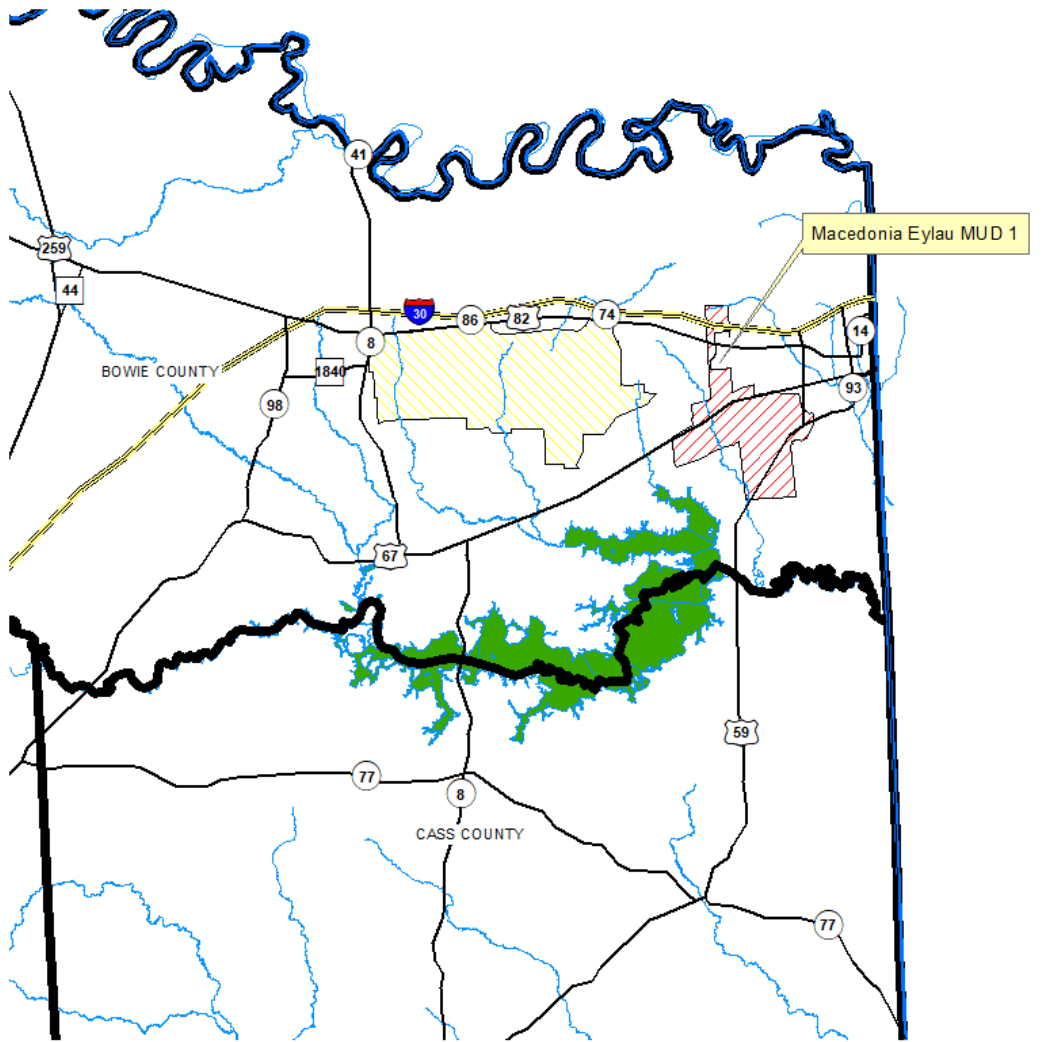
There were four alternative strategies considered to meet the MUD’s water supply shortages as summarized in the table below. Advanced conservation was not considered because the per capita use per day was less than the 140 gpcd threshold established by the water planning group. Reuse is not a feasible option because water supply is mainly used for public consumption. Groundwater was not selected because the MUD is planning on continuing to purchase surface water from the City of Texarkana.

Strategy	Firm Yield (ac-ft)	Total Capital Cost	Total Annualized Cost	Unit Cost	Environmental Impact
Advanced Water Conservation					
Water Reuse					
Ground Water					
Renew Existing Contract	601		\$290,000	\$483	1

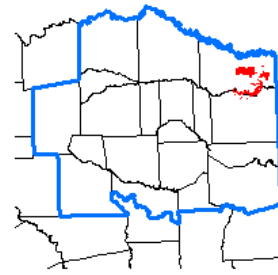
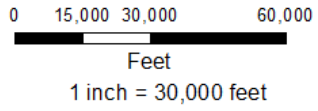
Recommendations:

	2020	2030	2040	2050	2060	2070
Renew Existing Contract (ac-ft/yr)	588	598	601	601	601	601

Renewal of the existing surface water purchase from City of Texarkana is the recommended strategy to meet the Macedonia-Eylau MUD No. 1’s needs contingent on Riverbend WRD’s recommended strategies.



- Relation**
- Buyer
 - Seller
 - Source
 - Region D Boundary
 - Counties
 - Streams
 - Reservoirs



Attachment A
 Macedonia Eylau MUD 1
 Recommended Strategy
 Renew Existing Contract (Riverbend WRD)

**Cost Estimate Summary
Water Supply Project Option
September 2018 Prices**

Macedonia Eylau MUD - Renew Existing Contract

**Cost based on ENR CCI 11170.28 for September 2018 and
a PPI of 201.9 for September 2018**

<i>Item</i>	<i>Estimated Costs for Facilities</i>
ANNUAL COST	
Operation and Maintenance	
Intakes and Pump Stations (2.5% of Cost of Facilities)	\$0
Dam and Reservoir (1.5% of Cost of Facilities)	\$0
Water Treatment Plant	\$0
Advanced Water Treatment Facility	\$0
Pumping Energy Costs (0 kW-hr @ 0.08 \$/kW-hr)	\$0
Purchase of Water (601 acft/yr @ 482.23 \$/acft)	<u>\$290,000</u>
TOTAL ANNUAL COST	\$290,000
Available Project Yield (acft/yr)	601
Annual Cost of Water (\$ per acft), based on PF=1	\$483
Annual Cost of Water After Debt Service (\$ per acft), based on PF=1	\$483
Annual Cost of Water (\$ per 1,000 gallons), based on PF=1	\$1.48
Annual Cost of Water After Debt Service (\$ per 1,000 gallons), based on PF=1	\$1.48
<i>JMP</i>	<i>10/2/2019</i>

EVALUATION OF WATER MANAGEMENT STRATEGIES FOR MEETING THE PROJECTED WATER SUPPLY NEEDS OF MANUFACTURING IN BOWIE COUNTY

Description of Water User Group:

The Manufacturing WUG in Bowie County has a demand that is projected to be 1,611 ac-ft/yr in 2020 increasing to 2,047 ac-ft/yr in 2070. Manufacturing demands identified via contract between the Riverbend WRD and TexAmericas Center range from 33,604 ac-ft/yr in 2020 to 100,813 ac-ft/yr in 2070. The Manufacturing WUG in Bowie County is projected to be supplied by existing groundwater supplies from the Carrizo-Wilcox Aquifer, surface water from existing run-of-river rights in the Red River Basin, and contracted water supplies from Wright Patman Lake from the Riverbend WRD. The current round of planning has identified a projected 2020 deficit of 1,579 ac-ft/yr in the Sulphur River Basin with a surplus of 3 ac-ft/yr in the Red River Basin. This deficit in the Sulphur River Basin is projected to increase to 2,014 ac-ft/yr by 2070, whereas the projected surplus in the Red River Basin decreases slightly to 2 ac-ft/yr by 2070. Contractual need in the Sulphur River Basin is established by the aforementioned contract between Riverbend WRD and TexAmericas Center, and the need established by Riverbend WRD to replace aging infrastructure by 2030. This contractual need ranges from 33,604 ac-ft/yr in 2020 to 100,813 ac-ft/yr in 2070.

Water Supply and Demand Analysis:

	2020	2030	2040	2050	2060	2070
Projected Water Demand	1,611	2,047	2,047	2,047	2,047	2,047
Current Water Supply	35	35	35	35	35	35
Projected Supply Surplus (+)/Deficit(-)	-2,012	-2,012	-2,012	-2,012	-2,012	-2,012

Projected Supply Surplus (+)/Deficit(-) by Basin	2020	2030	2040	2050	2060	2070
Red River Basin	3	2	2	2	2	2
Sulphur Basin	-1,579	-2,014	-2,014	-2,014	-2,014	-2,014
Total	-1,576	-2,012	-2,012	-2,012	-2,012	-2,012

Contracted Supply Surplus (+)/Deficit(-) by Basin	2020	2030	2040	2050	2060	2070
Sulphur Basin	-33,604	-59,928	-66,509	-74,735	-82,961	-100,813
Total	-33,604	-59,928	-66,509	-74,735	-82,961	-100,813

Evaluation of Potentially Feasible Water Management Strategies:

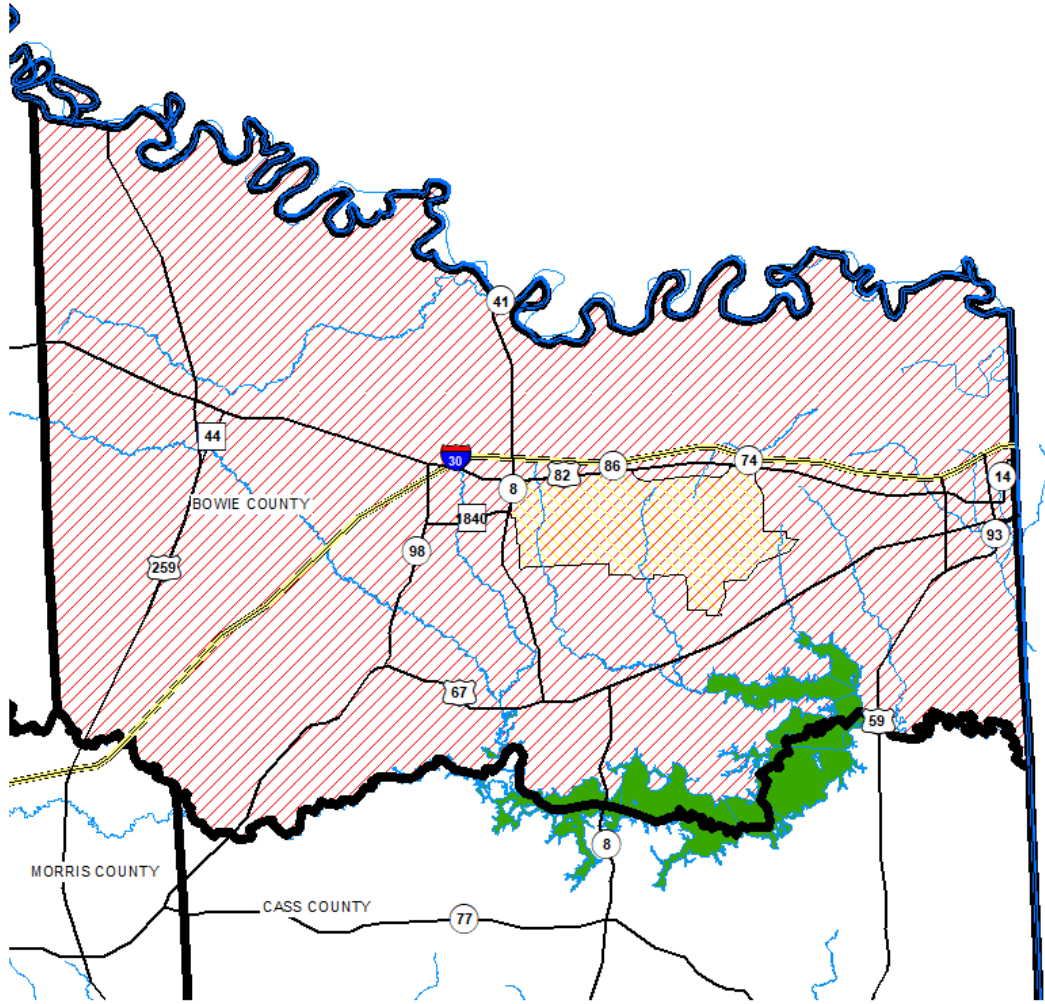
Five alternative strategies were considered to meet the Bowie County Manufacturing WUG’s projected water supply shortages. Advanced water conservation for manufacturing practices were considered feasible, whereby industrial water auditing BMPs could extend water supplies through an assumed 10% demand reduction. The use of reuse water from nearby municipalities is not considered feasible as it would not be effective to deliver reuse water to this WUG. Groundwater from the Carrizo-Wilcox and Nacatoch aquifers was considered insufficient to meet the full contractual needs identified for manufacturing in Bowie County. Riverbend WRD requested consideration of the Riverbend WRD WMSPs to meet the identified need.

Strategy	Strategy Yield (AF)	Total Capital Cost	Total Annualized Cost	Unit Cost	Environmental Impact
Advanced Water Conservation	204	\$0	\$0	\$0	1
Water Reuse					
Renew Existing Contract contingent upon Riverbend Strategy	100,609		\$48,517,000	\$482	1

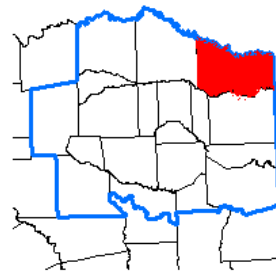
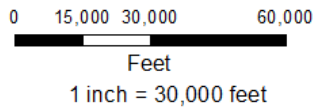
Recommendations:

	2020	2030	2040	2050	2060	2070
Advanced Water Conservation	161	204	204	204	204	204
Renew Existing Contract contingent upon Riverbend Strategy	789	59,724	66,305	74,531	82,757	100,609
Unmet Projected Need	631	0	0	0	0	0

The recommended strategy for the Bowie County Manufacturing WUG to meet projected demands during the planning period is advanced conservation and renewal of the existing contract with Riverbend WRD contingent upon implementation of the Riverbend WRD's recommended WMS and WMSPs. As the recommended approach is contingent upon the Riverbend WRD's recommended WMSPs, which are not planned to come online until 2026, for the purposes of the 2021 Region D Plan there remains a projected unmet manufacturing need in 2020 of 631 ac-ft/yr.



- Relation**
-  Buyer
 -  Seller
 -  Source
 -  Region D Boundary
 -  Counties
 -  Streams
 -  Reservoirs



Attachment A
 Manufacturing Bowie Co
 Recommended Strategy
 Renew Existing Contract (Riverbend WRD)

**Cost Estimate Summary
Water Supply Project Option
September 2018 Prices**

Bowie County Manufacturing - Renew Existing Contract

**Cost based on ENR CCI 11170.28 for September 2018 and
a PPI of 201.9 for September 2018**

<i>Item</i>	<i>Estimated Costs for Facilities</i>
ANNUAL COST	
Operation and Maintenance	
Intakes and Pump Stations (2.5% of Cost of Facilities)	\$0
Dam and Reservoir (1.5% of Cost of Facilities)	\$0
Water Treatment Plant	\$0
Advanced Water Treatment Facility	\$0
Pumping Energy Costs (0 kW-hr @ 0.08 \$/kW-hr)	\$0
Purchase of Water (100609 acft/yr @ 482.23 \$/acft)	\$48,517,000
TOTAL ANNUAL COST	\$48,517,000
Available Project Yield (acft/yr)	100,609
Annual Cost of Water (\$ per acft), based on PF=1	\$482
Annual Cost of Water After Debt Service (\$ per acft), based on PF=1	\$482
Annual Cost of Water (\$ per 1,000 gallons), based on PF=1	\$1.48
Annual Cost of Water After Debt Service (\$ per 1,000 gallons), based on PF=1	\$1.48
<i>JMP</i>	<i>10/2/2019</i>

EVALUATION OF WATER MANAGEMENT STRATEGIES FOR MEETING THE PROJECTED WATER SUPPLY NEEDS OF MAUD

Description of Water User Group:

The City of Maud provides water service in Bowie County. The City population is projected to be 1,358 in 2020 and 1,642 in the year 2070. The City has a contract for water supply with the City of Texarkana from Lake Wright Patman. The City is projected to have a shortage in 2020 due to aging of Texarkana’s Water Treatment Plant.

Water Supply and Demand Analysis:

	2020	2030	2040	2050	2060	2070
Population	1,358	1,500	1,642	1,642	1,642	1,642
Projected Water Demand	211	226	241	238	237	237
Water Demand from other entities	0	0	0	0	0	0
Current Water Supply	0	0	0	0	0	0
Projected Supply Surplus (+) / Deficit (-)	-211	-226	-241	-238	-237	-237

Evaluation of Potentially Feasible Water Management Strategies:

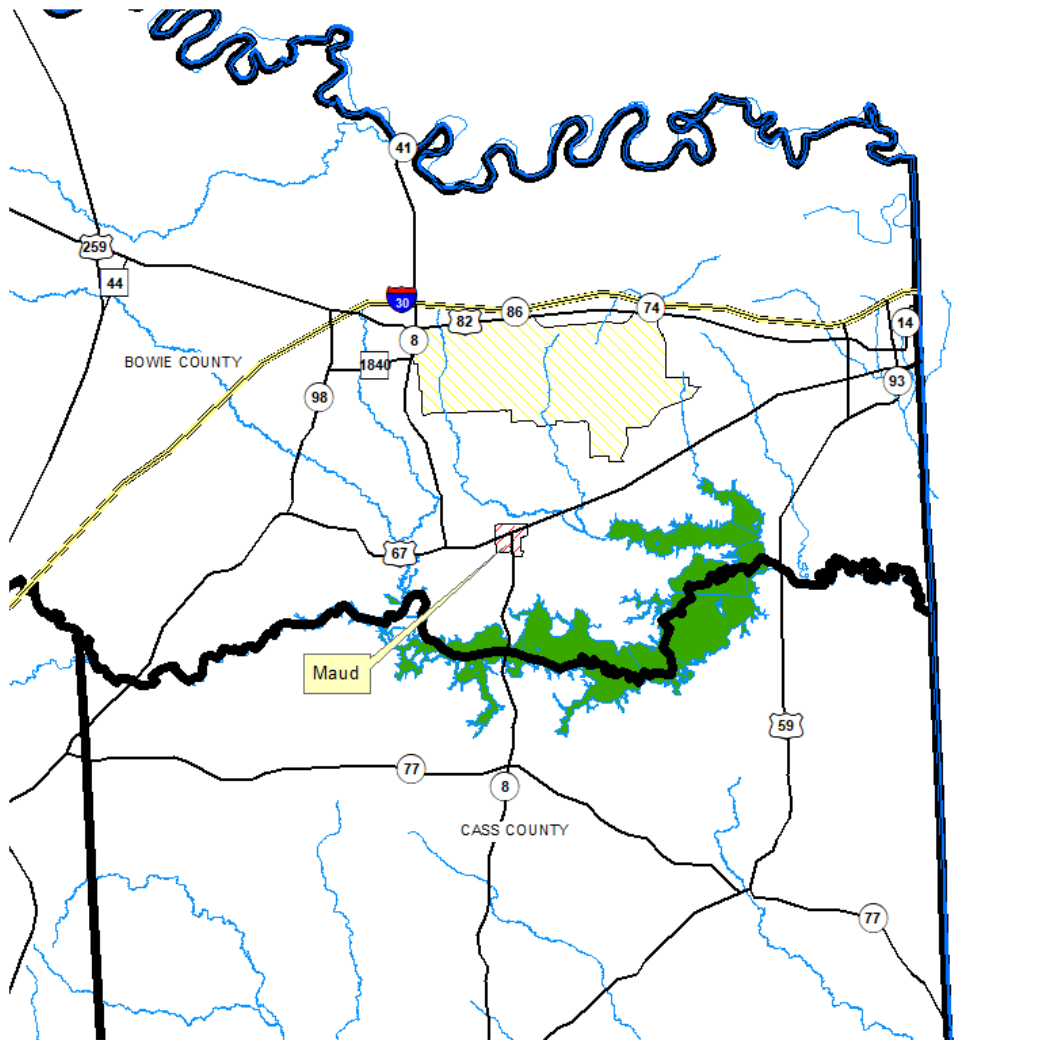
There were four alternative strategies considered to meet the City’s water supply shortages as summarized in the Table below. Advanced conservation was not considered because Maud’s supply would not be projected to meet TCEQ regulatory minimums. Reuse is not a feasible option because water supply is mainly used for public consumption. Groundwater was not selected because the City is planning on continuing to purchase surface water from the City of Texarkana. A request was submitted by Riverbend Water Resources District to consider a new Water Treatment Plant, pipeline, pump station, and intake to Wright Patman Reservoir. Thus, a renewal contract with Texarkana/Riverbend has been considered herein.

Strategy	Firm Yield (ac-ft)	Total Capital Cost	Total Annualized Cost	Unit Cost	Env. Impact
Advanced Water Conservation					
Water Reuse					
Ground Water					
Renew Existing Contract (ac-ft/yr)	241		\$58,000	\$241	1

Recommendations:

	2020	2030	2040	2050	2060	2070
Renew Existing Contract (ac-ft/yr)	211	226	241	238	237	237

It is recommended that the City of Maud renew its existing contract with Texarkana contingent upon Riverbend WRD recommended strategies.



- Relation**
- Buyer
 - Seller
 - Source
 - Region D Boundary
 - Counties
 - Streams
 - Reservoirs

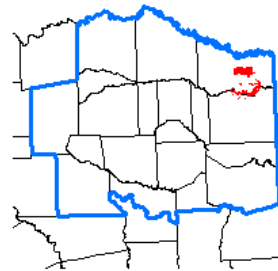
0 15,000 30,000 60,000

Feet

1 inch = 30,000 feet

Attachment A

Maud
 Recommended Strategy
 Renew Existing Contract (Riverbend WRD)



**Cost Estimate Summary
Water Supply Project Option
September 2018 Prices
Maud - Renew Existing Contract**

**Cost based on ENR CCI 11170.28 for September 2018 and
a PPI of 201.9 for September 2018**

<i>Item</i>	<i>Estimated Costs for Facilities</i>
ANNUAL COST	
Operation and Maintenance	
Intakes and Pump Stations (2.5% of Cost of Facilities)	\$0
Dam and Reservoir (1.5% of Cost of Facilities)	\$0
Water Treatment Plant	\$0
Advanced Water Treatment Facility	\$0
Pumping Energy Costs (0 kW-hr @ 0.08 \$/kW-hr)	\$0
Purchase of Water (241 acft/yr @ 242.68 \$/acft)	<u>\$58,000</u>
TOTAL ANNUAL COST	\$58,000
Available Project Yield (acft/yr)	241
Annual Cost of Water (\$ per acft), based on PF=1	\$241
Annual Cost of Water After Debt Service (\$ per acft), based on PF=1	\$241
Annual Cost of Water (\$ per 1,000 gallons), based on PF=1	\$0.74
Annual Cost of Water After Debt Service (\$ per 1,000 gallons), based on PF=1	\$0.74
<i>JMP</i>	<i>10/2/2019</i>

EVALUATION OF WATER MANAGEMENT STRATEGIES FOR MEETING THE PROJECTED WATER SUPPLY NEEDS OF NASH

Description of Water User Group:

The City of Nash provides water service in Bowie County. The City population is projected to be 4,070 in 2020 and 6,111 in the year 2070. The City has a contract for water supply with the City of Texarkana from Lake Wright Patman. The City is projected to have a shortage in 2020 due to constraints in supply availability and aging of Texarkana’s Water Treatment Plant.

Water Supply and Demand Analysis:

	2020	2030	2040	2050	2060	2070
Population	4,070	4,751	5,431	6,111	6,111	6,111
Projected Water Demand	392	458	523	589	589	589
Water Demand from other entities	0	0	0	0	0	0
Current Water Supply	0	0	0	0	0	0
Projected Supply Surplus (+) / Deficit (-)	-392	-458	-523	-589	-589	-589

Evaluation of Potentially Feasible Water Management Strategies:

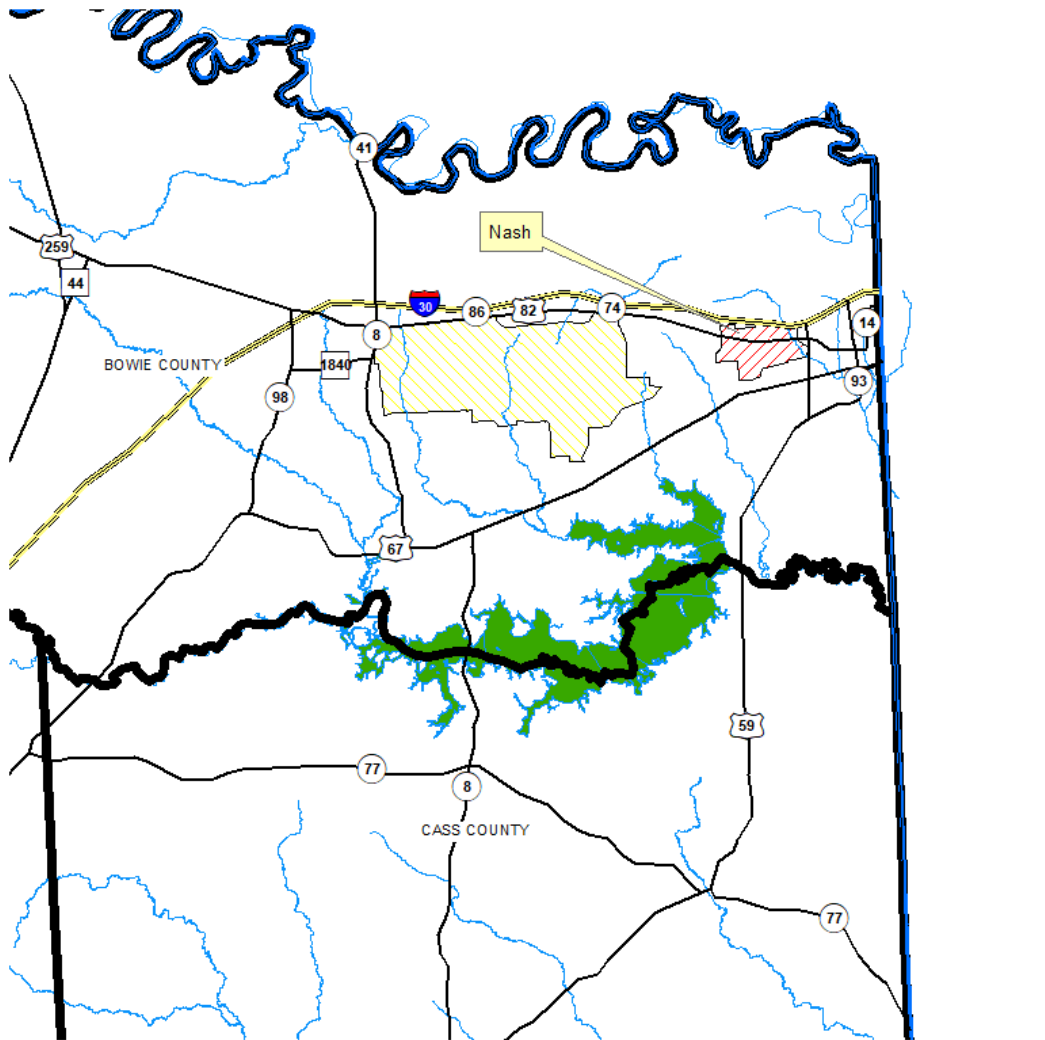
There were four alternative strategies considered to meet the City’s water supply shortages as summarized in the Table below. Advanced conservation was not considered because Nash’s supply would not be projected to meet TCEQ regulatory minimums. Reuse is not a feasible option because water supply is mainly used for public consumption. Groundwater was not selected because the City is planning on continuing to purchase surface water from the City of Texarkana. A request was submitted by Riverbend Water Resources District to consider a new Water Treatment Plant, pipeline, and intake to Wright Patman Reservoir. Thus, a renewal contract with Texarkana/Riverbend has been considered herein.

Strategy	Firm Yield (ac-ft)	Total Capital Cost	Total Annualized Cost	Unit Cost	Env. Impact
Advanced Water Conservation					
Water Reuse					
Ground Water					
Renew Existing Contract (ac-ft/yr)	589		\$143,000	\$243	1

Recommendations:

	2020	2030	2040	2050	2060	2070
Renew Existing Contract (ac-ft/yr)	392	458	523	589	589	589

It is recommended that the City of Nash continue its surface water purchase from Texarkana contingent upon Riverbend WRD’s recommended strategies.



- Relation**
-  Buyer
 -  Seller
 -  Source
 -  Region D Boundary
 -  Counties
 -  Streams
 -  Reservoirs

0 15,000 30,000 60,000

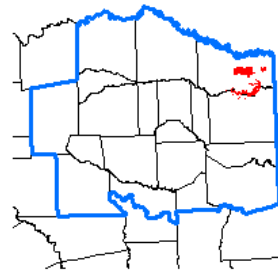


Feet

1 inch = 30,000 feet

Attachment A

Nash
 Recommended Strategy
 Renew Existing Contract (Riverbend WRD)



**Cost Estimate Summary
Water Supply Project Option
September 2018 Prices
Nash - Renew Existing Contract**

**Cost based on ENR CCI 11170.28 for September 2018 and
a PPI of 201.9 for September 2018**

<i>Item</i>	<i>Estimated Costs for Facilities</i>
ANNUAL COST	
Operation and Maintenance	
Intakes and Pump Stations (2.5% of Cost of Facilities)	\$0
Dam and Reservoir (1.5% of Cost of Facilities)	\$0
Water Treatment Plant	\$0
Advanced Water Treatment Facility	\$0
Pumping Energy Costs (0 kW-hr @ 0.08 \$/kW-hr)	\$0
Purchase of Water (589 acft/yr @ 242.68 \$/acft)	<u>\$143,000</u>
TOTAL ANNUAL COST	\$143,000
Available Project Yield (acft/yr)	589
Annual Cost of Water (\$ per acft), based on PF=1	\$243
Annual Cost of Water After Debt Service (\$ per acft), based on PF=1	\$243
Annual Cost of Water (\$ per 1,000 gallons), based on PF=1	\$0.74
Annual Cost of Water After Debt Service (\$ per 1,000 gallons), based on PF=1	\$0.74
<i>JMP</i>	<i>10/2/2019</i>

EVALUATION OF WATER MANAGEMENT STRATEGIES FOR MEETING THE PROJECTED WATER SUPPLY NEEDS OF CITY OF NEW BOSTON IN BOWIE COUNTY

Description of Water User Group:

The City of New Boston provides water service in Bowie County. The WUG population is projected to be 5,960 in 2020 and 6,180 in the year 2070. The city has a contract for water supply with the City of Texarkana for 1,680 ac-ft/yr that expires in 2016, with a one year auto renewal. New Boston also has a water right permit for run-of-river diversions from the Sulphur River, but no infrastructure to utilize it. The City is projected to have a shortage in 2020 due to constraints in supply availability and aging of Texarkana’s Water Treatment Plant.

Water Supply and Demand Analysis:

	2020	2030	2040	2050	2060	2070
Population	5,960	6,129	6,180	6,180	6,180	6,180
Projected Water Demand	1,390	1,399	1,385	1,381	1,379	1,379
Water Demand from other entities	0	0	0	0	0	0
Current Water Supply	0	0	0	0	0	0
Projected Supply Surplus (+) / Deficit (-)	-1,390	-1,399	-1,385	-1,381	-1,379	-1,379

Evaluation of Potentially Feasible Water Management Strategies:

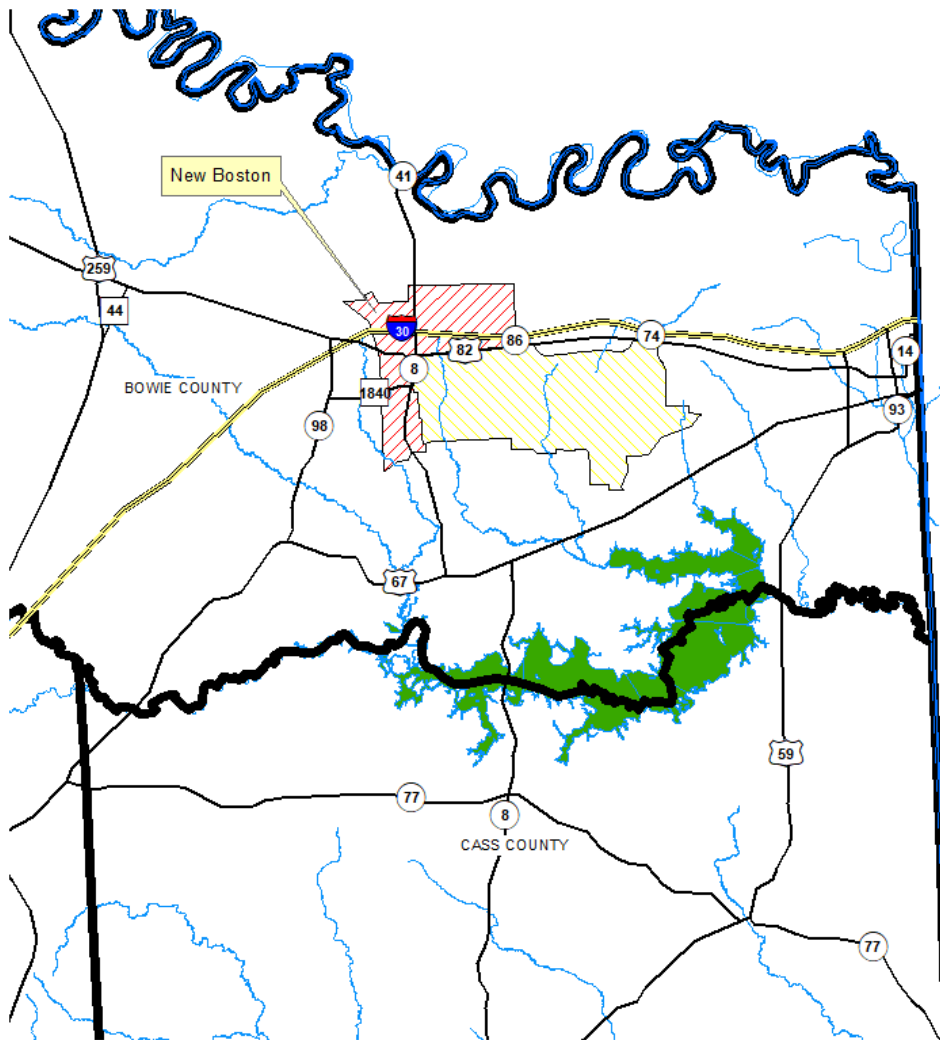
There were four alternative strategies considered to meet New Boston’s water supply shortages as summarized in the Table below. Advanced conservation was not considered because New Boston’s supply would not be projected to meet TCEQ regulatory minimums. Reuse is not a feasible option because water supply is mainly used for public consumption. Groundwater was not selected because the city has historically utilized surface water supplies and, at present, is planning on continuing to purchase surface water from the City of Texarkana. A request was submitted by Riverbend Water Resources District to consider a new Water Treatment Plant, pipeline, pump station, and intake to Wright Patman Reservoir. Thus, a renewal contract with Texarkana/Riverbend has been considered herein.

Strategy	Firm Yield (ac-ft)	Total Capital Cost	Total Annualized Cost	Unit Cost	Environmental Impact
Advanced Water Conservation					
Water Reuse					
Ground Water					
Renew Existing Contract	1,399		\$340,000	\$243	1

Recommendations:

	2020	2030	2040	2050	2060	2070
Renew Existing Contract (ac-ft/yr)	1,390	1,399	1,385	1,381	1,379	1,379

It is recommended that the City of New Boston continue its surface water purchase from Texarkana contingent upon Riverbend WRD’s recommended strategies.



- Relation**
- Buyer
 - Seller
 - Source
 - Region D Boundary
 - Counties
 - Streams
 - Reservoirs

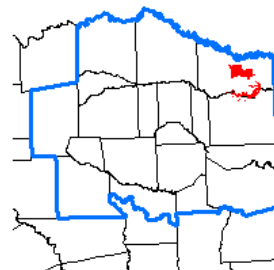
0 15,000 30,000 60,000

Feet

1 inch = 30,000 feet

Attachment A

New Boston
 Recommended Strategy
 Renew Existing Contract (Riverbend WRD)



**Cost Estimate Summary
Water Supply Project Option
September 2018 Prices**

New Boston - Renew Existing Contract

**Cost based on ENR CCI 11170.28 for September 2018 and
a PPI of 201.9 for September 2018**

<i>Item</i>	<i>Estimated Costs for Facilities</i>
ANNUAL COST	
Operation and Maintenance	
Intakes and Pump Stations (2.5% of Cost of Facilities)	\$0
Dam and Reservoir (1.5% of Cost of Facilities)	\$0
Water Treatment Plant	\$0
Advanced Water Treatment Facility	\$0
Pumping Energy Costs (0 kW-hr @ 0.08 \$/kW-hr)	\$0
Purchase of Water (1399 acft/yr @ 242.68 \$/acft)	<u>\$340,000</u>
TOTAL ANNUAL COST	\$340,000
Available Project Yield (acft/yr)	1,399
Annual Cost of Water (\$ per acft), based on PF=1	\$243
Annual Cost of Water After Debt Service (\$ per acft), based on PF=1	\$243
Annual Cost of Water (\$ per 1,000 gallons), based on PF=1	\$0.75
Annual Cost of Water After Debt Service (\$ per 1,000 gallons), based on PF=1	\$0.75
<i>JMP</i>	<i>10/2/2019</i>

EVALUATION OF WATER MANAGEMENT STRATEGIES FOR MEETING THE PROJECTED WATER SUPPLY NEEDS OF REDWATER

Description of Water User Group:

The City of Redwater provides water service in Bowie County. The City population is projected to be 3,749 in 2020 and 5,429 in the year 2070. The City has a contract for water supply with the City of Texarkana from Lake Wright Patman, and groundwater supply from the Carrizo-Wilcox Aquifer. The City is projected to have a shortage in 2020 due to constraints in water supply and aging of the Texarkana's Water Treatment Plant.

Water Supply and Demand Analysis:

	2020	2030	2040	2050	2060	2070
Population	3,749	4,229	4,709	5,189	5,429	5,429
Projected Water Demand	506	553	601	654	682	682
Water Demand from other entities	0	0	0	0	0	0
Current Water Supply	66	66	66	66	66	66
Projected Supply Surplus (+) / Deficit (-)	-440	-487	-535	-588	-616	-616

Evaluation of Potentially Feasible Water Management Strategies:

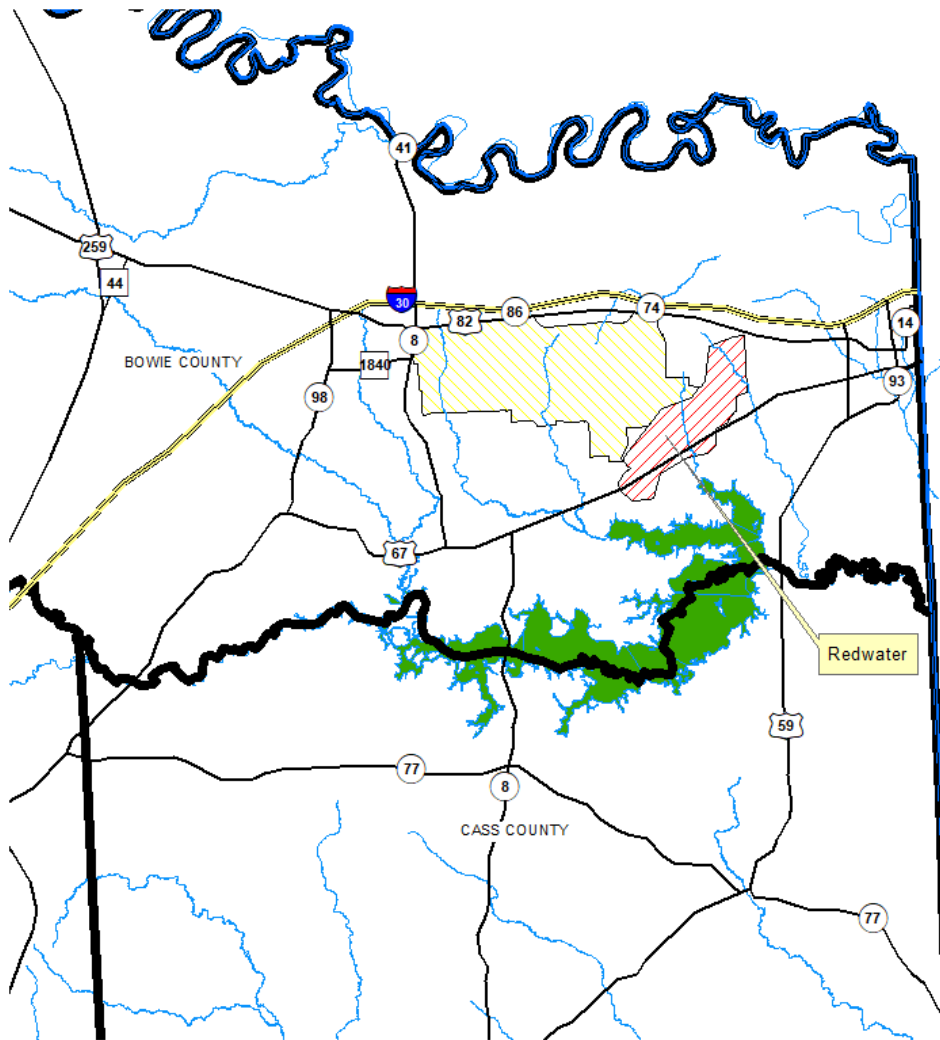
There were four alternative strategies considered to meet the City's water supply shortages. Advanced conservation was not considered because Redwater's supply would not be projected to meet TCEQ regulatory minimums. Reuse is not a feasible option because water supply is mainly used for public consumption. Groundwater was not selected because the City is planning on continuing to purchase surface water from the City of Texarkana. A request was submitted by Riverbend Water Resources District to consider a new Water Treatment Plant, pipeline, pump station, and intake to Wright Patman Reservoir. Thus, a renewal contract with Texarkana/Riverbend has been considered herein.

Strategy	Firm Yield (ac-ft)	Total Capital Cost	Total Annualized Cost	Unit Cost	Env. Impact
Advanced Water Conservation					
Water Reuse					
Ground Water					
Renew Existing Contract (ac-ft/yr)	616		\$149,000	\$242	1

Recommendations:

	2020	2030	2040	2050	2060	2070
Renew Existing Contract (ac-ft/yr)	440	487	535	588	616	616

It is recommended that the City of Redwater continue its surface water purchase from Texarkana contingent upon Riverbend WRD's recommended strategies. Development of infrastructure necessary to provide water to the City's customers is to be considered consistent with this recommended strategy.



- Relation**
- Buyer
 - Seller
 - Source
 - Region D Boundary
 - Counties
 - Streams
 - Reservoirs

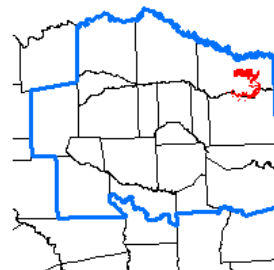
0 15,000 30,000 60,000

Feet

1 inch = 30,000 feet

Attachment A

Redwater
 Recommended Strategy
 Renew Existing Contract (Riverbend WRD)



**Cost Estimate Summary
Water Supply Project Option
September 2018 Prices**

Red Water - Renew Existing Contract

**Cost based on ENR CCI 11170.28 for September 2018 and
a PPI of 201.9 for September 2018**

<i>Item</i>	<i>Estimated Costs for Facilities</i>
ANNUAL COST	
Operation and Maintenance	
Intakes and Pump Stations (2.5% of Cost of Facilities)	\$0
Dam and Reservoir (1.5% of Cost of Facilities)	\$0
Water Treatment Plant	\$0
Advanced Water Treatment Facility	\$0
Pumping Energy Costs (0 kW-hr @ 0.08 \$/kW-hr)	\$0
Purchase of Water (616 acft/yr @ 242.68 \$/acft)	\$149,000
TOTAL ANNUAL COST	\$149,000
Available Project Yield (acft/yr)	616
Annual Cost of Water (\$ per acft), based on PF=1	\$242
Annual Cost of Water After Debt Service (\$ per acft), based on PF=1	\$242
Annual Cost of Water (\$ per 1,000 gallons), based on PF=1	\$0.74
Annual Cost of Water After Debt Service (\$ per 1,000 gallons), based on PF=1	\$0.74
<i>JMP</i>	<i>10/2/2019</i>

EVALUATION OF WATER MANAGEMENT STRATEGIES FOR MEETING THE PROJECTED WATER SUPPLY NEEDS OF RIVERBEND WRD

Description of Water User Group:

Riverbend Water Resources District (WRD) provides water service in Bowie, Cass, and Red River Counties via two separate intake structures. The system population is projected to be 542 in 2020 and 563 in the year 2070. Riverbend is now the contracting entity for the water supply made available from the surface water right owned by the City of Texarkana from Lake Wright Patman. The WRD is projected to have a shortage in 2020 due to constraints in water supply and aging of Texarkana’s New Boston Road Water Treatment Plant and GPI Water Treatment Plant.

Water Supply and Demand Analysis:

	2020	2030	2040	2050	2060	2070
Population	542	558	563	563	563	563
Projected Water Demand	523	536	539	537	537	537
Water Demand from other entities	0	0	0	0	0	0
Current Water Supply	0	0	0	0	0	0
Projected Supply Surplus (+) / Deficit (-)	-523	-536	-539	-537	-537	-537

Evaluation of Potentially Feasible Water Management Strategies:

Riverbend WRD is supplied by water in Lake Wright Patman. A request was submitted by Riverbend WRD to consider a number of WMS and WMSPs, including implementation of the Ultimate Rule Curve via contract with the USACE, amending the current surface water right to increase diversion from Wright Patman Lake up to a maximum firm storage available within the Ultimate Rule Curve, and new infrastructure including a new intake, pump station, pipeline, and water treatment plant to be located at the Texas Americas Center, and a new 2.5 MGD water treatment plant for the provision of municipal supplies in Cass County.

The requested strategies have been considered to meet the Riverbend WRD’s (along with its member entities and their customers) identified contractual water supply shortages. There are no significant current water needs in the area that could be met by water reuse. Groundwater was not considered as an alternative as the entities rely upon existing surface water supplies. Conservation targets for near term reductions in demand are reflected in the City of Texarkana, Texas’ Water Conservation and Drought Contingency Plan. However, Advanced Water Conservation is not recommended as a water management strategy as such a strategy would not potentially meet the TCEQ regulatory minimum of 0.6 gpm/connection.

Riverbend WRD has requested consideration of the strategy to decommission the existing New Boston Rd WTP and construct a new WTP by 2030 (referred to hereafter as the Riverbend Strategy), although the timing of this action is still under development by the Riverbend WRD and its member entities. As the Riverbend WRD has indicated a desire to remain flexible, alternatives as to the timing of various WMS projects have not been ruled out at present, and should be considered consistent for the purposes of the 2021 Region D Plan.

While future growth utilizing the adopted TWDB methodology is limited, significant growth has been contractually obligated for customer demands for manufacturing in Bowie County. Along with moderate projections of municipal growth in the area, the contracted manufacturing demands largely represent the dominant need over the 2020 – 2070 period.

Detailed Description of Evaluated Water Management Strategy Projects

Riverbend WRD has requested for inclusion a water management strategy entailing multiple WMS Projects (WMSPs). A summary of each project is included here.

Amend and Increase of Water Right (2020) – Based on the contractual demands identified herein, this WMSP is planned to occur by 2020, and would entail amendment of Certificate of Adjudication 03-4836. The amendment would include changing the total use of the water right to a more general, multi-use permit, and an increase in diversion of 57,517 ac-ft/yr, for a total permitted diversion of 237,517 ac-ft/yr. If the actual implementation of this strategy is a new surface water permit, such an approach should be considered consistent for the purposes of this Plan.

Interim to Ultimate Storage (2020) – In order to meet the contracted and projected demands for the District, development of this WMSP by 2020 would entail full implementation of the Ultimate Rule Curve per the contract with the USACE for storage in Lake Wright Patman.

New Wright Patman Intake, Pump Station, Raw Water Pipeline, and New WTP (2030) – The District has requested this WMSP to meet contractual and projected demands by 2030. This evolving WMSP has been identified specifically to provide the infrastructure necessary to meet member entities’ and their customers’ needs in the year 2030. The Riverbend WRD’s Regional Water Master Plan (Roth, 2018) and the Second Cost Estimates (AECOM 2018) were utilized as the basis to evaluate and identify the specifics of the project. Sizing, timing, and costs were necessarily updated from that information to meet the contractual demands identified by Riverbend WRD and adopted for the purposes of the 2021 Region D Plan. Costs have been derived utilizing the UCM. Where appropriate, costs and assumptions from the Riverbend WRD Regional Water Master Plan and Second Cost Estimates were incorporated into the UCM. This strategy entails the construction of a new intake location with a deeper invert elevation allowing access to additional storage in Wright Patman, a new pump station, raw water pipeline, a new 25 MGD WTP, and the decommissioning of the existing New Boston WTP to meet member entities’ and wholesale customer contractual and projected needs. The supply necessary to meet the contractual needs identified in the 2021 planning process is a maximum firm supply of 117,313 ac-ft/yr. The total project cost is \$356.4 million, with an annual cost up to \$35.5 million and a unit cost of \$307 per ac-ft. during debt service (\$0.94/1,000 gal.) and \$129 per ac-ft after debt service. Supply adequate to meet the identified needs, when considered in conjunction with all member entities’ and customer needs, do not over allocate the existing firm supply available from Wright Patman Reservoir within the Ultimate Rule Curve, if other recommended Water Management Strategy Projects are also employed. It is noted that the District’s present plans are for implementation of this project by 2026, although the timing of this WMSP may vary and should be considered consistent with the 2021 Region D Plan. However, this timing results in a projected Bowie County manufacturing unmet need by 2020 of 629 ac-ft/yr.

New 2.5 MGD Package WTP and Transmission Line (2030) – The District has requested this WMSP to meet municipal demands starting in 2030 for its member entities and customers in Cass County. Utilizing the existing Graphics Packaging International (GPI) intake, this WMSP entails construction of a 12” transmission pipeline to be connected from the IP intake, which would be routed to a new 2.5 MGD package WTP, along with clearwells for a total of 3 MG of ground storage capacity, high service pumps, and electrical modifications. The supply from this WMSP would total 1,918 ac-ft/yr, assuming a peaking factor of 1.46. The total project cost is \$22.8 million, with an annual cost of \$2.7 million and a unit cost of \$1,812 per ac-ft during debt service (\$5.56/1,000 gal.) and \$739 per ac-ft after debt service.

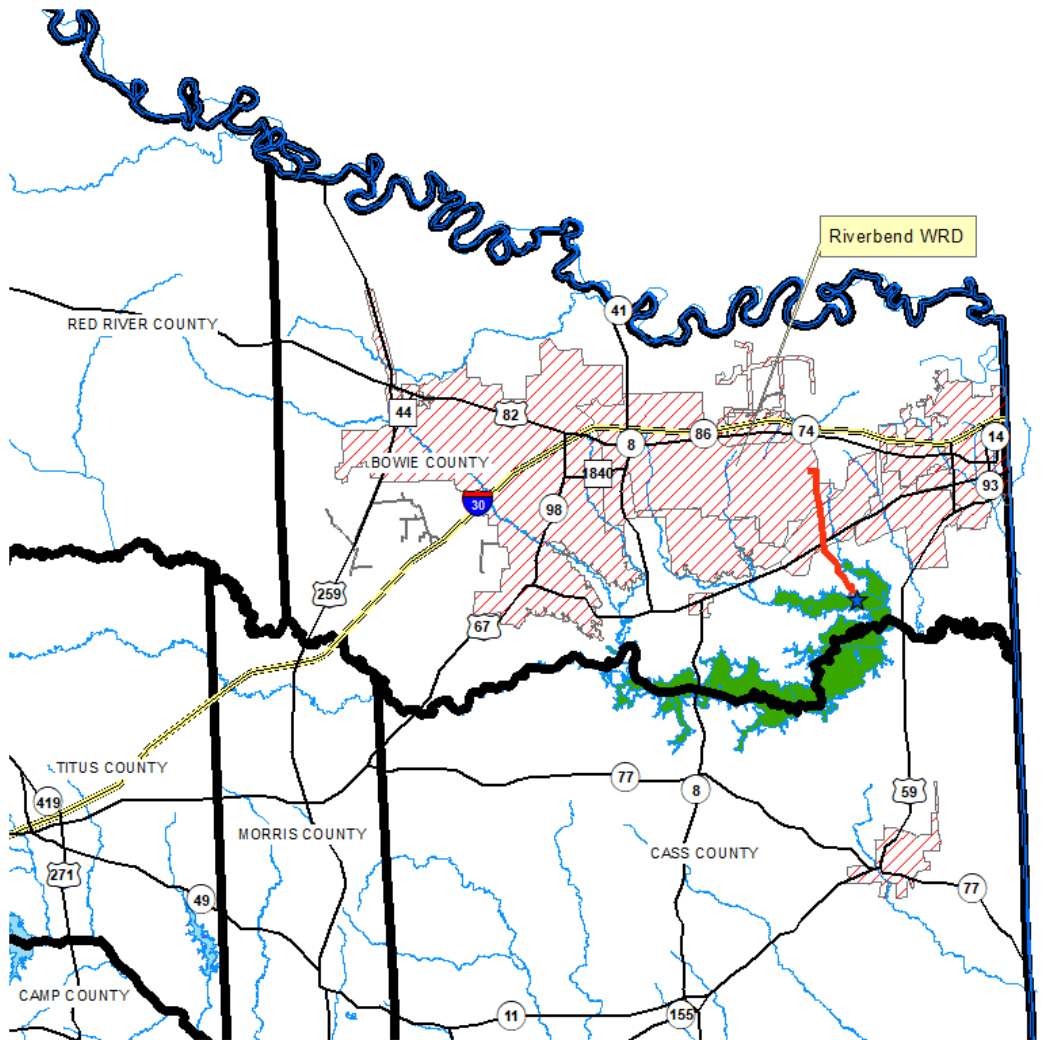
Strategy	Firm Yield (ac-ft)	Total Capital Cost	Total Annualized Cost	Unit Cost	Environmental Impact
Advanced Water Conservation					
Water Reuse					
Ground Water					
Riverbend WMS	115,820	\$350,917,000	\$38,593,000	\$333	1
New 2.5 MGD Package WTP and Transmission Line	1,496	\$22,807,000	\$2,711,000	\$1,812	1

Recommendations:

	2020	2030	2040	2050	2060	2070
Riverbend WMS	13,810	73,099	80,081	88,793	97,520	115,820
New 2.5 MGD Package WTP and Transmission Line	0	1,370	1,423	1,496	1,493	1,493

To meet the Riverbend WRD's, its member entities', and customers' contractual and projected needs and the requested approach for the 2021 RWP, it is recommended that the water right be amended to multi-use for a total permitted diversion of 237,517 ac-ft/yr utilizing the permitted storage at the Ultimate Rule Curve, full implementation up to the Ultimate Rule Curve per contract for storage out of Lake Wright Patman with the USACE, and construction of a new intake, pipeline, and water treatment plant be constructed by 2030 to meet these WUGs' contractual needs. It is further recommended that a new 2.5 MGD package WTP and transmission line be constructed by 2030 to meet identified municipal needs in Cass County. Each of these WMSPs are contingent upon the other, as each are necessary to secure the identified supplies necessary to meet the projected municipal demands and contractual industrial demands identified herein.

At present, considerable discussions are underway between all of the member entities of Riverbend Water Resources District. As noted previously and reiterated here, this 2021 Plan recognizes that Riverbend may become the contracting entity between its members and the City of Texarkana, Texas. The strategies shown herein for entities with shortages in Bowie, Cass, and Red River Counties rely on continued use of water from Lake Wright Patman. Presently, the strategies related to Riverbend WRD are presented with the Riverbend WRD's water management strategies. However, the strategies should be considered consistent with the plan for this planning cycle if the City of Texarkana, Texas, is the contracting party rather than Riverbend WRD, as long as the water source remains Lake Wright Patman.

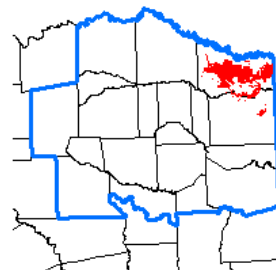


- Relation**
- Buyer
 - Seller
 - Source
 - Region D Boundary
 - Counties
 - Streams
 - Reservoirs
- Riverbend WMS Wright Patman Intake
 - Riverbend WMS Raw Water Pipeline
 - Riverbend WMS New WTP

0 20,000 40,000 80,000

Feet

1 inch = 40,000 feet



Attachment A

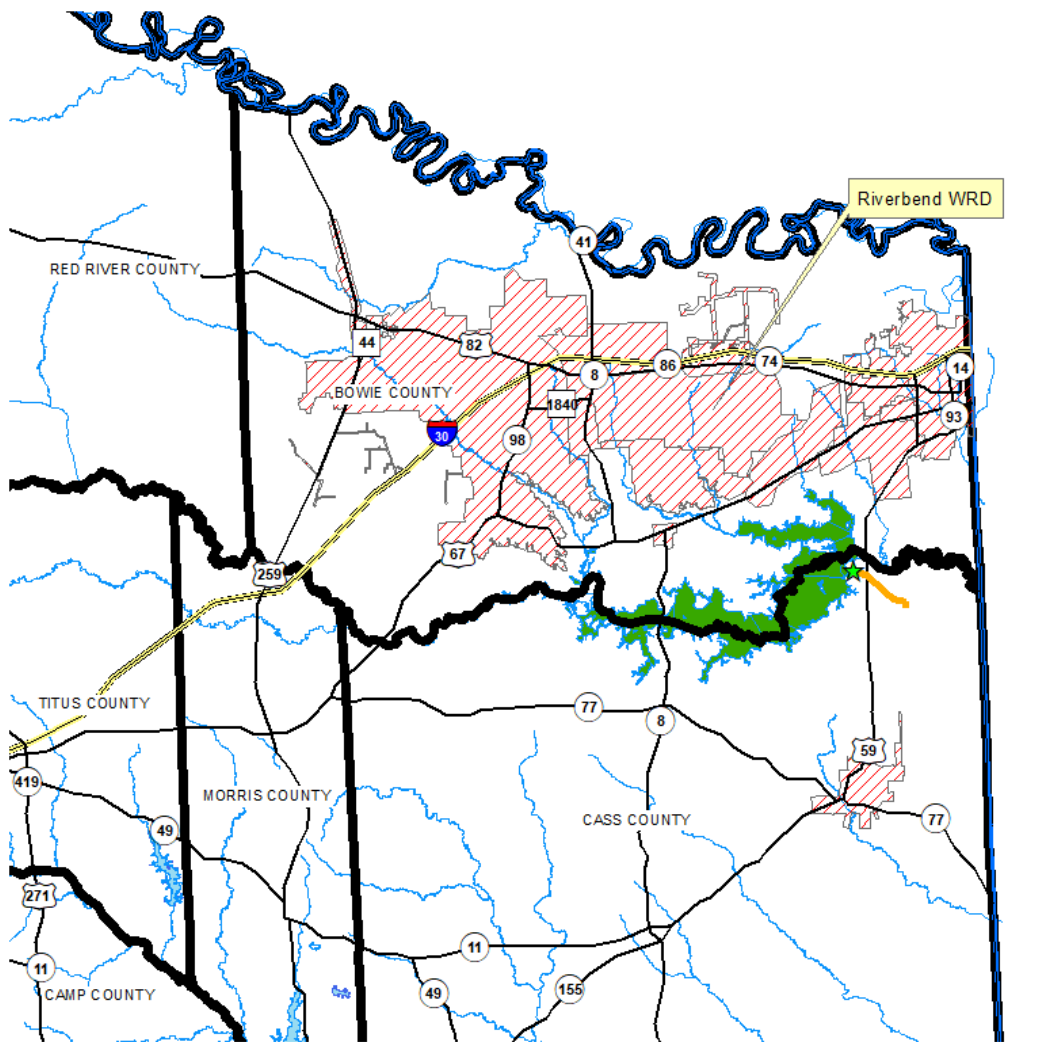
Riverbend WRD
Recommended Strategy
Riverbend Strategy

**Cost Estimate Summary
Water Supply Project Option
September 2018 Prices
Riverbend WMS - Riverbend WMS**

**Cost based on ENR CCI 11170.28 for September 2018 and
a PPI of 201.9 for September 2018**

<i>Item</i>	<i>Estimated Costs for Facilities</i>
Primary Pump Station (0 MGD)	\$66,514,000
Transmission Pipeline (0 in dia., miles)	\$42,770,000
Two Water Treatment Plants (25 MGD and 15 MGD)	\$129,862,000
TOTAL COST OF FACILITIES	\$239,146,000
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	\$81,563,000
Environmental & Archaeology Studies and Mitigation	\$20,576,000
Land Acquisition and Surveying (45 acres)	\$240,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	<u>\$9,392,000</u>
TOTAL COST OF PROJECT	\$350,917,000
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	\$24,691,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	\$428,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	\$1,663,000
Dam and Reservoir (1.5% of Cost of Facilities)	\$0
Water Treatment Plant	\$8,651,000
Advanced Water Treatment Facility	\$0
Pumping Energy Costs (39497383 kW-hr @ 0.08 \$/kW-hr)	\$3,160,000
Purchase of Water (acft/yr @ \$/acft)	<u>\$0</u>
TOTAL ANNUAL COST	\$38,593,000
Available Project Yield (acft/yr)	115,820
Annual Cost of Water (\$ per acft), based on PF=1.46	\$333
Annual Cost of Water After Debt Service (\$ per acft), based on PF=1.46	\$120
Annual Cost of Water (\$ per 1,000 gallons), based on PF=1.46	\$1.02
Annual Cost of Water After Debt Service (\$ per 1,000 gallons), based on PF=1.46	\$0.37

Note: One or more cost element has been calculated externally

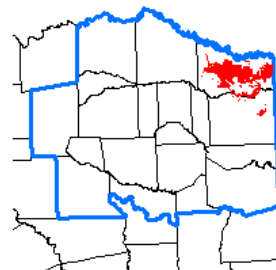


- Relation**
- Buyer
 - Seller
 - Source
 - Region D Boundary
 - Counties
 - Streams
 - Reservoirs
 - ★ Riverbend WMS Cass Co 2.5 MGD WTP
 - Riverbend WMS Cass Co Water Pipeline

0 20,000 40,000 80,000

Feet

1 inch = 40,000 feet



Attachment B

Riverbend WRD
 Recommended Strategy
 Riverbend Strategy Cass Co WTP

**Cost Estimate Summary
Water Supply Project Option
September 2018 Prices**

Riverbend - New 2.5 MGD WTP and transmission line

**Cost based on ENR CCI 11170.28 for September 2018 and
a PPI of 201.9 for September 2018**

<i>Item</i>	<i>Estimated Costs for Facilities</i>
Primary Pump Station (0 MGD)	\$1,171,000
Transmission Pipeline (0 in dia., miles)	\$1,400,000
Storage Tanks (Other Than at Booster Pump Stations)	\$1,527,000
Water Treatment Plant (2.5 MGD)	\$12,263,000
TOTAL COST OF FACILITIES	\$16,361,000
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	\$5,657,000
Environmental & Archaeology Studies and Mitigation	\$121,000
Land Acquisition and Surveying (18 acres)	\$57,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	<u>\$611,000</u>
TOTAL COST OF PROJECT	\$22,807,000
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	\$1,605,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	\$29,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	\$29,000
Dam and Reservoir (1.5% of Cost of Facilities)	\$0
Water Treatment Plant	\$1,014,000
Advanced Water Treatment Facility	\$0
Pumping Energy Costs (428004 kW-hr @ 0.08 \$/kW-hr)	\$34,000
Purchase of Water (acft/yr @ \$/acft)	<u>\$0</u>
TOTAL ANNUAL COST	\$2,711,000
Available Project Yield (acft/yr)	1,496
Annual Cost of Water (\$ per acft), based on PF=1.46	\$1,812
Annual Cost of Water After Debt Service (\$ per acft), based on PF=1.46	\$739
Annual Cost of Water (\$ per 1,000 gallons), based on PF=1.46	\$5.56
Annual Cost of Water After Debt Service (\$ per 1,000 gallons), based on PF=1.46	\$2.27

EVALUATION OF WATER MANAGEMENT STRATEGIES FOR MEETING THE PROJECTED WATER SUPPLY NEEDS OF THE CITY OF TEXARKANA

Description of Water User Group:

The City of Texarkana, Texas, is a municipality located in Bowie County, Texas. Although the City of Texarkana, Texas, is a separate and distinct entity from the City of Texarkana, Arkansas, both entities are served by the same system (operated by Texarkana Water Utility). For the purposes of the 2021 Region D Water Plan, it has been assumed that water supplied from Arkansas (i.e., Millwood Reservoir) serves the population of Texarkana, Arkansas, while water supplied from Texas serves Texarkana, Texas.

For the City of Texarkana, Texas, the system is projected to serve 38,007 people in 2020, increasing to 47,102 by 2070. The current sources of supply based in Texas are surface water from Lake Wright Patman and a run of river diversion permit from the Red River (although no infrastructure is currently in place for the latter). The City provides water to area municipal and industrial customers and is projected to have a water supply deficit of 7,145 ac-ft/yr in 2020 increasing to 8,380 ac-ft/yr in 2070, due to water supply constraints and the age and functionality of the existing New Boston Water Treatment Plant and GPI treatment plant.

In 1969 Texarkana, Texas, entered into separate water supply contracts with surrounding communities. The contracts provided that Texarkana, Texas, and member cities would participate in paying debt service on bonds to be issued by Lake Texarkana Water Supply Corporation (LTWSC, today known as Riverbend Water Resources District, referred to hereafter as Riverbend). These member cities would all make payments for water supplied through facilities. In exchange Texarkana, Texas, and member cities were guaranteed ownership interest in LTWSC facilities and specified amounts of water in Wright Patman. Each city was guaranteed a maximum amount of water sufficient to meet the needs of the member cities, but also agreed to pay a minimum amount to ensure adequate funding for LTWSC facilities. Member cities historically relied on Texarkana, Texas, to manage and administer the water, the LTWSC facilities and water rates fairly for the benefits of all parties. When debt was paid off member cities would own an undivided interest in LTWSC facilities equal to that percentage that was paid by each member city to discharge debt.

In 2010, Texarkana, Texas executes water supply contract extensions, an interlocal cooperation agreement with Riverbend, and the formation of an advisory committee regarding the creation of water facilities and new cooperative agreements. The City of Texarkana sells and/or supplies surface water to: City of Atlanta, Central Bowie County WSC, City of De Kalb, City of Hooks, Macedonia-Eylau MUD#1, City of Maud, City of Nash, City of New Boston, City of Queen City, Red River County WSC, City of Redwater, TexAmericas Center, City of Wake Village, County-Other portions of Bowie, Cass and Red River Counties, and Manufacturing in Bowie and Cass Counties. Texarkana, along with the Cities of DeKalb, Hooks, Maud, Nash, New Boston, Redwater, Wake Village, TexAmericas Center, and sub-WUG entities comprising Bowie County-Other and Red River County-Other, comprise Riverbend Water Resources District (Riverbend). The system does have a water conservation and drought management plan in place.

Water Supply and Demand Analysis:

	2020	2030	2040	2050	2060	2070
Population	38,007	39,674	41,413	43,229	45,124	47,102
Projected Water Demand	7,145	7,282	7,459	7,706	8,028	8,380
Current Water Supply	0	0	0	0	0	0
Projected Supply Surplus (+) / Deficit (-)	-7,145	-7,282	-7,459	-7,706	-8,028	-8,380

Evaluation of Potentially Feasible Water Management Strategies:

There were several alternative strategies considered to meet the City’s water supply shortages. Advanced conservation was not considered because the City’s supply would not be projected to meet TCEQ regulatory minimums. Reuse is not a feasible option because water supply is mainly used for public

consumption. Groundwater was not selected because the City is planning on continuing to utilize surface water from Lake Wright Patman. A request was submitted by Riverbend Water Resources District to consider a new Water Treatment Plant, pipeline, pump station, and intake to Wright Patman Reservoir. Thus, a renewal for supply in conjunction with Riverbend WRD has been considered herein.

Each alternative is summarized in the following table.

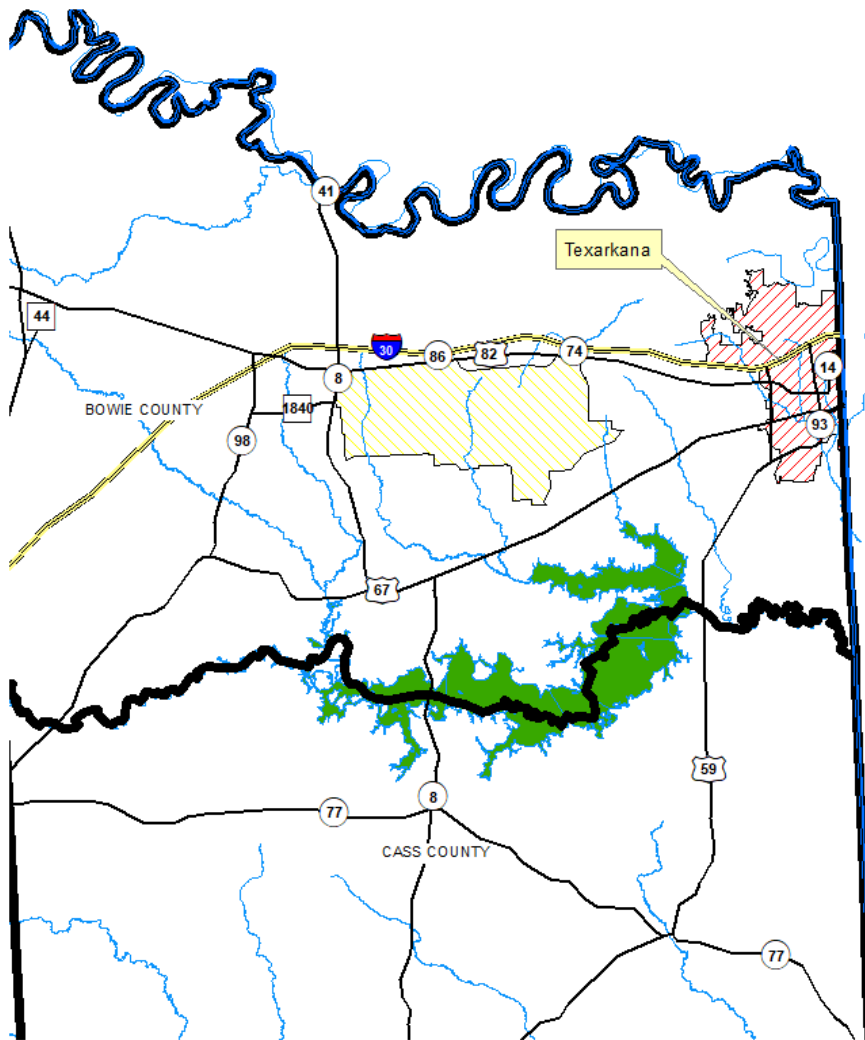
Strategy	Firm Yield (ac-ft)	Start Year	Total Capital Cost	Total Annual Cost	Unit Cost	Env. Impact
Advanced Water Conservation						
Water Reuse						
Ground Water						
Renew contract with Riverbend WRD contingent upon Riverbend Strategy	8,380	2020	\$0	\$2,034,000	\$243	1

Recommendations:

	2020	2030	2040	2050	2060	2070
Renew contract with Riverbend WRD contingent upon Riverbend Strategy	7,145	7,282	7,459	7,706	8,028	8,380

It is recommended that the City of Texarkana, Texas continue and renew its surface water use and contracting approach as a participating member entity with Riverbend WRD contingent upon Riverbend WRD’s recommended strategies.

At present, considerable discussions are underway between all of the member cities of Riverbend Water Resources District. As noted previously and reiterated here, this 2021 Plan recognizes that Riverbend has become the contracting entity between its members and Texarkana, Texas. The strategies shown herein for entities with shortages in Bowie, Cass, and Red River Counties rely on continued use of water from Lake Wright Patman. Presently, the strategies related to the City of Texarkana, Texas, are presented with the Riverbend WRD’s water management strategies. However, the strategies should be considered consistent with the plan for this planning cycle if the City of Texarkana, Texas, is the contracting party rather than Riverbend WRD, as long as the water source remains Lake Wright Patman.



- Relation**
- Buyer
 - Seller
 - Source
 - Region D Boundary
 - Counties
 - Streams
 - Reservoirs

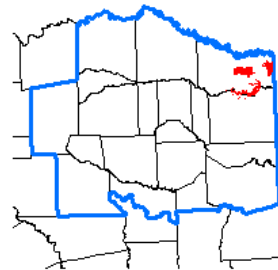
0 15,000 30,000 60,000

Feet

1 inch = 30,000 feet

Attachment A

Texarkana
 Recommended Strategy
 Renew Existing Contract (Riverbend WRD)



**Cost Estimate Summary
Water Supply Project Option
September 2018 Prices**

Texarkana - Renew Existing Contract

**Cost based on ENR CCI 11170.28 for September 2018 and
a PPI of 201.9 for September 2018**

<i>Item</i>	<i>Estimated Costs for Facilities</i>
ANNUAL COST	
Operation and Maintenance	
Intakes and Pump Stations (2.5% of Cost of Facilities)	\$0
Dam and Reservoir (1.5% of Cost of Facilities)	\$0
Water Treatment Plant	\$0
Advanced Water Treatment Facility	\$0
Pumping Energy Costs (0 kW-hr @ 0.08 \$/kW-hr)	\$0
Purchase of Water (8380 acft/yr @ 242.68 \$/acft)	<u>\$2,034,000</u>
TOTAL ANNUAL COST	\$2,034,000
Available Project Yield (acft/yr)	8,380
Annual Cost of Water (\$ per acft), based on PF=1	\$243
Annual Cost of Water After Debt Service (\$ per acft), based on PF=1	\$243
Annual Cost of Water (\$ per 1,000 gallons), based on PF=1	\$0.74
Annual Cost of Water After Debt Service (\$ per 1,000 gallons), based on PF=1	\$0.74
<i>JMP</i>	<i>10/2/2019</i>

EVALUATION OF WATER MANAGEMENT STRATEGIES FOR MEETING THE PROJECTED WATER SUPPLY NEEDS OF WAKE VILLAGE

Description of Water User Group:

The City of Wake Village provides water service in Bowie County. The City’s population is projected to be 6,150 in 2020 and 8,950 in the year 2070. The City has a contract for water supply with the City of Texarkana from Lake Wright Patman. The City is projected to have a shortage in 2020 due to constraints on water supply and aging of Texarkana’s Water Treatment Plant.

Water Supply and Demand Analysis:

	2020	2030	2040	2050	2060	2070
Population	6,150	6,850	7,550	8,250	8,950	8,950
Projected Water Demand	699	750	802	861	932	931
Water Demand from other entities	0	0	0	0	0	0
Current Water Supply	0	0	0	0	0	0
Projected Supply Surplus (+) / Deficit (-)	-699	-750	-802	-861	-932	-931

Evaluation of Potentially Feasible Water Management Strategies:

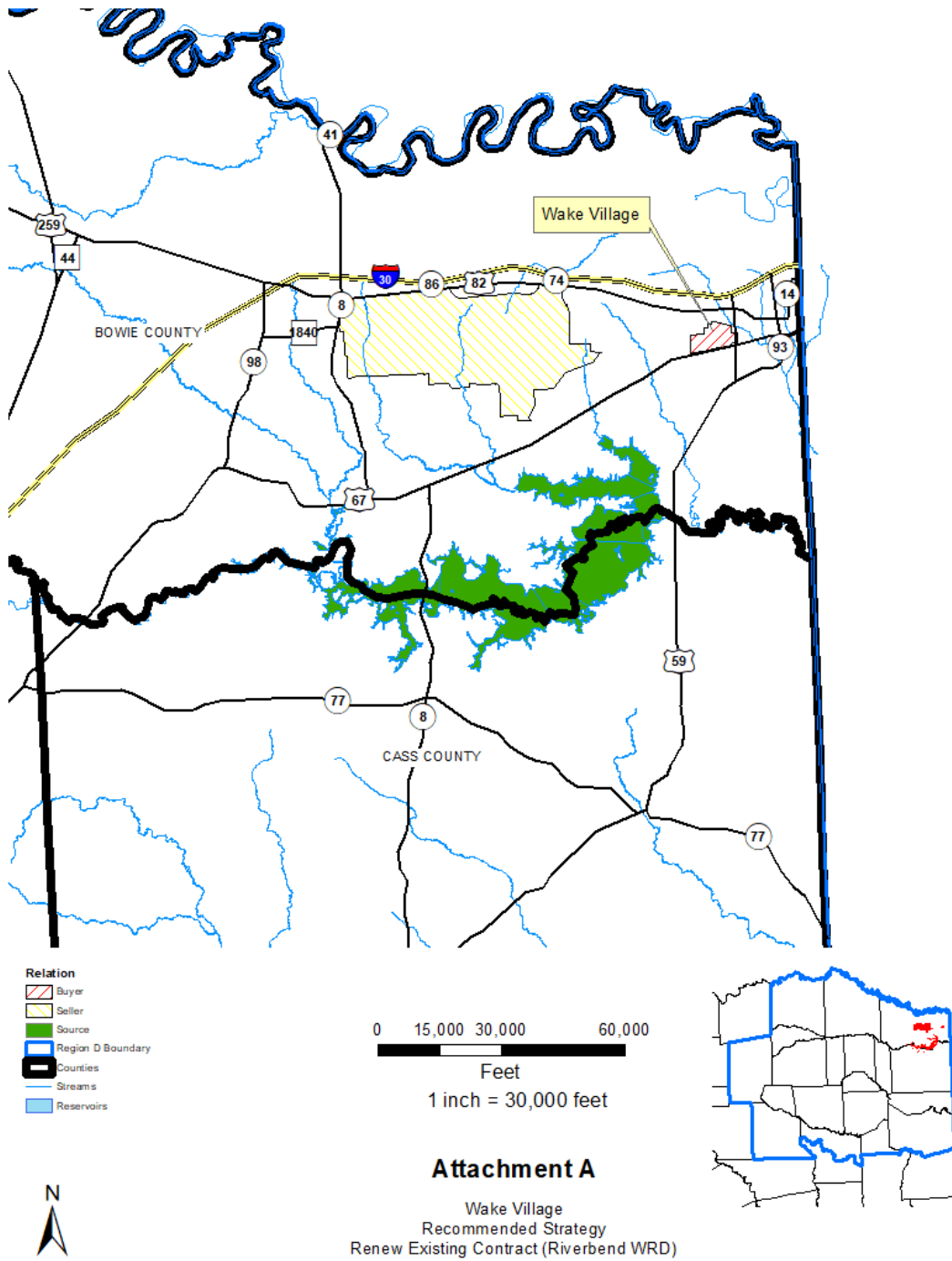
There were four alternative strategies considered to meet the City’s water supply shortages. Advanced conservation was not considered because the per capita use per day was less than the 140 gpcd threshold set by the water planning group. Reuse is not a feasible option because water supply is mainly used for public consumption. Groundwater was not selected because the City is planning on continuing to purchase surface water from the City of Texarkana. A request was submitted by Riverbend Water Resources District to consider a new Water Treatment Plant, pipeline, pump station, and intake to Wright Patman Reservoir. Thus, a renewal contract with Texarkana/Riverbend has been considered herein.

Strategy	Firm Yield (ac-ft)	Total Capital Cost	Total Annualized Cost	Unit Cost	Environmental Impact
Advanced Water Conservation					
Water Reuse					
Ground Water					
Renew Existing Contract	932	\$0	\$226,000	\$242	1

Recommendations:

	2020	2030	2040	2050	2060	2070
Renew Existing Contract (ac-ft/yr)	699	750	802	861	932	931

It is recommended that the City of Wake Village continue its surface water purchase from Texarkana contingent upon Riverbend WRD recommended strategies.



**Cost Estimate Summary
Water Supply Project Option
September 2018 Prices**

Wake Village - Renew Existing Contract

**Cost based on ENR CCI 11170.28 for September 2018 and
a PPI of 201.9 for September 2018**

<i>Item</i>	<i>Estimated Costs for Facilities</i>
ANNUAL COST	
Operation and Maintenance	
Intakes and Pump Stations (2.5% of Cost of Facilities)	\$0
Dam and Reservoir (1.5% of Cost of Facilities)	\$0
Water Treatment Plant	\$0
Advanced Water Treatment Facility	\$0
Pumping Energy Costs (0 kW-hr @ 0.08 \$/kW-hr)	\$0
Purchase of Water (932 acft/yr @ 242.68 \$/acft)	<u>\$226,000</u>
TOTAL ANNUAL COST	\$226,000
Available Project Yield (acft/yr)	932
Annual Cost of Water (\$ per acft), based on PF=1	\$242
Annual Cost of Water After Debt Service (\$ per acft), based on PF=1	\$242
Annual Cost of Water (\$ per 1,000 gallons), based on PF=1	\$0.74
Annual Cost of Water After Debt Service (\$ per 1,000 gallons), based on PF=1	\$0.74
<i>JMP</i>	<i>10/2/2019</i>

REGION D
EVALUATIONS OF WATER MANAGEMENT STRATEGIES
FOR MEETING PROJECTED WATER SUPPLY NEEDS
TO YEAR 2070

CAMP COUNTY

WUGs:

Camp County Livestock

EVALUATION OF WATER MANAGEMENT STRATEGIES FOR MEETING THE PROJECTED WATER SUPPLY NEEDS LIVESTOCK IN CAMP COUNTY – CYPRESS

Description of Water User Group:

The Livestock WUG in Camp County has a demand that is projected to be a constant 4,914 ac-ft/yr from 2020 to 2070. Livestock in Cass County, Cypress has a current water supply consisting of water wells from the Carrizo-Wilcox Aquifer, Queen City Aquifer, and Local Supplies. The total rated available supply from these sources is 952 ac-ft/yr in 2020 thru 2070. Livestock in Cass County, Cypress is projected to have a water supply deficit of 3,962 ac-ft/yr in 2020 thru 2070.

Water Supply and Demand Analysis:

Livestock Camp Cypress	2020	2030	2040	2050	2060	2070
Projected Water Demand	4,914	4,914	4,914	4,914	4,914	4,914
Current Water Supply	952	952	952	952	952	952
Projected Supply Surplus (+)/Deficit(-)	-3,962	-3,962	-3,962	-3,962	-3,962	-3,962

Evaluation of Potentially Feasible Water Management Strategies:

Three alternative strategies were considered to meet the Camp County, Livestock, Cypress water supply shortages as summarized in the following table. Advanced conservation and water reuse were not considered because the demands are very rural in nature. Surface water alternatives were not utilized due to the rural nature of the demands.

Strategy	Firm Yield (AF)	Total Capital Cost	Total Annualized Cost	Unit Cost	Environmental Impact
Advanced Water Conservation					
Water Reuse					
Groundwater	4,000	\$4,401,500	\$ 493,082	\$ 123	Minimal
Surface Water					

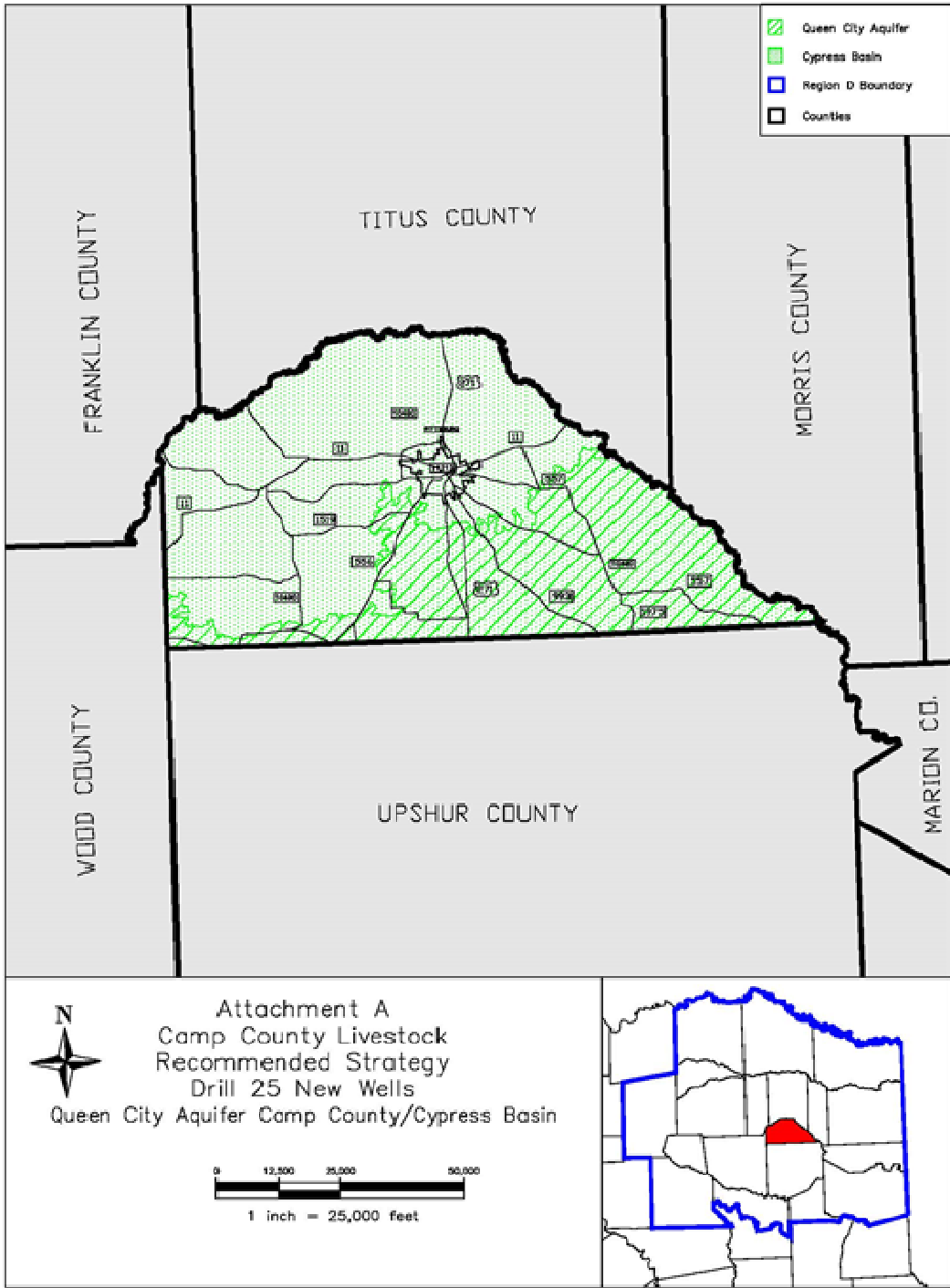
Recommendations:

	2020	2030	2040	2050	2060	2070
Drill New Wells (Queen City Aquifer, Cypress; ac-ft/yr)	4,000	4,000	4,000	4,000	4,000	4,000

The recommended strategy for the Camp County, Livestock, Cypress to meet their projected deficit of 3,962 ac-ft/yr in 2020 thru 2070 would be to construct twenty-five water wells prior to 2020. The recommended supply source will be the Queen City Aquifer in Camp County. One well with rated capacity of 100 gpm each would provide approximately 160 ac-ft/yr. Twenty-five new wells will be needed to provide the 3,962 ac-ft/yr needed. The Queen Aquifer in Camp County is projected to have a more than ample supply availability to meet the needs of the Livestock in Camp County for the planning period.

Given the increasing costs to comply with more stringent regulations and the decreasing reliability of groundwater as a future supply source due to quality issues in this region, it is recommended that groundwater supply systems consider combining resources and/or soliciting future water supply from neighboring systems and/or major water providers in the region. If a feasible alternative becomes available, then the recommendations previously discussed should be disregarded and a re-evaluation completed.

Cost Estimate Summary	
Water Supply Project Option	
September 2018 Prices	
Livestock Camp Cypress - Drill New Well Queen City Aquifer Camp Cypress	
Cost based on ENR CCI 11170.28 for September 2018 and	
a PPI of 202.4 for September 2018	
Item	Estimated Costs for Facilities
CAPITAL COST	
Dam and Reservoir (Conservation Pool acft, acres)	\$0
Off-Channel Storage/Ring Dike (Conservation Pool acft, acres)	\$0
Terminal Storage (Conservation Pool acft, acres)	\$0
Primary Pump Station (0 MGD)	\$0
Transmission Pipeline (6 in dia., miles)	\$0
Transmission Pump Station(s) & Storage Tank(s)	\$0
Well Fields (Wells, Pumps, and Piping)	\$1,242,000
Storage Tanks (Other Than at Booster Pump Stations)	\$0
Water Treatment Plant (0 MGD)	\$0
Advanced Water Treatment Facility (MGD)	\$0
Conservation (Leaking Pipe/Meter Replacement)	\$0
Integration, Relocations, & Other	\$0
TOTAL COST OF FACILITIES	\$1,242,000
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	\$435,000
Environmental & Archaeology Studies and Mitigation	\$19,000
Land Acquisition and Surveying (5 acres)	\$16,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	\$48,000
TOTAL COST OF PROJECT	\$1,760,000
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	\$124,000
Reservoir Debt Service (3.5 percent, 40 years)	\$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	\$12,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	\$0
Dam and Reservoir (1.5% of Cost of Facilities)	\$0
Water Treatment Plant	\$0
Advanced Water Treatment Facility	\$0
Pumping Energy Costs (761634 kW-hr @ 0.08 \$/kW-hr)	\$61,000
Purchase of Water (acft/yr @ \$/acft)	\$0
TOTAL ANNUAL COST	\$197,000
Available Project Yield (acft/yr)	1,600
Annual Cost of Water (\$ per acft), based on PF=1	\$123
Annual Cost of Water After Debt Service (\$ per acft), based on PF=1	\$46
Annual Cost of Water (\$ per 1,000 gallons), based on PF=1	\$0.38
Annual Cost of Water After Debt Service (\$ per 1,000 gallons), based on PF=1	\$0.14
Stanley Hayes	11/3/2019



EVALUATION OF WATER MANAGEMENT STRATEGIES FOR MEETING THE PROJECTED WATER SUPPLY NEEDS OF ATLANTA

Description of Water User Group:

The City of Atlanta provides water service in Cass County. The City’s population is projected to be 5,877 in 2020 and 7,427 in the year 2070. The City has a contract for water supply with the City of Texarkana from Lake Wright Patman. The City is expected to have shortages due to constraints on water supply and aging of Texarkana’s existing Water Treatment Plant located at the Graphics Packaging International (GPI) facility as identified in the Riverbend WRD’s Regional Water Master Plan.

Water Supply and Demand Analysis:

	2020	2030	2040	2050	2060	2070
Population	5,877	6,394	6,910	7,427	7,427	7,427
Projected Water Demand	1,017	1,075	1,135	1,209	1,206	1,206
Water Demand from other entities	0	0	0	0	0	0
Current Water Supply	1,017	1,075	1,135	1,209	1,206	1,206
Projected Supply Surplus (+) / Deficit (-)	0	0	0	0	0	0

Evaluation of Potentially Feasible Water Management Strategies:

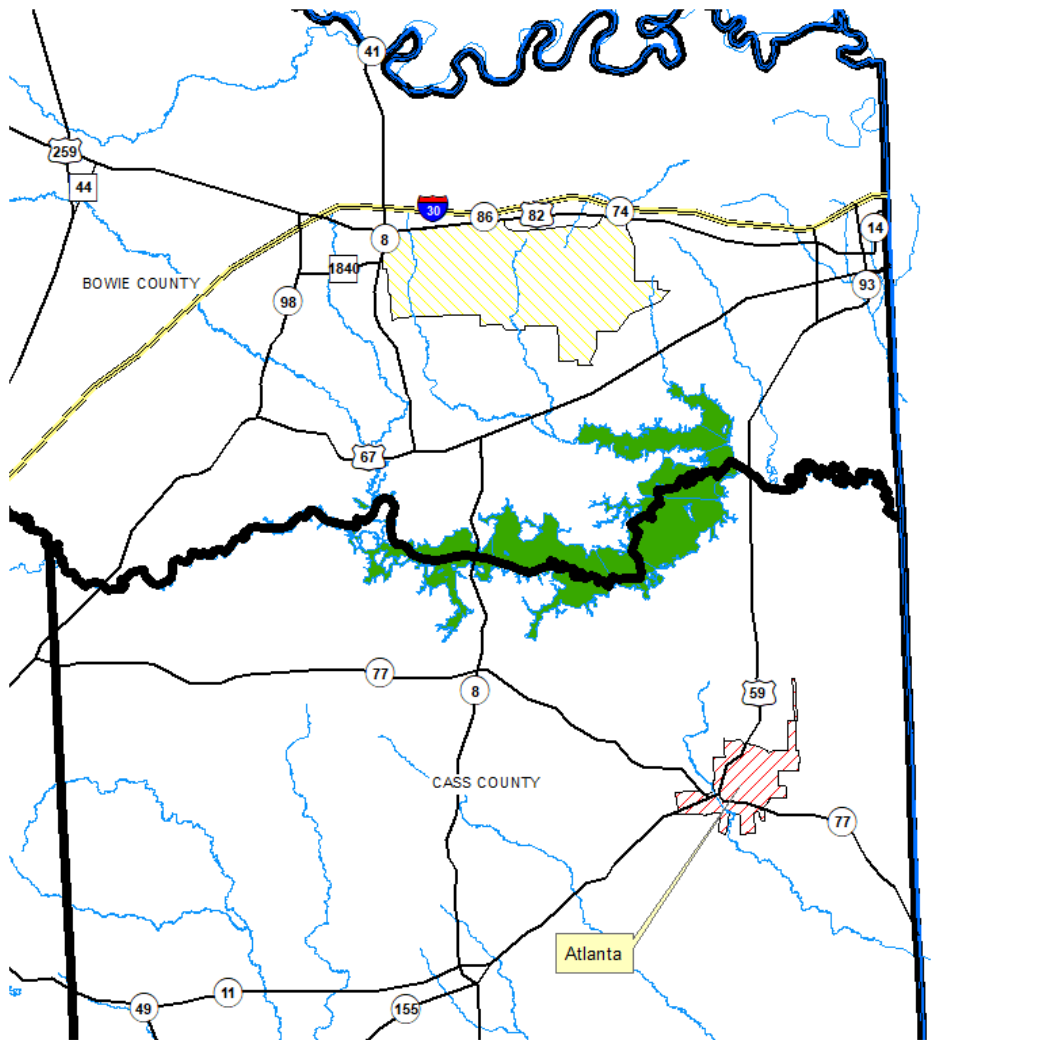
There were five alternative strategies considered to meet the City’s water supply shortages. Advanced conservation was not considered because the per capita use per day would be less than the 140 gpcd threshold set by the water planning group. Reuse is not a feasible option because water supply is mainly used for public consumption. Groundwater was not selected because the City is planning on continuing to purchase surface water from the City of Texarkana. Voluntary reallocation of manufacturing supply was identified in order to account for the fact that the City’s present supply comes via diversion of supply for GPI at Lake Wright Patman, a part of the Cass Manufacturing WUG, thus the amount for voluntary reallocation does not affect the 120,000 ac-ft/yr of contracted supply between Texarkana and GPI. Further, a request was submitted by Riverbend Water Resources District to consider a new 2.5 MGD package water treatment plant and transmission line for supply from Wright Patman Reservoir. Thus, a renewal contract with Texarkana/Riverbend has been considered herein.

Strategy	Firm Yield (ac-ft)	Total Capital Cost	Total Annualized Cost	Unit Cost	Environmental Impact
Advanced Water Conservation					
Water Reuse					
Ground Water					
Voluntary Reallocation (from Cass Manufacturing)	1,209	\$0	\$0	\$0	1
Renew Existing Contract	1,209	\$0	\$293,000	\$242	1

Recommendations:

	2020	2030	2040	2050	2060	2070
Voluntary Reallocation (from Cass Manufacturing)	0	1,075	1,135	1,209	1,206	1,206
Renew Existing Contract (ac-ft/yr)	0	1,075	1,135	1,209	1,206	1,206

It is recommended that the City of Atlanta continue its surface water purchase from Texarkana contingent upon voluntary reallocation of supply from Cass Manufacturing and Riverbend WRD’s recommended strategy for a new 2.5 MGD package water treatment plant and transmission line.



- Relation**
-  Buyer
 -  Seller
 -  Source
 -  Region D Boundary
 -  Counties
 -  Streams
 -  Reservoirs

0 15,000 30,000 60,000

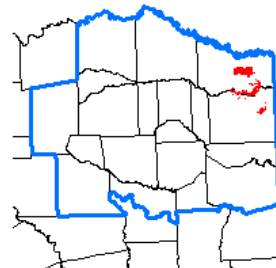


Feet

1 inch = 30,000 feet

Attachment A

Atlanta
 Recommended Strategy
 Renew Existing Contract (Riverbend WRD)



**Cost Estimate Summary
Water Supply Project Option
September 2018 Prices**

Atlanta - Renew Existing Contract

**Cost based on ENR CCI 11170.28 for September 2018 and
a PPI of 201.9 for September 2018**

<i>Item</i>	<i>Estimated Costs for Facilities</i>
ANNUAL COST	
Operation and Maintenance	
Intakes and Pump Stations (2.5% of Cost of Facilities)	\$0
Dam and Reservoir (1.5% of Cost of Facilities)	\$0
Water Treatment Plant	\$0
Advanced Water Treatment Facility	\$0
Pumping Energy Costs (0 kW-hr @ 0.08 \$/kW-hr)	\$0
Purchase of Water (1209 acft/yr @ 242.68 \$/acft)	<u>\$293,000</u>
TOTAL ANNUAL COST	\$293,000
Available Project Yield (acft/yr)	1,209
Annual Cost of Water (\$ per acft), based on PF=1	\$242
Annual Cost of Water After Debt Service (\$ per acft), based on PF=1	\$242
Annual Cost of Water (\$ per 1,000 gallons), based on PF=1	\$0.74
Annual Cost of Water After Debt Service (\$ per 1,000 gallons), based on PF=1	\$0.74
<i>JMP</i>	<i>10/2/2019</i>

REGION D
EVALUATIONS OF WATER MANAGEMENT STRATEGIES
FOR MEETING PROJECTED WATER SUPPLY NEEDS
TO YEAR 2070

CASS COUNTY

WUGs:

City of Atlanta
County-Other, Cass
Holly Springs WSC
Livestock, Cass County
Queen City

EVALUATION OF WATER MANAGEMENT STRATEGIES FOR MEETING THE PROJECTED WATER SUPPLY NEEDS COUNTY OTHER IN CASS COUNTY

Description of Water User Group:

The County Other WUG in Cass County is a split entity and has a demand that is projected to be decreasing from 1,087 ac-ft/yr in 2020 to 846 ac-ft/yr in 2070. County Other in Cass County has a current water supply consisting of water wells from the Carrizo-Wilcox Aquifer and surface water from Lake O' the Pines (Avinger thru NETMWD), and Wright Patman Lake (Domino thru Texarkana Water Utilities/Riverbend). The total rated available supply from these sources is 638 ac-ft/yr. County Other in Cass County is projected to have a water supply deficit of 449 ac-ft/yr in 2020 and declining to a deficit of 208 ac-ft/yr in 2070.

Water Supply and Demand Analysis:

County Other Cass	2020	2030	2040	2050	2060	2070
Projected Water Demand						
Cypress Basin	796	729	664	623	620	620
Sulphur Basin	291	266	243	227	226	226
Total	1,087	995	907	850	846	846
Current Water Supply						
Cypress Basin	514	514	514	514	514	514
Sulphur Basin	124	124	124	124	124	124
Total	638	638	638	638	638	638
Projected Supply Surplus (+)/Deficit(-)						
Cypress Basin	-282	-215	-150	-109	-106	-106
Sulphur Basin	-167	-142	-119	-103	-102	-102
Total	-449	-357	-269	-212	-208	-208

Evaluation of Potentially Feasible Water Management Strategies:

Three alternative strategies were considered to meet the Cass County, County Other Cypress water supply shortages as summarized in the following table. Advanced conservation and water reuse were not considered because the demands are very rural in nature. Surface water alternatives were utilized where feasible since the demands are not concentrated it is impossible to distribute the water. Groundwater has been identified as a potentially feasible strategy.

Strategy	Firm Yield (AF)	Total Capital Cost	Total Annualized Cost	Unit Cost	Environmental Impact
Advanced Water Conservation					
Water Reuse					
Groundwater Carrizo Wilcox, Cypress	323	\$ 1,973,000	\$ 166,000	\$ 514	Minimal
Groundwater Carrizo Wilcox, Sulphur	216	\$ 1,324,000	\$ 114,000	\$ 528	Minimal
Surface Water					

Recommendations:

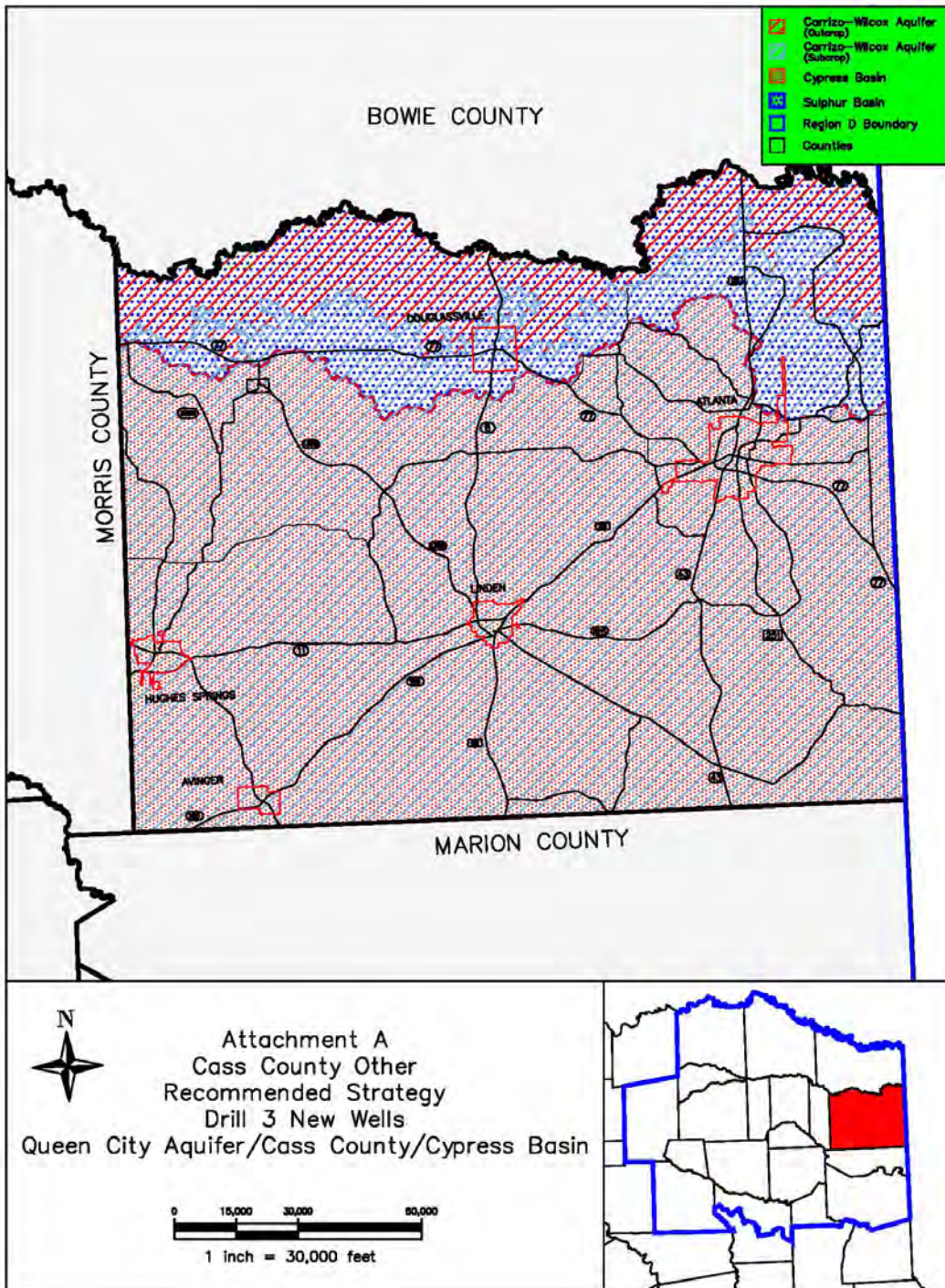
	2020	2030	2040	2050	2060	2070
Drill New Wells(Carrizo Wilcox, Cypress; ac-ft/yr)	323	323	323	323	323	323
Drill New Wells (Carrizo Wilcox, Sulphur; ac-ft/yr)	216	216	216	216	216	216

The recommended strategy for the Cass County, County Other, Cypress to meet their projected deficit of 282 ac-ft/yr in 2020 reducing to 106 ac-ft/yr in 2070 would be to construct three water wells prior to 2020. The recommended supply source will be the Carrizo Wilcox Aquifer in Cass County. One well with rated capacity of 200 gpm each would provide approximately 108 ac-ft/yr. Three new wells will be needed to provide the 282 ac-ft/yr needed.

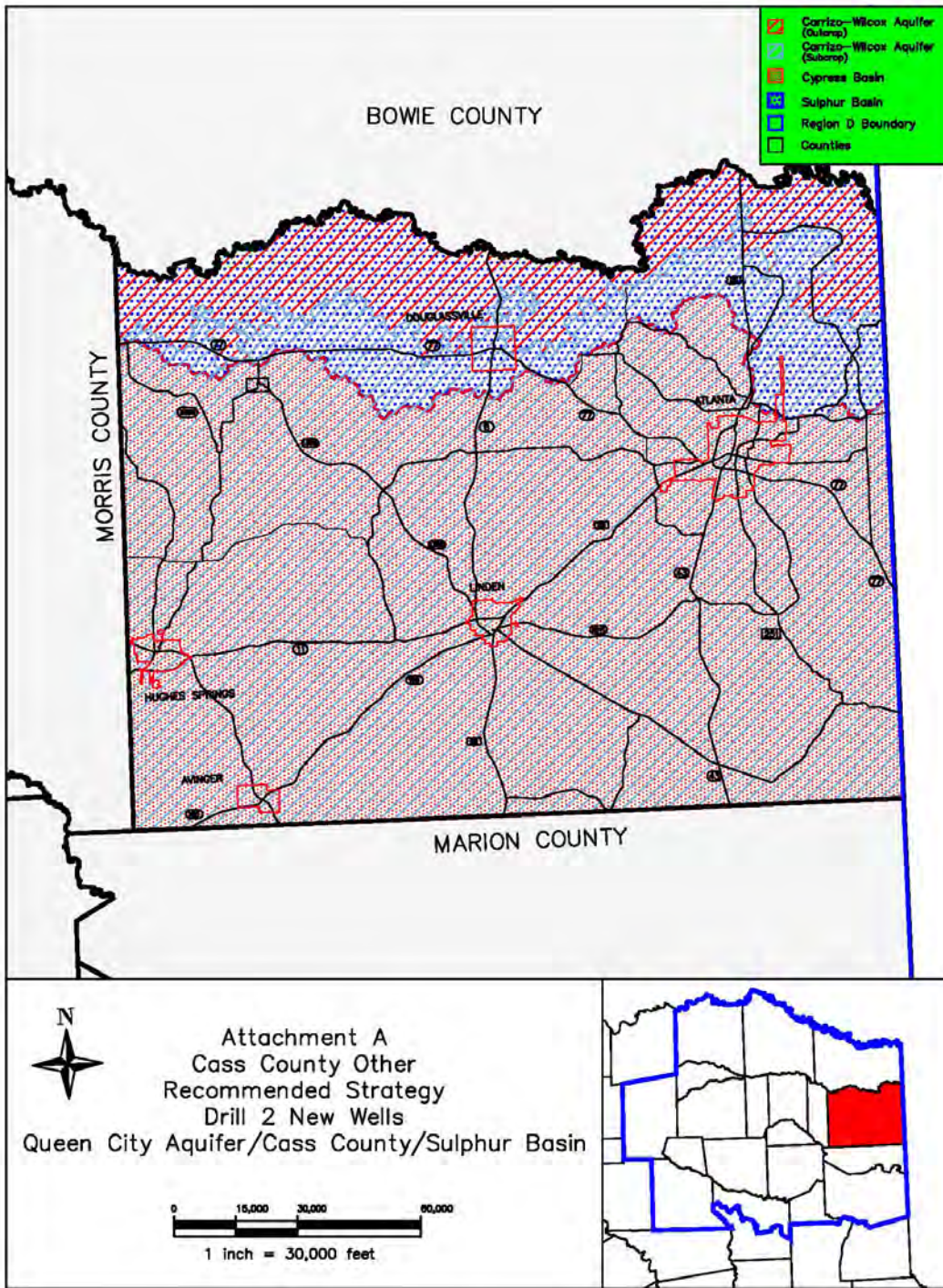
The recommended strategy for the Cass County, County Other, Sulphur to meet their projected deficit of 167 ac-ft/yr in 2020 reducing to 102 ac-ft/yr in 2070 would be to construct two water wells prior to 2020. The recommended supply source will be the Carrizo Wilcox Aquifer in Cass County. One well with rated capacity of 200 gpm each would provide approximately 108 ac-ft/yr. Two new wells will be needed to provide the 167 ac-ft/yr needed. The Carrizo Wilcox Aquifer in Cass County is projected to have a more than ample supply availability to meet the needs of the County Other in Cass County for the planning period.

Given the increasing costs to comply with more stringent regulations and the decreasing reliability of groundwater as a future supply source due to quality issues in this region, it is recommended that groundwater supply systems consider combining resources and/or soliciting future water supply from neighboring systems and/or major water providers in the region. If a feasible alternative becomes available, then the recommendations previously discussed should be disregarded and a re-evaluation completed.

Cost Estimate Summary	
Water Supply Project Option	
September 2018 Prices	
County Other Cass Cypress - Drill New Well Carrizo Wilcox Aquifer Cass Cypress	
Cost based on ENR CCI 11170.28 for September 2018 and	
a PPI of 202.4 for September 2018	
Item	Estimated Costs for Facilities
CAPITAL COST	
Dam and Reservoir (Conservation Pool acft, acres)	\$0
Off-Channel Storage/Ring Dike (Conservation Pool acft, acres)	\$0
Terminal Storage (Conservation Pool acft, acres)	\$0
Primary Pump Station (0 MGD)	\$0
Transmission Pipeline (6 in dia., miles)	\$0
Transmission Pump Station(s) & Storage Tank(s)	\$0
Well Fields (Wells, Pumps, and Piping)	\$1,394,000
Storage Tanks (Other Than at Booster Pump Stations)	\$0
Water Treatment Plant (0 MGD)	\$0
Advanced Water Treatment Facility (MGD)	\$0
Conservation (Leaking Pipe/Meter Replacement)	\$0
Integration, Relocations, & Other	\$0
TOTAL COST OF FACILITIES	\$1,394,000
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	\$488,000
Environmental & Archaeology Studies and Mitigation	\$33,000
Land Acquisition and Surveying (2 acres)	\$5,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	\$53,000
TOTAL COST OF PROJECT	\$1,973,000
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	\$139,000
Reservoir Debt Service (3.5 percent, 40 years)	\$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	\$14,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	\$0
Dam and Reservoir (1.5% of Cost of Facilities)	\$0
Water Treatment Plant	\$0
Advanced Water Treatment Facility	\$0
Pumping Energy Costs (157800 kW-hr @ 0.08 \$/kW-hr)	\$13,000
Purchase of Water (acft/yr @ \$/acft)	\$0
TOTAL ANNUAL COST	\$166,000
Available Project Yield (acft/yr)	323
Annual Cost of Water (\$ per acft), based on PF=1	\$514
Annual Cost of Water After Debt Service (\$ per acft), based on PF=1	\$84
Annual Cost of Water (\$ per 1,000 gallons), based on PF=1	\$1.58
Annual Cost of Water After Debt Service (\$ per 1,000 gallons), based on PF=1	\$0.26
<i>Stanley Hayes</i>	<i>10/3/2019</i>



Cost Estimate Summary Water Supply Project Option September 2018 Prices	
County-Other Cass Sulpur - Drill New Well Carrizo Wilcox Aquifer Cass Sulpur	
Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 202.4 for September 2018	
Item	Estimated Costs for Facilities
CAPITAL COST	
Dam and Reservoir (Conservation Pool acft, acres)	\$0
Off-Channel Storage/Ring Dike (Conservation Pool acft, acres)	\$0
Terminal Storage (Conservation Pool acft, acres)	\$0
Primary Pump Station (0 MGD)	\$0
Transmission Pipeline (6 in dia., miles)	\$0
Transmission Pump Station(s) & Storage Tank(s)	\$0
Well Fields (Wells, Pumps, and Piping)	\$929,000
Storage Tanks (Other Than at Booster Pump Stations)	\$0
Water Treatment Plant (0 MGD)	\$0
Advanced Water Treatment Facility (MGD)	\$0
Conservation (Leaking Pipe/Meter Replacement)	\$0
Integration, Relocations, & Other	\$0
TOTAL COST OF FACILITIES	\$929,000
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	\$325,000
Environmental & Archaeology Studies and Mitigation	\$31,000
Land Acquisition and Surveying (1 acres)	\$3,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	\$36,000
TOTAL COST OF PROJECT	\$1,324,000
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	\$93,000
Reservoir Debt Service (3.5 percent, 40 years)	\$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	\$9,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	\$0
Dam and Reservoir (1.5% of Cost of Facilities)	\$0
Water Treatment Plant	\$0
Advanced Water Treatment Facility	\$0
Pumping Energy Costs (146646 kW-hr @ 0.08 \$/kW-hr)	\$12,000
Purchase of Water (acft/yr @ \$/acft)	\$0
TOTAL ANNUAL COST	\$114,000
Available Project Yield (acft/yr)	216
Annual Cost of Water (\$ per acft), based on PF=1	\$528
Annual Cost of Water After Debt Service (\$ per acft), based on PF=1	\$97
Annual Cost of Water (\$ per 1,000 gallons), based on PF=1	\$1.62
Annual Cost of Water After Debt Service (\$ per 1,000 gallons), based on PF=1	\$0.30
<i>Paula Coleman</i>	<i>11/1/2019</i>



EVALUATION OF WATER MANAGEMENT STRATEGIES FOR MEETING THE PROJECTED WATER SUPPLY NEEDS HOLLY SPRINGS WSC

Description of Water User Group:

The Holly Springs WSC WUG is a split WUG. In Cass County Cypress, it has a demand that is projected to be decreasing from 107 ac-ft/yr in 2020 to 97 ac-ft/yr in 2070. Holly Springs WSC in Cass County has a current water supply from Hughes Springs thru NETMWD and Lake O’ Pines. The total rated available supply from these sources is 60 ac-ft/yr in 2020 thru 2070. Holly Springs WSC in Cass County is projected to have a water supply deficit of 47 ac-ft/yr in 2020 and decreasing to 38 ac-ft/yr in 2070.

In Morris County, Cypress, it has a demand that is projected to be decreasing from 58 ac-ft/yr in 2020 to 53 ac-ft/yr in 2070. Holly Springs WSC in Morris County has a current water supply from Hughes Springs thru NETMWD and Lake O’ Pines. The total rated available supply from this source is 32 ac-ft/yr in 2020 thru 2040 and 33 ac-ft/yr in 2050 thru 2070. Holly Springs WSC in Morris County is projected to have a water supply deficit of 26 ac-ft/yr in 2020 and decreasing to 20 ac-ft/yr in 2070.

Water Supply and Demand Analysis:

	2020	2030	2040	2050	2060	2070
Projected Water Demand						
Cass County	107	103	99	97	97	97
Morris County	58	56	53	53	53	53
Total	165	159	150	150	150	150
Current Water Supply						
Cass County	60	60	60	59	59	59
Morris County	32	32	32	33	33	33
Total	92	92	92	92	92	92
Projected Supply Surplus (+)/Deficit(-)						
Cass County	-47	-43	-39	-38	-38	-38
Morris County	-26	-24	-21	-20	-20	-20
Total	-73	-67	-60	-58	-58	-58

Evaluation of Potentially Feasible Water Management Strategies:

Three alternative strategies were considered to meet the Holly Springs WSC Cass County water supply shortages as summarized in the following table. Advanced conservation and water reuse was not considered because it is a rural system. Surface water alternatives include increasing their contract with the City of Hughes Springs thru NETMWD and Lake O’ Pines.

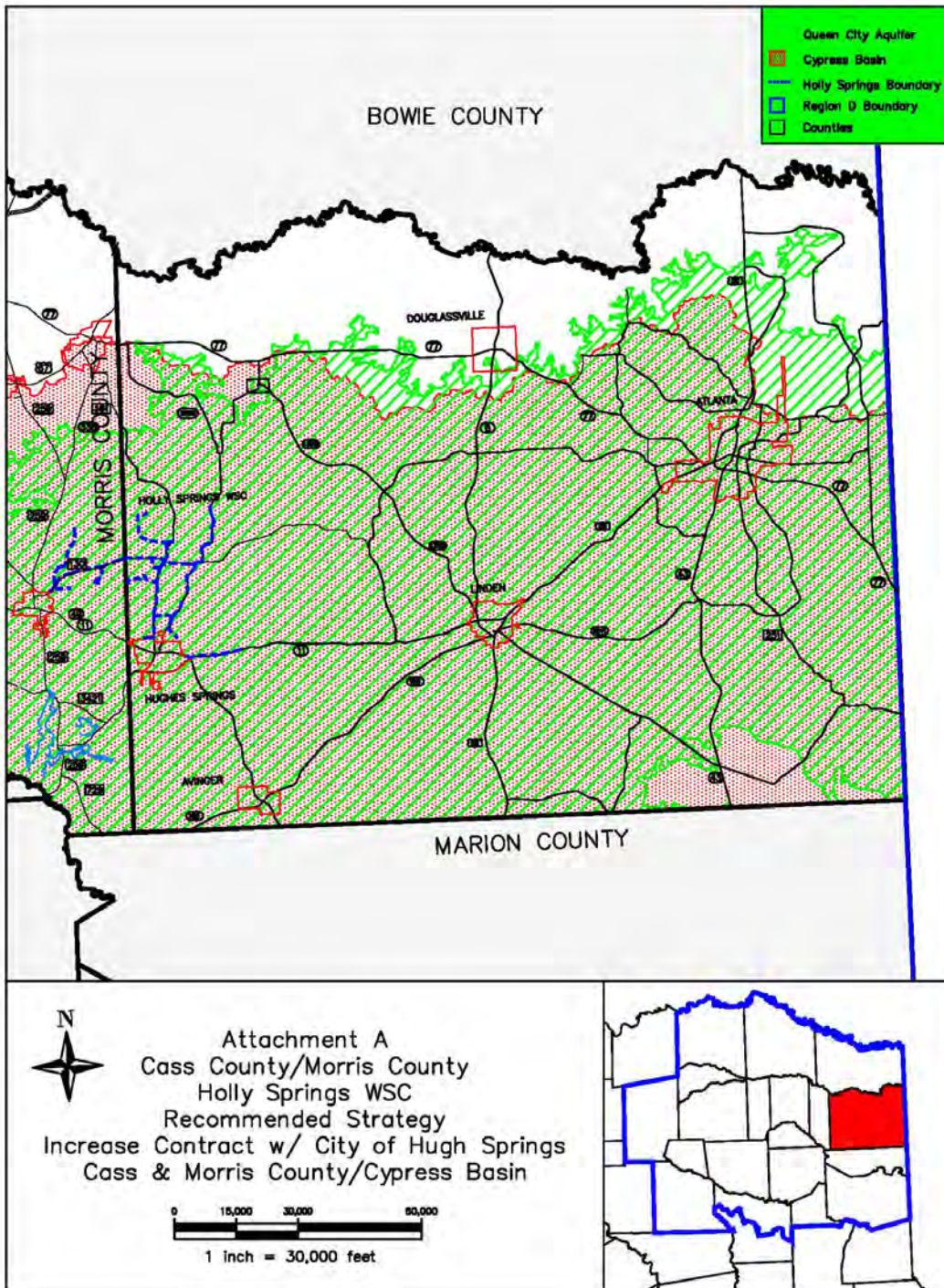
Strategy	Firm Yield (AF)	Total Capital Cost	Total Annualized Cost	Unit Cost	Environmental Impact
Advanced Water Conservation					
Water Reuse					
Groundwater					
Surface Water	80	0	\$130,000	\$1,629	None

Recommendations:

	2020	2030	2040	2050	2060	2070
Cass County	50	50	50	50	50	50
Morris County	30	30	30	30	30	30
Increase Contract (NETMWD; ac-ft/yr)	80	80	80	80	80	80

The recommended strategy for the Holly Springs WSC to meet their projected deficit of 73 ac-ft/yr in 2020 would be to increase their contract with City of Hughes Springs thru NETMWD and Lake O’ Pines. The recommended supply source will be the Lake O’Pines in Marion County. Lake O’ Pines in Marion County is projected to have a more than ample supply availability to meet the needs of the Holly Springs WSC thru Hughes Springs and NETMWD for the planning period.

Cost Estimate Summary Water Supply Project Option September 2018 Prices	
Holly Springs - Increase Existing Contract from Hughes Springs	
Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 202.4 for September 2018	
Item	Estimated Costs for Facilities
CAPITAL COST	
Dam and Reservoir (Conservation Pool acft, acres)	\$0
Off-Channel Storage/Ring Dike (Conservation Pool acft, acres)	\$0
Terminal Storage (Conservation Pool acft, acres)	\$0
Primary Pump Station (0 MGD)	\$0
Transmission Pipeline (0 in dia., miles)	\$0
Transmission Pump Station(s) & Storage Tank(s)	\$0
Well Fields (Wells, Pumps, and Piping)	\$0
Storage Tanks (Other Than at Booster Pump Stations)	\$0
Water Treatment Plant (0 MGD)	\$0
Advanced Water Treatment Facility (MGD)	\$0
Conservation (Leaking Pipe/Meter Replacement)	\$0
Integration, Relocations, & Other	\$0
TOTAL COST OF FACILITIES	\$0
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	\$0
Environmental & Archaeology Studies and Mitigation	\$0
Land Acquisition and Surveying (0 acres)	\$0
Interest During Construction (3% for 1 years with a 0.5% ROI)	\$0
TOTAL COST OF PROJECT	\$0
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	\$0
Reservoir Debt Service (3.5 percent, 40 years)	\$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	\$0
Intakes and Pump Stations (2.5% of Cost of Facilities)	\$0
Dam and Reservoir (1.5% of Cost of Facilities)	\$0
Water Treatment Plant	\$0
Advanced Water Treatment Facility	\$0
Pumping Energy Costs (0 kW-hr @ 0.08 \$/kW-hr)	\$0
Purchase of Water (80 acft/yr @ 1629 \$/acft)	\$130,000
TOTAL ANNUAL COST	\$130,000
Available Project Yield (acft/yr)	80
Annual Cost of Water (\$ per acft), based on PF=1	\$1,625
Annual Cost of Water After Debt Service (\$ per acft), based on PF=1	\$1,625
Annual Cost of Water (\$ per 1,000 gallons), based on PF=1	\$4.99
Annual Cost of Water After Debt Service (\$ per 1,000 gallons), based on PF=1	\$4.99
<i>Paula Coleman</i>	<i>11/3/2019</i>



EVALUATION OF WATER MANAGEMENT STRATEGIES FOR MEETING THE PROJECTED WATER SUPPLY NEEDS LIVESTOCK IN CASS COUNTY

Description of Water User Group:

The Livestock WUG in Cass County is a split entity and has a demand that is projected to be a constant 2,657 ac-ft/yr from 2020 to 2070. Livestock in Cass County, Cypress has a current water supply consisting of water wells from the Carrizo-Wilcox Aquifer, Queen City Aquifer, Local Supplies, and surface water from a Cypress Run -of-River Water Right. The total rated available supply from these sources is 484 ac-ft/yr in 2020 thru 2070. Livestock in Cass County, Cypress is projected to have a water supply deficit of 865 ac-ft/yr in 2020 thru 2070.

Livestock in Cass County, Sulphur has a current water supply consisting of water wells from the Carrizo-Wilcox Aquifer, Queen City Aquifer, and Local Supplies. The total rated available supply from these sources is 355 ac-ft/yr in 2020 to 357 ac-ft/yr in 2070. Livestock in Cass County, Sulphur is projected to have a water supply deficit of 953 ac-ft/yr in 2020 and reducing to a deficit of 951 ac-ft/yr in 2070.

Water Supply and Demand Analysis:

Livestock Cass	2020	2030	2040	2050	2060	2070
Projected Water Demand						
Cypress	1,349	1,349	1,349	1,349	1,349	1,349
Sulphur	1,308	1,308	1,308	1,308	1,308	1,308
Total	2,657	2,657	2,657	2,657	2,657	2,657
Current Water Supply						
Cypress	484	484	484	484	484	484
Sulphur	355	355	355	357	357	357
Total	839	839	839	841	841	841
Projected Supply Surplus (+)/Deficit(-)						
Cypress	-865	-865	-865	-865	-865	-865
Sulphur	-953	-953	-953	-951	-951	-951
Total	-1,818	-1,818	-1,818	-1,816	-1,816	-1,816

Evaluation of Potentially Feasible Water Management Strategies:

Three alternative strategies were considered to meet the Cass County, Livestock, Cypress water supply shortages as summarized in the following table. Advanced conservation and water reuse were not considered because the demands are very rural in nature. Surface water alternatives were utilized where currently available but increase in permit amounts are not available. Construction of new wells accessing groundwater from the Queen City Aquifer was identified as a potentially feasible strategy.

Strategy	Firm Yield (AF)	Total Capital Cost	Total Annualized Cost	Unit Cost	Environmental Impact
Advanced Water Conservation					
Water Reuse					
Groundwater Queen City Aquifer Cypress	968	\$ 1,037,000	\$ 107,000	\$ 111	Minimal
Groundwater Queen City Aquifer Sulphur	966	\$ 1,037,000	\$ 107,000	\$ 111	Minimal
Surface Water					

Recommendations:

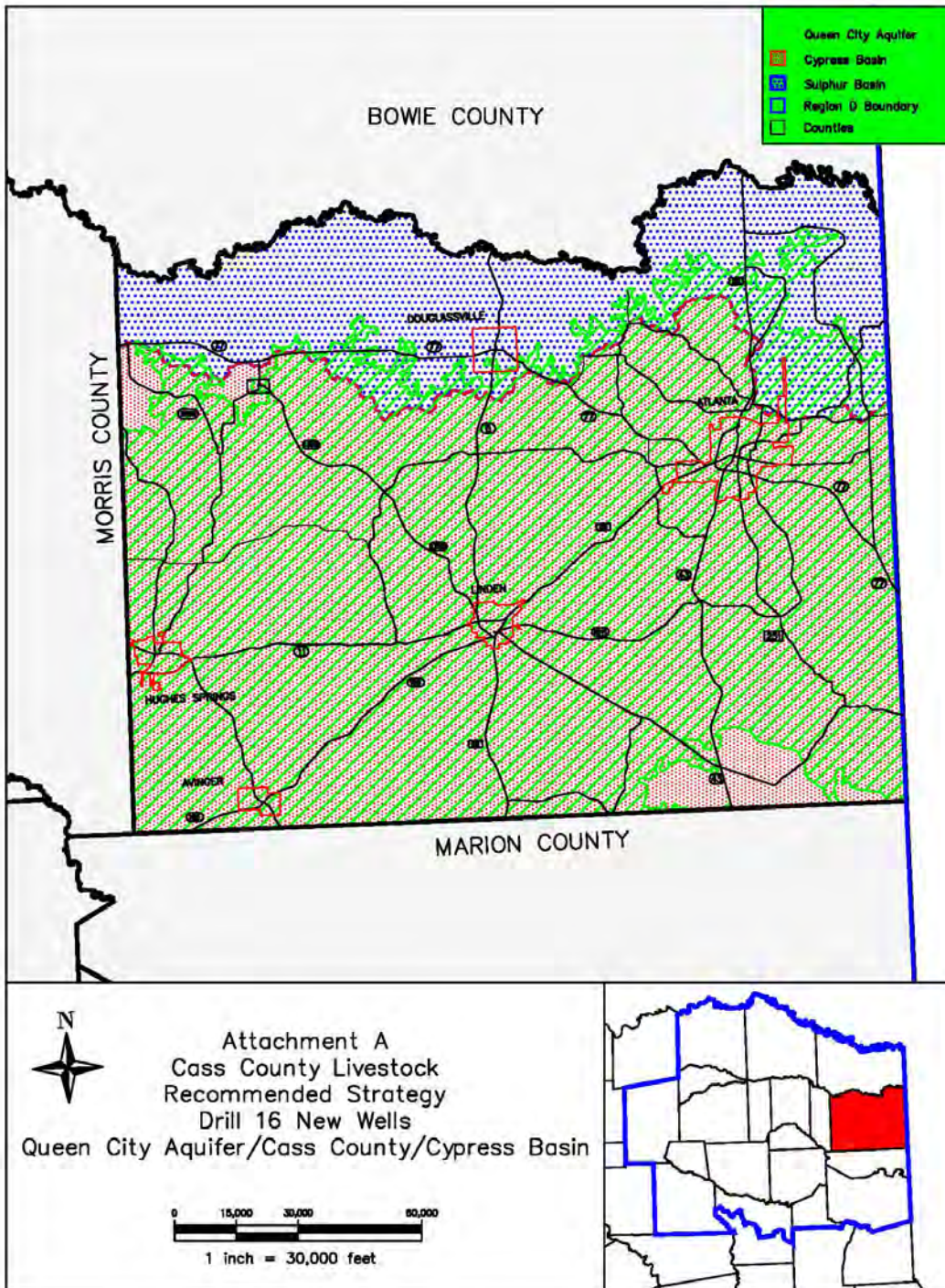
	2020	2030	2040	2050	2060	2070
Drill New Wells (Queen City Aquifer, Cypress; ac-ft/yr)	968	968	968	968	968	968
Drill New Wells (Queen City Aquifer, Sulphur; ac-ft/yr)	966	966	966	966	966	966

The recommended strategy for the Cass County, Livestock, Cypress to meet their projected deficit of 865 ac-ft/yr in 2020 thru 2070 would be to construct six water wells prior to 2020. The recommended supply source will be the Queen City Aquifer in Cass County. One well with rated capacity of 100 gpm each would provide approximately 161 ac-ft/yr. Six new wells will be needed to provide the 865 ac-ft/yr needed. The Queen Aquifer in Cass County is projected to have a more than ample supply availability to meet the needs of the Livestock in Cass County for the planning period.

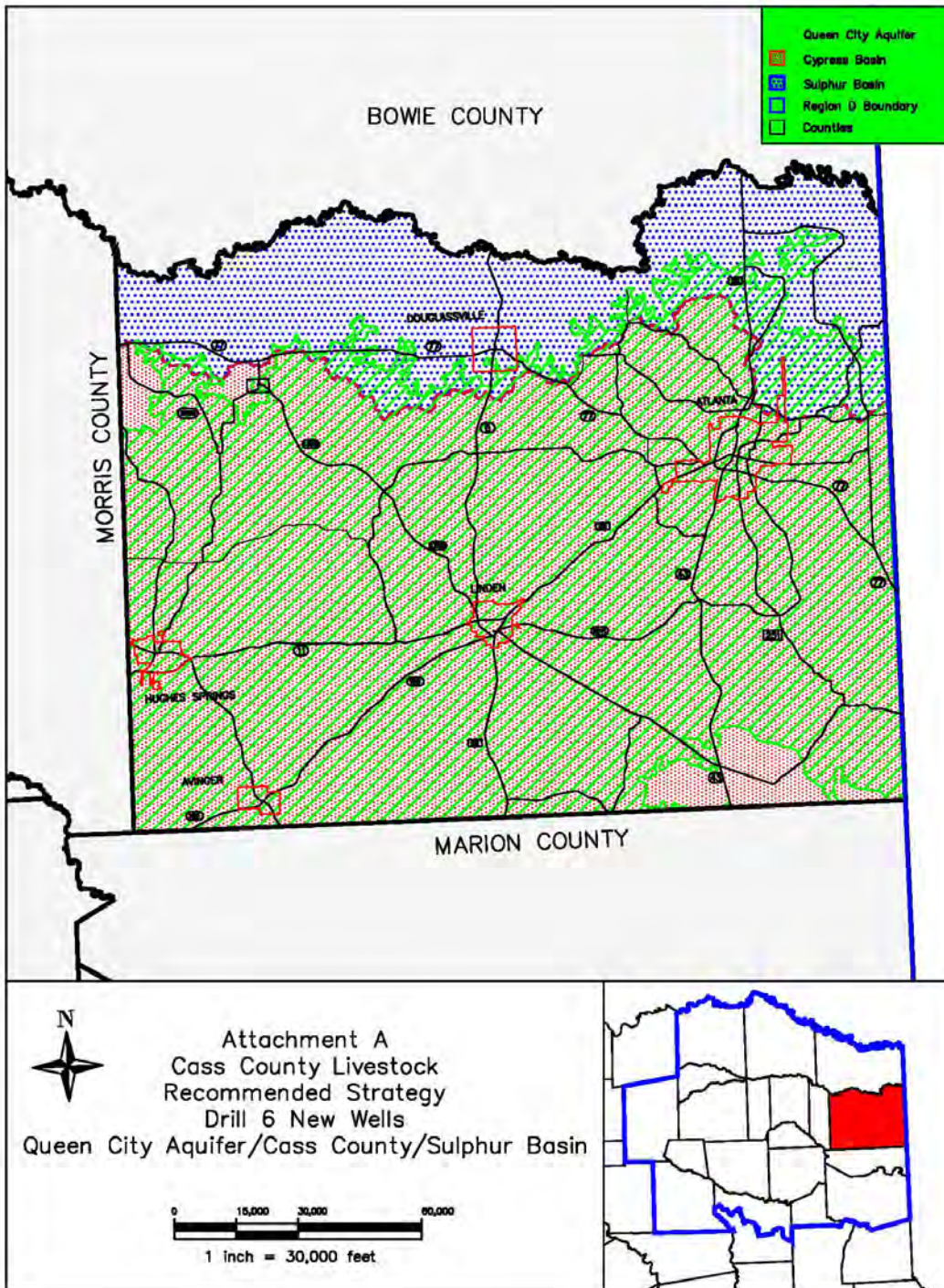
The recommended strategy for the Cass County, Livestock, Sulphur to meet their projected deficit of 953 ac-ft/yr in 2020 reducing to 951 ac-ft/yr in 2070 would be to construct six water wells prior to 2020. The recommended supply source will be the Queen City Aquifer in Cass County. One well with rated capacity of 100 gpm each would provide approximately 161 ac-ft/yr. Six new wells will be needed to provide the 953 ac-ft/yr needed. The Queen Aquifer in Cass County is projected to have a more than ample supply availability to meet the needs of the Livestock in Cass County for the planning period.

Given the increasing costs to comply with more stringent regulations and the decreasing reliability of groundwater as a future supply source due to quality issues in this region, it is recommended that groundwater supply systems consider combining resources and/or soliciting future water supply from neighboring systems and/or major water providers in the region. If a feasible alternative becomes available, then the recommendations previously discussed should be disregarded and a re-evaluation completed.

Cost Estimate Summary Water Supply Project Option September 2018 Prices	
Livestock Cass Cypress - Drill New Well Queen City Aquifer Cass Cypress	
Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 202.4 for September 2018	
Item	Estimated Costs for Facilities
CAPITAL COST	
Dam and Reservoir (Conservation Pool acft, acres)	\$0
Off-Channel Storage/Ring Dike (Conservation Pool acft, acres)	\$0
Terminal Storage (Conservation Pool acft, acres)	\$0
Primary Pump Station (0 MGD)	\$0
Transmission Pipeline (6 in dia., miles)	\$0
Transmission Pump Station(s) & Storage Tank(s)	\$0
Well Fields (Wells, Pumps, and Piping)	\$745,000
Storage Tanks (Other Than at Booster Pump Stations)	\$0
Water Treatment Plant (0 MGD)	\$0
Advanced Water Treatment Facility (MGD)	\$0
Conservation (Leaking Pipe/Meter Replacement)	\$0
Integration, Relocations, & Other	\$0
TOTAL COST OF FACILITIES	\$745,000
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	\$261,000
Environmental & Archaeology Studies and Mitigation	\$3,000
Land Acquisition and Surveying (3 acres)	\$0
Interest During Construction (3% for 1 years with a 0.5% ROI)	\$28,000
TOTAL COST OF PROJECT	\$1,037,000
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	\$73,000
Reservoir Debt Service (3.5 percent, 40 years)	\$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	\$7,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	\$0
Dam and Reservoir (1.5% of Cost of Facilities)	\$0
Water Treatment Plant	\$0
Advanced Water Treatment Facility	\$0
Pumping Energy Costs (336892 kW-hr @ 0.08 \$/kW-hr)	\$27,000
Purchase of Water (acft/yr @ \$/acft)	\$0
TOTAL ANNUAL COST	\$107,000
Available Project Yield (acft/yr)	968
Annual Cost of Water (\$ per acft), based on PF=1	\$111
Annual Cost of Water After Debt Service (\$ per acft), based on PF=1	\$35
Annual Cost of Water (\$ per 1,000 gallons), based on PF=1	\$0.34
Annual Cost of Water After Debt Service (\$ per 1,000 gallons), based on PF=1	\$0.11
Stanley Hayes	9/29/2019



Cost Estimate Summary Water Supply Project Option September 2018 Prices	
Livestock Cass Sulphur - Drill New Well Queen City Aquifer Cass Sulphur	
Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 202.4 for September 2018	
Item	Estimated Costs for Facilities
CAPITAL COST	
Dam and Reservoir (Conservation Pool acft, acres)	\$0
Off-Channel Storage/Ring Dike (Conservation Pool acft, acres)	\$0
Terminal Storage (Conservation Pool acft, acres)	\$0
Primary Pump Station (0 MGD)	\$0
Transmission Pipeline (6 in dia., miles)	\$0
Transmission Pump Station(s) & Storage Tank(s)	\$0
Well Fields (Wells, Pumps, and Piping)	\$745,000
Storage Tanks (Other Than at Booster Pump Stations)	\$0
Water Treatment Plant (0 MGD)	\$0
Advanced Water Treatment Facility (MGD)	\$0
Conservation (Leaking Pipe/Meter Replacement)	\$0
Integration, Relocations, & Other	\$0
TOTAL COST OF FACILITIES	\$745,000
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	\$261,000
Environmental & Archaeology Studies and Mitigation	\$3,000
Land Acquisition and Surveying (3 acres)	\$0
Interest During Construction (3% for 1 years with a 0.5% ROI)	\$28,000
TOTAL COST OF PROJECT	\$1,037,000
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	\$73,000
Reservoir Debt Service (3.5 percent, 40 years)	\$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	\$7,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	\$0
Dam and Reservoir (1.5% of Cost of Facilities)	\$0
Water Treatment Plant	\$0
Advanced Water Treatment Facility	\$0
Pumping Energy Costs (336892 kW-hr @ 0.08 \$/kW-hr)	\$27,000
Purchase of Water (acft/yr @ \$/acft)	\$0
TOTAL ANNUAL COST	\$107,000
Available Project Yield (acft/yr)	966
Annual Cost of Water (\$ per acft), based on PF=1	\$111
Annual Cost of Water After Debt Service (\$ per acft), based on PF=1	\$35
Annual Cost of Water (\$ per 1,000 gallons), based on PF=1	\$0.34
Annual Cost of Water After Debt Service (\$ per 1,000 gallons), based on PF=1	\$0.11
Stanley Hayes	9/29/2019



EVALUATION OF WATER MANAGEMENT STRATEGIES FOR MEETING THE PROJECTED WATER SUPPLY NEEDS OF QUEEN CITY

Description of Water User Group:

The City of Queen City provides water service in Cass County. The City’s population is projected to be 1,701 in 2020 and 1,714 in the year 2070. The City primarily utilizes groundwater supply from the Carrizo-Wilcox Aquifer, although it has the capability to use water supply from the City of Texarkana from Lake Wright Patman that it has used in the past. The City is not expected to have shortages as sufficient groundwater supplies are projected over the 2020 – 2070 planning period. However, the City’s full demands have been considered in evaluation of strategies for the purposes of the 2021 Region D Plan as the City’s demands were included as part of the evaluation of strategies within the Riverbend WRD’s Regional Water Master Plan.

Water Supply and Demand Analysis:

	2020	2030	2040	2050	2060	2070
Population	1,701	1,714	1,714	1,714	1,714	1,714
Projected Water Demand	258	251	244	243	243	243
Current Water Supply	269	269	269	269	269	269
Projected Supply Surplus (+) / Deficit (-)	11	18	25	26	26	26

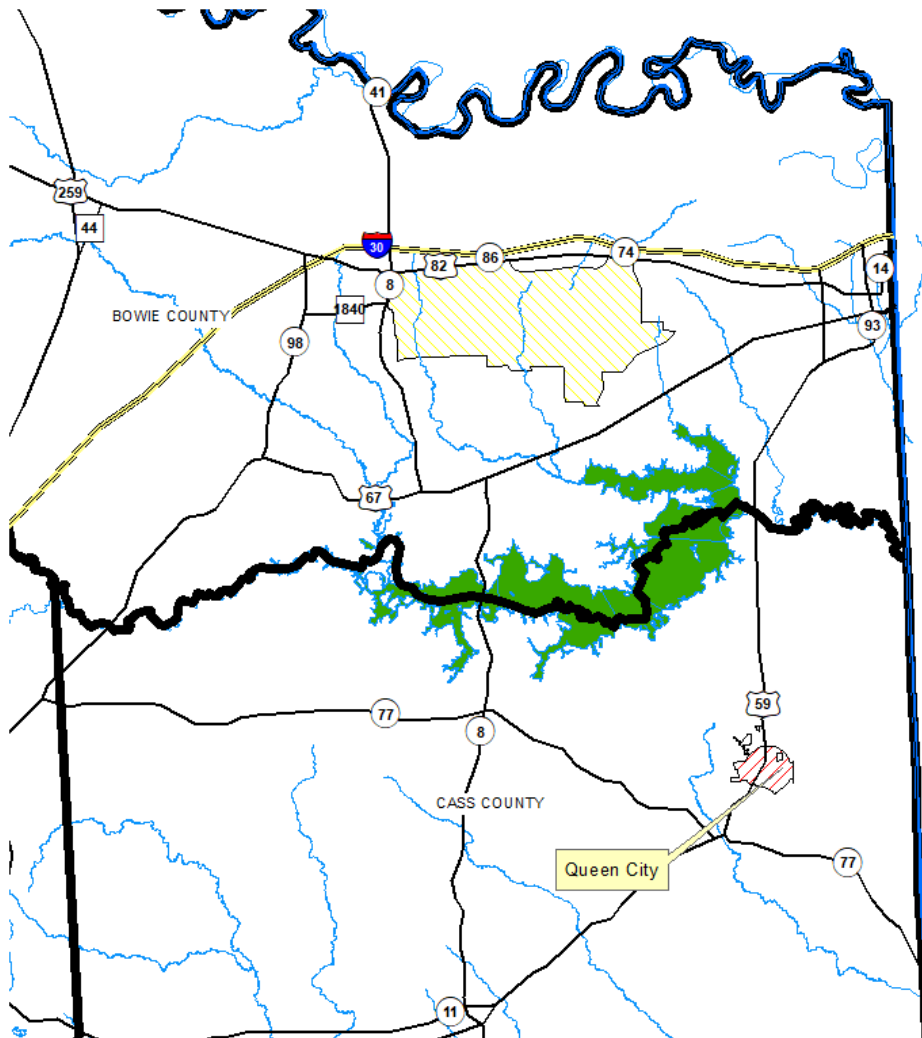
Evaluation of Potentially Feasible Water Management Strategies:

There were five alternative strategies considered to meet the City’s water supply shortages as summarized in the Table below. Advanced conservation was not considered because the per capita use per day would be less than the 140 gpcd threshold set by the water planning group. Reuse is not a feasible option because water supply is mainly used for public consumption. Existing groundwater supply is sufficient to meet the City’s needs, and is expected to continue to meet projected future demands for the City. Voluntary reallocation of manufacturing supply was identified in order to account for the fact that the Riverbend WRD Regional Master Plan indicates that supply could be provided via diversion of supply for GPI at Lake Wright Patman, a part of the Cass Manufacturing WUG, thus the amount for voluntary reallocation does not affect the 120,000 ac-ft/yr of contracted supply between Texarkana and GPI. Further, a request was submitted by Riverbend Water Resources District to consider a new 2.5 MGD package water treatment plant and transmission line for supply from Wright Patman Reservoir. Thus, a new contract with Texarkana/Riverbend has been considered herein.

Strategy	Firm Yield (ac-ft)	Total Capital Cost	Total Annualized Cost	Unit Cost	Environmental Impact
Advanced Water Conservation					
Water Reuse					
Ground Water					
Voluntary Reallocation (from Cass Manufacturing)	251	\$0	\$0	\$0	1
New Contract	251	\$0	\$121,000	\$482	1

Recommendations:

As the City of Queen City’s groundwater supplies are sufficient to meet projected future demands for the City, no additional WMS is recommended.



- Relation**
- Buyer
 - Seller
 - Source
 - Region D Boundary
 - Counties
 - Streams
 - Reservoirs

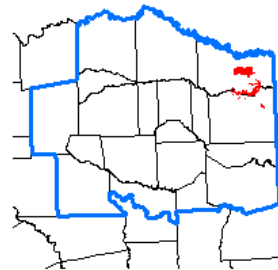
0 15,000 30,000 60,000

Feet

1 inch = 30,000 feet

Attachment A

Queen City
 Alternative Strategy
 New Contract (Riverbend WRD)



Cost Estimate Summary Water Supply Project Option September 2018 Prices Queen City - New Contract with Riverbend WRD	
Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 201.9 for September 2018	
<i>Item</i>	<i>Estimated Costs for Facilities</i>
ANNUAL COST	
Operation and Maintenance	
Intakes and Pump Stations (2.5% of Cost of Facilities)	\$0
Dam and Reservoir (1.5% of Cost of Facilities)	\$0
Water Treatment Plant	\$0
Advanced Water Treatment Facility	\$0
Pumping Energy Costs (0 kW-hr @ 0.08 \$/kW-hr)	\$0
Purchase of Water (251 acft/yr @ 482.28 \$/acft)	<u>\$121,000</u>
TOTAL ANNUAL COST	\$121,000
Available Project Yield (acft/yr)	251
Annual Cost of Water (\$ per acft), based on PF=1	\$482
Annual Cost of Water After Debt Service (\$ per acft), based on PF=1	\$482
Annual Cost of Water (\$ per 1,000 gallons), based on PF=1	\$1.48
Annual Cost of Water After Debt Service (\$ per 1,000 gallons), based on PF=1	\$1.48
<i>JMP</i>	<i>10/2/2019</i>

REGION D
EVALUATIONS OF WATER MANAGEMENT STRATEGIES
FOR MEETING PROJECTED WATER SUPPLY NEEDS
TO YEAR 2070

DELTA COUNTY

WUGs:

Delta County Livestock

EVALUATION OF WATER MANAGEMENT STRATEGIES FOR MEETING THE PROJECTED WATER SUPPLY NEEDS OF LIVESTOCK IN DELTA COUNTY

Description of Water User Group:

The Livestock WUG in Delta County has a demand that is projected to remain constant at 541 ac-ft/yr over the 2020 – 2070 planning period. The Livestock WUG in Delta County is supplied by groundwater from the Nacatoch and Trinity Aquifers and livestock local supplies from the Sulphur basin. A deficit of 262 ac-ft/yr is projected to occur in 2020 decreasing to 250 ac-ft/yr by 2030 that remains throughout the planning period.

Water Supply and Demand Analysis:

	2020	2030	2040	2050	2060	2070
Projected Water Demand	541	541	541	541	541	541
Current Water Supply	279	291	291	291	291	291
Projected Supply Surplus (+)/Deficit(-)	-262	-250	-250	-250	-250	-250

Evaluation of Potentially Feasible Water Management Strategies:

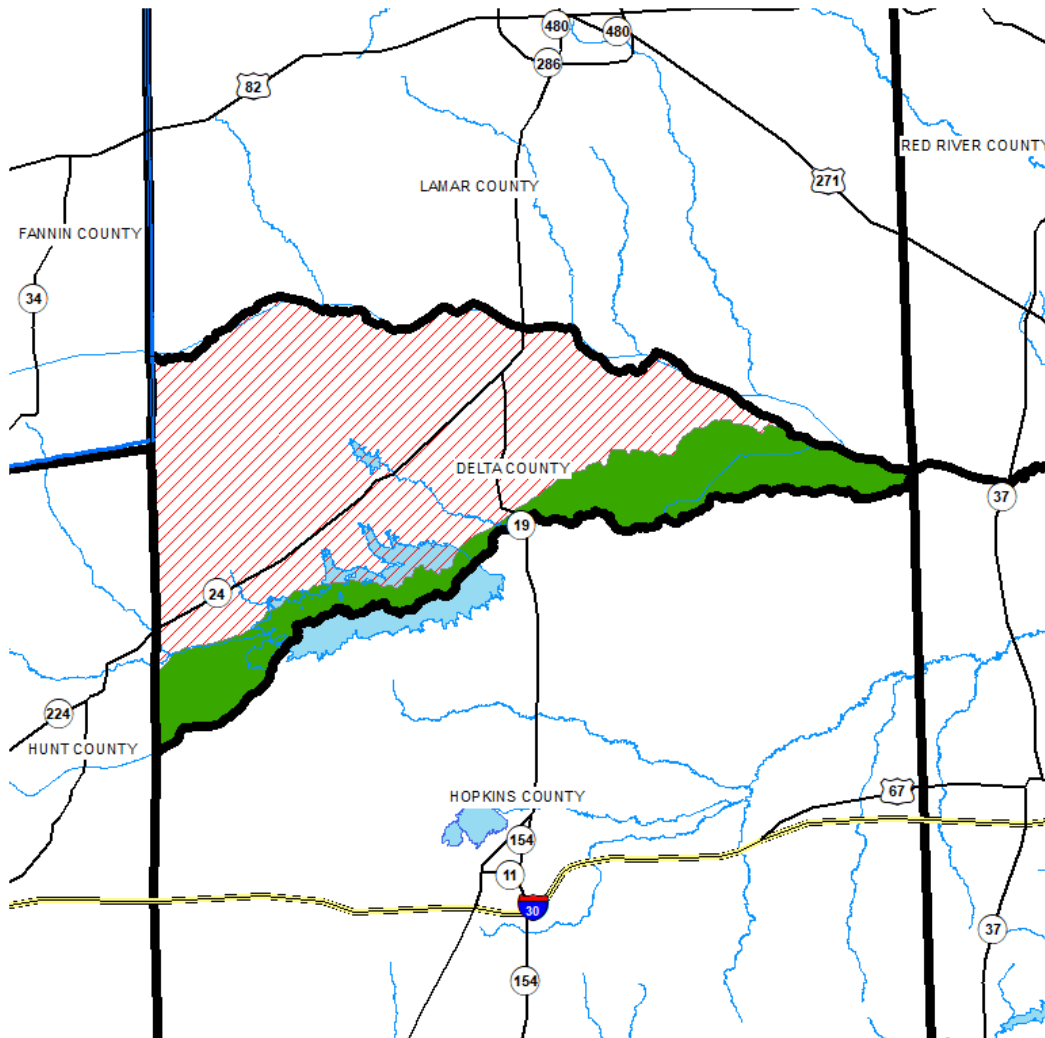
Three alternative strategies were considered to meet the projected shortages for Delta County Livestock. Advanced water conservation for livestock practices was not considered, as present livestock practices likely result in sale of the livestock to reduce demand and extend water supply. The use of reuse water was not considered feasible as no centralized supply is available. Groundwater from the Nacatoch aquifer has been identified as a potential source of water.

Strategy	Strategy Yield (AF)	Total Capital Cost	Total Annualized Cost	Unit Cost	Environmental Impact
Advanced Water Conservation					
Water Reuse					
Drill New Wells (Nacatoch, Sulphur Basin)	262	\$1,929,000	\$297,000	\$1,134	1

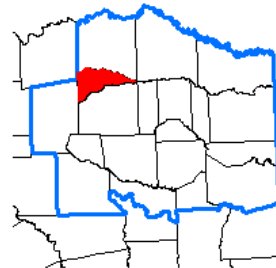
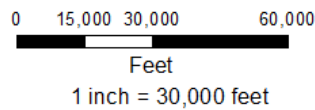
Recommendations:

	2020	2030	2040	2050	2060	2070
Drill New Wells (Nacatoch Aquifer, Sulphur Basin; ac-ft/yr)	262	250	250	250	250	250

The recommended strategies for the Delta County Livestock to meet their projected deficit of 262 ac-ft/yr is to construct four (4) additional water wells with a rated capacity of 75 gpm in the Nacatoch aquifer. A well operating at an average of 75 gpm is capable of delivering 121 ac-ft per year per well with a well in reserve.



- Relation**
-  Buyer
 -  Seller
 -  Source
 -  Region D Boundary
 -  Counties
 -  Streams
 -  Reservoirs



Attachment A
Livestock Delta Co
Recommended Strategy
Drill New Wells (Delta, Nacatoch, Sulphur)

**Cost Estimate Summary
Water Supply Project Option
September 2018 Prices**

Delta Livestock - Drill New Wells (Delta, Nacatoch Aquifer, Sulphur Basin)

**Cost based on ENR CCI 11170.28 for September 2018 and
a PPI of 201.9 for September 2018**

<i>Item</i>	<i>Estimated Costs for Facilities</i>
Well Fields (Wells, Pumps, and Piping)	\$1,321,000
TOTAL COST OF FACILITIES	\$1,321,000
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	\$462,000
Environmental & Archaeology Studies and Mitigation	\$64,000
Land Acquisition and Surveying (6 acres)	\$30,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	<u>\$52,000</u>
TOTAL COST OF PROJECT	\$1,929,000
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	\$136,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	\$13,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	\$0
Dam and Reservoir (1.5% of Cost of Facilities)	\$0
Water Treatment Plant	\$0
Advanced Water Treatment Facility	\$0
Pumping Energy Costs (216873 kW-hr @ 0.08 \$/kW-hr)	\$17,000
Purchase of Water (262 acft/yr @ 500 \$/acft)	<u>\$131,000</u>
TOTAL ANNUAL COST	\$297,000
Available Project Yield (acft/yr)	262
Annual Cost of Water (\$ per acft), based on PF=1	\$1,134
Annual Cost of Water After Debt Service (\$ per acft), based on PF=1	\$615
Annual Cost of Water (\$ per 1,000 gallons), based on PF=1	\$3.48
Annual Cost of Water After Debt Service (\$ per 1,000 gallons), based on PF=1	\$1.89
<i>JMP</i>	9/30/2019

REGION D
EVALUATIONS OF WATER MANAGEMENT STRATEGIES
FOR MEETING PROJECTED WATER SUPPLY NEEDS
TO YEAR 2070

FRANKLIN COUNTY

WUGs:

Franklin County Livestock

EVALUATION OF WATER MANAGEMENT STRATEGIES FOR MEETING THE PROJECTED WATER SUPPLY NEEDS LIVESTOCK IN FRANKLIN COUNTY – CYPRESS

Description of Water User Group:

The Livestock WUG in Franklin County is a split entity and has a demand that is projected to be a constant 2,850 ac-ft/yr from 2020 to 2070. Livestock in Franklin County, Cypress has a current water supply consisting of water wells from the Carrizo-Wilcox Aquifer, Queen City Aquifer, and Local Supplies. The total rated available supply from these sources is 425 ac-ft/yr in 2020 thru 2070. Livestock in Franklin County, Cypress is projected to have a water supply deficit of 714 ac-ft/yr in 2020 thru 2070.

Livestock in Franklin County, Sulphur has a current water supply consisting of water wells from the Carrizo-Wilcox Aquifer, Queen City Aquifer, and Local Supplies. The total rated available supply from these sources is 621 ac-ft/yr in 2020 thru 2070. Livestock in Franklin County, Sulphur is projected to have a water supply deficit of 1,090 ac-ft/yr in 2020 thru 2070.

Water Supply and Demand Analysis:

Livestock Franklin	2020	2030	2040	2050	2060	2070
Projected Water Demand						
Cypress	1,139	1,139	1,139	1,139	1,139	1,139
Sulphur	1,711	1,711	1,711	1,711	1,711	1,711
Total	2,850	2,850	2,850	2,850	2,850	2,850
Current Water Supply						
Cypress	425	425	425	425	425	425
Sulphur	621	621	621	621	621	621
Total	1,046	1,046	1,046	1,046	1,046	1,046
Projected Supply Surplus (+)/Deficit(-)						
Cypress	-714	-714	-714	-714	-714	-714
Sulphur	-1,090	-1,090	-1,090	-1,090	-1,090	-1,090
Total	-1,804	-1,804	-1,804	-1,804	-1,804	-1,804

Evaluation of Potentially Feasible Water Management Strategies:

Three alternative strategies were considered to meet the Franklin County, Livestock, Cypress water supply shortages as summarized in the following table. Advanced conservation and water reuse were not considered because the demands are very rural in nature. Surface water alternatives were not utilized due to the rural nature of livestock demands. New wells in the Carrizo-Wilcox Aquifer were also identified as a potentially feasible strategy for the WUG.

Strategy	Firm Yield (AF)	Total Capital Cost	Total Annualized Cost	Unit Cost	Environmental Impact
Advanced Water Conservation					
Water Reuse					
Groundwater Carrizo-Wilcox Cypress	805	\$ 865,000	\$ 89,000	\$ 111	Minimal
Groundwater Carrizo-Wilcox Sulphur	1,129	\$ 1,211,000	\$ 125,000	\$ 111	Minimal
Surface Water					

Recommendations:

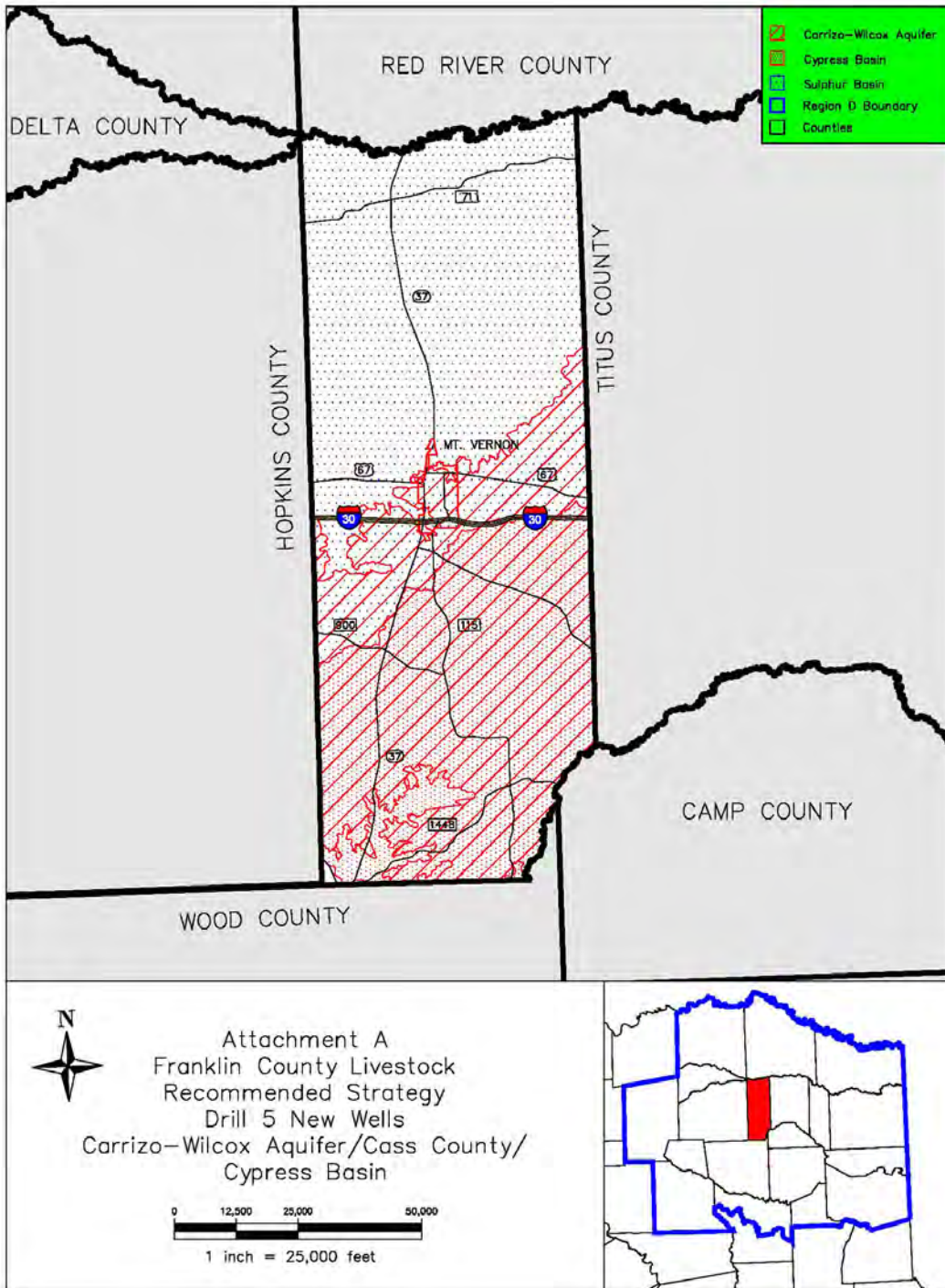
	2020	2030	2040	2050	2060	2070
Drill New Wells (Carrizo-Wilcox, Cypress; ac-ft/yr)	805	805	805	805	805	805
Drill New Wells (Carrizo-Wilcox, Sulphur; ac-ft/yr)	1,129	1,129	1,129	1,129	1,129	1,129

The recommended strategy for the Franklin County, Livestock, Cypress to meet their projected deficit of 865 ac-ft/yr in 2020 thru 2070 would be to construct five water wells prior to 2020. The recommended supply source will be the Carrizo Aquifer in Franklin County. One well with rated capacity of 100 gpm each would provide approximately 161 ac-ft/yr. Five new wells will be needed to provide the 714 ac-ft/yr needed. The Carrizo Aquifer in Franklin County is projected to have a more than ample supply availability to meet the needs of the Livestock in Franklin County for the planning period.

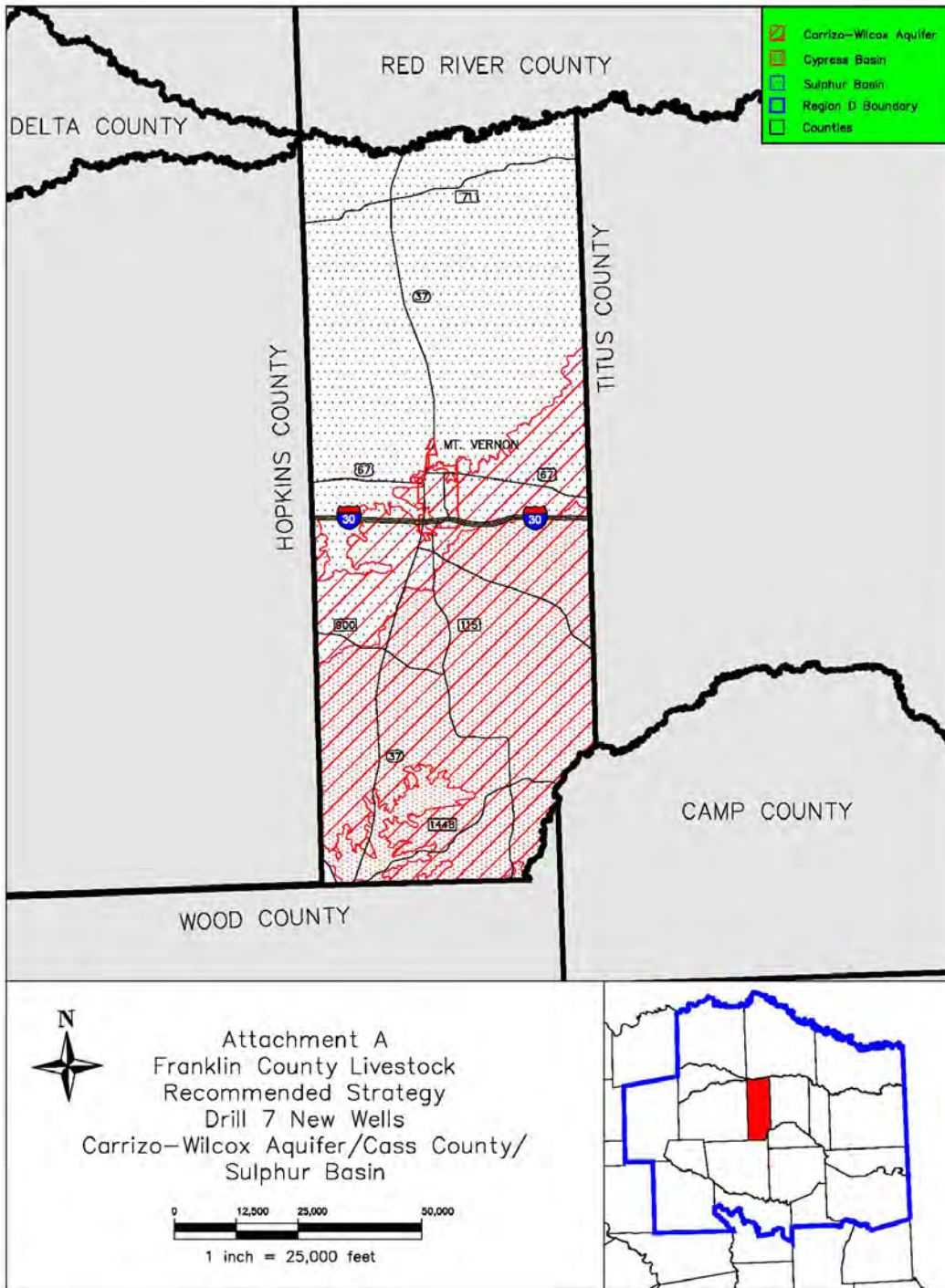
The recommended strategy for the Franklin County, Livestock, Sulphur to meet their projected deficit of 1,090 ac-ft/yr in 2020 thru 2070 would be to construct seven water wells prior to 2020. The recommended supply source will be the Carrizo Aquifer in Franklin County. One well with rated capacity of 100 gpm each would provide approximately 161 ac-ft/yr. Seven new wells will be needed to provide the 1,090 ac-ft/yr needed. The Carrizo Aquifer in Franklin County is projected to have a more than ample supply availability to meet the needs of the Livestock in Franklin County for the planning period.

Given the increasing costs to comply with more stringent regulations and the decreasing reliability of groundwater as a future supply source due to quality issues in this region, it is recommended that groundwater supply systems consider combining resources and/or soliciting future water supply from neighboring systems and/or major water providers in the region. If a feasible alternative becomes available, then the recommendations previously discussed should be disregarded and a re-evaluation completed.

Cost Estimate Summary Water Supply Project Option September 2018 Prices	
Livestock Franklin Cypress - Drill New Well Carrizo Wilcox Aquifer Franklin Cypress	
Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 202.4 for September 2018	
Item	Estimated Costs for Facilities
CAPITAL COST	
Dam and Reservoir (Conservation Pool acft, acres)	\$0
Off-Channel Storage/Ring Dike (Conservation Pool acft, acres)	\$0
Terminal Storage (Conservation Pool acft, acres)	\$0
Primary Pump Station (0 MGD)	\$0
Transmission Pipeline (6 in dia., miles)	\$0
Transmission Pump Station(s) & Storage Tank(s)	\$0
Well Fields (Wells, Pumps, and Piping)	\$870,000
Storage Tanks (Other Than at Booster Pump Stations)	\$0
Water Treatment Plant (0 MGD)	\$0
Advanced Water Treatment Facility (MGD)	\$0
Conservation (Leaking Pipe/Meter Replacement)	\$0
Integration, Relocations, & Other	\$0
TOTAL COST OF FACILITIES	\$870,000
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	\$304,000
Environmental & Archaeology Studies and Mitigation	\$4,000
Land Acquisition and Surveying (4 acres)	\$0
Interest During Construction (3% for 1 years with a 0.5% ROI)	\$33,000
TOTAL COST OF PROJECT	\$1,211,000
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	\$85,000
Reservoir Debt Service (3.5 percent, 40 years)	\$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	\$9,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	\$0
Dam and Reservoir (1.5% of Cost of Facilities)	\$0
Water Treatment Plant	\$0
Advanced Water Treatment Facility	\$0
Pumping Energy Costs (393040 kW-hr @ 0.08 \$/kW-hr)	\$31,000
Purchase of Water (acft/yr @ \$/acft)	\$0
TOTAL ANNUAL COST	\$125,000
Available Project Yield (acft/yr)	1,129
Annual Cost of Water (\$ per acft), based on PF=1	\$111
Annual Cost of Water After Debt Service (\$ per acft), based on PF=1	\$35
Annual Cost of Water (\$ per 1,000 gallons), based on PF=1	\$0.34
Annual Cost of Water After Debt Service (\$ per 1,000 gallons), based on PF=1	\$0.11
Stanley Hayes	10/3/2019



Cost Estimate Summary Water Supply Project Option September 2018 Prices	
Livestock Cass Sulphur - Drill New Well Queen City Aquifer Cass Sulphur	
Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 202.4 for September 2018	
Item	Estimated Costs for Facilities
CAPITAL COST	
Dam and Reservoir (Conservation Pool acft, acres)	\$0
Off-Channel Storage/Ring Dike (Conservation Pool acft, acres)	\$0
Terminal Storage (Conservation Pool acft, acres)	\$0
Primary Pump Station (0 MGD)	\$0
Transmission Pipeline (6 in dia., miles)	\$0
Transmission Pump Station(s) & Storage Tank(s)	\$0
Well Fields (Wells, Pumps, and Piping)	\$745,000
Storage Tanks (Other Than at Booster Pump Stations)	\$0
Water Treatment Plant (0 MGD)	\$0
Advanced Water Treatment Facility (MGD)	\$0
Conservation (Leaking Pipe/Meter Replacement)	\$0
Integration, Relocations, & Other	\$0
TOTAL COST OF FACILITIES	\$745,000
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	\$261,000
Environmental & Archaeology Studies and Mitigation	\$3,000
Land Acquisition and Surveying (3 acres)	\$0
Interest During Construction (3% for 1 years with a 0.5% ROI)	\$28,000
TOTAL COST OF PROJECT	\$1,037,000
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	\$73,000
Reservoir Debt Service (3.5 percent, 40 years)	\$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	\$7,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	\$0
Dam and Reservoir (1.5% of Cost of Facilities)	\$0
Water Treatment Plant	\$0
Advanced Water Treatment Facility	\$0
Pumping Energy Costs (336892 kW-hr @ 0.08 \$/kW-hr)	\$27,000
Purchase of Water (acft/yr @ \$/acft)	\$0
TOTAL ANNUAL COST	\$107,000
Available Project Yield (acft/yr)	966
Annual Cost of Water (\$ per acft), based on PF=1	\$111
Annual Cost of Water After Debt Service (\$ per acft), based on PF=1	\$35
Annual Cost of Water (\$ per 1,000 gallons), based on PF=1	\$0.34
Annual Cost of Water After Debt Service (\$ per 1,000 gallons), based on PF=1	\$0.11
Stanley Hayes	9/29/2019



REGION D
EVALUATIONS OF WATER MANAGEMENT STRATEGIES
FOR MEETING PROJECTED WATER SUPPLY NEEDS
TO YEAR 2070

GREGG COUNTY

WUGs:

Gregg County Mining

EVALUATION OF WATER MANAGEMENT STRATEGIES FOR MEETING THE PROJECTED WATER SUPPLY NEEDS MINING IN GREGG COUNTY SABINE

Description of Water User Group:

The Mining WUG in Gregg County is a split entity and has a demand that is projected to be decreasing from 260 ac-ft/yr in 2020 to 171 ac-ft/yr in 2070. Mining in Gregg County has a current water supply consisting of water wells from the Carrizo-Wilcox Aquifer and a Sabine Run-of-River Permit. The total rated available supply from these sources varies from 171 ac-ft/yr to 407 ac-ft/yr over the planning period. Mining in Gregg County is projected to have a water supply deficit of 11 ac-ft/yr in 2020 increasing to a deficit of 19 ac-ft/yr in 2030 and decreasing to a deficit of 6 ac-ft/yr in 2070 for the Gregg Sabine split.

Water Supply and Demand Analysis:

Mining Gregg Sabine	2020	2030	2040	2050	2060	2070
Projected Water Demand	260	411	407	320	233	171
Current Water Supply	249	392	388	306	223	165
Projected Supply Surplus (+)/Deficit(-)	-11	-19	-19	-14	-10	-6

Evaluation of Potentially Feasible Water Management Strategies:

Three alternative strategies were considered to meet the Gregg County Mining water supply shortages as summarized in the following table. Advanced conservation and water reuse was not considered because operational procedures for the existing mines are not available. Surface water alternatives were omitted since there is not a supply source within close proximity to the county with available supply. Wells in the Carrizo-Wilcox Aquifer (Sabine River Basin) were identified as a potentially feasible strategy for the WUG.

Strategy	Firm Yield (AF)	Total Capital Cost	Total Annualized Cost	Unit Cost	Environmental Impact
Advanced Water Conservation					
Water Reuse					
Groundwater	27	\$117,000	\$10,000	\$370	1
Surface Water					

Recommendations:

	2020	2030	2040	2050	2060	2070
Drill New Wells (Carrizo-Wilcox, Sabine), ac-ft/yr)	27	27	27	27	27	27

The recommended strategy for the Gregg County Mining Sabine to meet their projected deficit of 11 ac-ft/yr in 2020 and 19 ac-ft/yr in 2030 would be to construct one additional water well similar to their existing wells just prior to each decade as the deficits occur. The recommended supply source will be the Carrizo-Wilcox Aquifer in Gregg County. One well with rated capacity of 50 gpm each would provide approximately 27 ac-ft/yr. The Carrizo-Wilcox Aquifer in Gregg County is projected to have a more than ample supply availability to meet the needs of the Mining in Gregg County Sabine for the planning period.

Given the increasing costs to comply with more stringent regulations and the decreasing reliability of groundwater as a future supply source due to quality issues in this region, it is recommended that groundwater supply systems consider combining resources and/or soliciting future water supply from neighboring systems and/or major water providers in the region. If a feasible alternative becomes available, then the recommendations previously discussed should be disregarded and a re-evaluation completed.

Cost Estimate Summary Water Supply Project Option September 2018 Prices	
Mining Gregg Sabine - Drill New Well Carrizo-Wilcox Aquifer Gregg Sabine	
Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 202.4 for September 2018	
Item	Estimated Costs for Facilities
CAPITAL COST	
Dam and Reservoir (Conservation Pool acft, acres)	\$0
Off-Channel Storage/Ring Dike (Conservation Pool acft, acres)	\$0
Terminal Storage (Conservation Pool acft, acres)	\$0
Primary Pump Station (0 MGD)	\$0
Transmission Pipeline (6 in dia., miles)	\$0
Transmission Pump Station(s) & Storage Tank(s)	\$0
Well Fields (Wells, Pumps, and Piping)	\$84,000
Storage Tanks (Other Than at Booster Pump Stations)	\$0
Water Treatment Plant (0 MGD)	\$0
Advanced Water Treatment Facility (MGD)	\$0
Conservation (Leaking Pipe/Meter Replacement)	\$0
Integration, Relocations, & Other	\$0
TOTAL COST OF FACILITIES	\$84,000
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	\$29,000
Environmental & Archaeology Studies and Mitigation	\$0
Land Acquisition and Surveying (1 acres)	\$0
Interest During Construction (3% for 1 years with a 0.5% ROI)	\$4,000
TOTAL COST OF PROJECT	\$117,000
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	\$8,000
Reservoir Debt Service (3.5 percent, 40 years)	\$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	\$1,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	\$0
Dam and Reservoir (1.5% of Cost of Facilities)	\$0
Water Treatment Plant	\$0
Advanced Water Treatment Facility	\$0
Pumping Energy Costs (9396 kW-hr @ 0.08 \$/kW-hr)	\$1,000
Purchase of Water (acft/yr @ \$/acft)	\$0
TOTAL ANNUAL COST	\$10,000
Available Project Yield (acft/yr)	27
Annual Cost of Water (\$ per acft), based on PF=1	\$370
Annual Cost of Water After Debt Service (\$ per acft), based on PF=1	\$74
Annual Cost of Water (\$ per 1,000 gallons), based on PF=1	\$1.14
Annual Cost of Water After Debt Service (\$ per 1,000 gallons), based on PF=1	\$0.23
Stanley Hayes	9/30/2019

